



An exploration of WEF-Nexus coping strategies of rural women in Masvingo Province, Zimbabwe and Limpopo Province, South Africa

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DECLARATION

I, **Hilda Jaka** solemnly declare that, this thesis entitled: ***An exploration of WEF-nexus coping strategies of rural women in Masvingo Province, Zimbabwe and Limpopo Province, South Africa*** is my own original work. All the sources used, cited or quoted have been duly acknowledged by means of complete references. This thesis has not been submitted in part or in its entirety by me or any other person for degree purposes at any other institution. It is being submitted for the degree **Doctor of Philosophy in Development and Management** at the North-West University.

Signature: _____

Date: _____

DEDICATION

I dedicate this thesis to **my Parents**

Your inspiration, drive, and support made me the person I am today.

I love you from the bottom of my heart.

To my Dad: *Behind every great daughter is a truly amazing dad, without you lifting me up to reach greater heights, I would not have made it.*

To my Mom: *Thank you for being my fountain of love, strength and endurance, one fountain that never runs dry.*

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**One can pay back the loan of gold, but one dies forever in debt to those who are kind -
Malayan Proverb**

First and foremost, I thank God Almighty for his grace to help me make it this far. Every time when I doubted my abilities I remembered that, **your grace is sufficient for me and your power is made perfect in my weakness (2 Corinthians 12:9)**. I know that: **Many are the plans in the mind of a man, but it is the purpose of the LORD that will stand (Proverbs 19:21)**. Now I say “EBENEZER” the Lord has helped me this far.

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Though the wine belongs to the owner, the thanks are given to the butler - Jewish Proverb

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**The Lord bless you and keep you;
The Lord make his face shine on you and be gracious to you;
The Lord turn his face toward you and give you peace (Numbers 6:24-26).**

ABSTRACT

This study explored the water-energy-food (WEF) nexus security and coping strategies of rural women in Chivi district, Zimbabwe and Vhembe district, South Africa. The WEF nexus is a term adopted to explore the connections linking the three resources of water, energy and food. The sectoral approach towards the achievement of WEF resource elements has not yielded much success over the years and posed a threat of trading off one resource security for another. This called for an integrated approach in dealing with water, energy and food challenges leading to the birth of the WEF nexus. The focus was on water, energy and food availability, accessibility and utilisation. The research reports on the identified similarities and differences in WEF nexus coping strategies used by women in rural households. The study acknowledges that women are the main managers of WEF nexus resources in a household context and they play a major role in ensuring availability and utilisation. Women also have views as managers of the WEF resources in the household on factors affecting access to these resources. Women make major choices especially on sources of water and energy which may either promote or reduce their WEF nexus security. Therefore, this study was guided by the WEF nexus theory, which is an integrative approach towards the achievement of sustainable use and security of WEF nexus resources.

The objectives of the research were: to explore the WEF nexus security and coping strategies of rural women in Zimbabwe and South Africa to; examine the applicability of the WEF nexus theory to rural households in Southern Africa; find the current WEF nexus security status of rural households in the Chivi and Vhembe districts; and compare the coping strategies used by rural women in the case study areas.

Data was collected in two phases. Firstly, a literature review was done which helped in the exploration of WEF nexus theories and application, WEF nexus security, the challenges and coping strategies thereof. Secondly, an empirical study based on qualitative approaches was used to guide the research. Focus group discussions, in-depth interviews and observations were used to gather the relevant information. The study had 100 participants, consisting of 60 women, 20 men, and 20 officials working in WEF nexus-related sectors or organisations. The data collected was analysed thematically and presented in narrative descriptions, tables, images and figures.

The research findings showed that rural households in Zimbabwe and South Africa face various, but similar challenges that make them vulnerable in terms of our understanding of compromised WEF nexus security. The rural households have poor access to an even flow of WEF nexus resources. Consequently, there is evidence of increased poverty and reduced family wellbeing. To cope with WEF nexus challenges, women use various coping strategies to adapt and reduce

the effects of WEF nexus insecurity in their rural households. In both case studies, the research found that there are similarities and differences in the manner in which women deal with challenges. The study also found that in each area resilience capacity is essentially driven by the availability of factors of production, e.g. land, labour and capital, for households to cope. In both Zimbabwe and South Africa, women play an important role in the management of the WEF nexus in their households. In many instances they have good coping strategies for household resilience.

Key terms: resilience, adaptation, coping strategies, water security, energy security, food security, WEF nexus, WEF nexus security, rural households, rural women, sustainable development, Zimbabwe, South Africa, Chivi, Vhembe, Masvingo and Limpopo.

OPSOMMING

Hierdie studie ondersoek die WEV-neksus-sekuriteits- en hanteringstrategieë van plattelandse vroue in die Chivi-distrik van die Masvingo-provinsie in Zimbabwe en die Vhembe-distrik van Limpopo-provinsie in Suid-Afrika. Die studie het gepoog om die wyse waarop plattelandse vroue met die algemene uitdagings van WEV-sekuriteit binne 'n huishouding te doen, te ondersoek. Dit het ten doel gehad om die WEV-sekuriteit en uitdagings wat huishoudings in die gesig staar, te bepaal. Die fokus was op WEV-beskikbaarheid, -toeganklikheid en -benutting. Die navorsing doen verslag oor die geïdentifiseerde ooreenkomste en verskille in die WEV-neksus hanteringstrategieë wat deur vroue in plattelandse huishoudings gebruik word. Die studie neem aan dat vroue die hoofbestuurders van hierdie hulpbronne in 'n huishoudelike konteks is en dat hulle die belangrikste besluite maak wat WEV-neksussekuriteit kan bevorder of verminder. Die sektorale benadering tot die bereiking van WEV-hulpbronelemente het oor die jare nie veel sukses opgelewer nie en het 'n bedreiging ingehou om een hulpbron sekuriteit vir 'n ander te verruil. Daarom is hierdie studie deur die WEV-neksusteorie gerig, met 'n geïntegreerde benadering tot die bereiking van volhoubare gebruik en sekuriteit van WEV-neksushulpbronne.

Die doelwitte van die navorsing was die volgende: om die WEV-neksus-sekuriteits- en hanteringstrategieë van plattelandse vroue in Zimbabwe en Suid-Afrika te ondersoek; om die toepaslikheid van die WEV-neksusteorie op plattelandse huishoudings in Suid-Afrika te ondersoek; om die huidige WEV-neksussekuriteitsstatus van plattelandse huishoudings in die Chivi- en Vhembe-distrikke te vind; en om die hanteringstrategieë wat plattelandse vroue in die gevallestudiegebiede gebruik, te vergelyk.

Data is in twee fases versamel. Eerstens is 'n literatuuroorsig gedoen wat gehelp het in die verkenning van die WEV-neksusteorieë en -toepassing, WEV-sekuriteit en die uitdagings en hanteringstrategieë daarvan. Tweedens is 'n empiriese studiedoen wat gebaseer is op verskeie gevallestudies. 'n Kwalitatiewe benadering is gebruik om die navorsing te lei. Fokusgroeppesprekings, in-diepte onderhoude en waarnemings is gebruik om die relevante inligting in te samel. Die studie het uit 100 deelnemers bestaan, waarvan 60 vroue, 20 mans en 20 amptenare in WEV-neksusverwante sektore of organisasies was. Die versamelde data is tematies geanaliseer en daarna voorgestel in tabelle, beelde en figure.

Die navorsingsbevindings het getoon dat plattelandse huishoudings in Zimbabwe en Suid-Afrika verskillende uitdagings ondervind wat hul WEV-neksussekuriteit verminder. Dié huishoudings het swak toegang tot WEV-neksushulpbronne wat armoede verhoog sowel as die welsyn van die gesinne verminder het. Om uitdagings te hanteer, gebruik vroue verskillende hanteringstrategieë om die by die effekte van WEV-neksusonsekerheid in huishoudings aan te pas en dit te

verminder. In beide gevalle het die navorsing bevind dat daar ooreenkomste en verskille bestaan in die hantering van uitdagings. Die studie het bevind dat die veerkragtigheidskapasiteit in elke area gedryf word deur die beskikbaarheid van hulpbronne en kapitaal waarop die huishoudings kan staatmaak om hul situasies te hanteer. In beide Zimbabwe en Suid-Afrika speel vroue 'n groot rol in die bestuur van WEV-neksus binne huishoudings en dat hulle goeie hanteringstrategieë het wat opgebou kan word om huishoudelike veerkragtigheid oral te verbeter.

Sleuteltermes: veerkragtigheid, aanpassing, hanteringstrategieë, watersekuriteit, energiesekuriteit, voedselsekerheid, WEV-neksus, WEV-neksussekuriteit, plattelandse huishoudings, plattelandse vroue, volhoubare ontwikkeling

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CHAPTER ONE

CONTEXTUALISING WEF NEXUS SECURITY AND COPING STRATEGIES OF RURAL WOMEN IN ZIMBABWE AND SOUTH AFRICA

1.1 Introduction

This study explored the coping strategies of rural women from a water-energy-food (WEF) nexus security perspective. The study assessed the manner in which rural women contend with critical problems of WEF nexus security in their households. The issue of WEF resources constraints is not new. However, from 2011 that there has been a general growing interest from different disciplines (academic, management, and policy making) in the particular grouping of water, energy, and food in the sustainable use of these resources. By studying the process philosophy (nexus) of these resources it is possible to indirectly gain valuable insight into modern state governance and future planning. International future planners, for example, point out that the prime challenge of the world is to increase our current supplies of water, energy, and food resources by as much as 30-50% by 2030 (FAO, 2014:4; WEF, 2011a:29). A foreseeable challenge in the context of this study was to understand the complex relationship between water, energy, and food in terms of a nexus. Only by understanding the interplay between these key components, would it be possible to ensure sustainability and stability in the development process. According to the Food and Agricultural Organisation (FAO), water, energy, and food are essential for human existence and development (FAO, 2014:5). If access to and sustainability of water, energy, and food were regarded as an acute challenge at global, national and regional levels, then the effects thereof would be more apparent for households and individuals – especially for women living in rural areas in developing countries.

Contemplated from a nexus perspective in an African context, it is evident that various impacts on households and the socio-economic state of women as a marginalised group in the rural areas of Zimbabwe and South Africa are experienced (FAO, 2014:4). The status of women and their rights in the African rural communities is primarily in a traditional mode. Indigenous culture and religious practices as well as the customary dominance of males in most communities diminishes the status of claims to modern notions of equality, women's rights and empowerment. The study purposively selected groups of rural women in both countries as the primary research population under investigation. The views and perceptions of women by women on their coping strategies to make households function under difficult circumstances were of primary importance for this study.

According to Hoff (2011:11), the world is not anywhere near achieving water, energy, and food security for its population. Therefore, the need for research on the coping strategies of rural women using the WEF nexus theory is of paramount importance to enhance resilience and adaptation to the stresses that arise from inadequate WEF nexus security. The WEF nexus approach has been promoted in the water sector since 2011. The WEF nexus is an approach that: 1) integrates management and governance; 2) supports transition to a green economy; 3) reduces trade-offs; and 4) builds synergies across sectors (Hoff, 2011:7). Ever since the World Economic Forum, (Bazilian *et al.*, 2011) and the Bonn 2011 Conference (Hoff, 2011), which dealt with the WEF nexus, the concept of interdependence between water, energy, and food to ensure sustainable resources security has been accepted. Both the World Economic Forum and the international water sector, at the time of the 2011 Bonn meeting had consensus that policy makers and development planners should not treat the three components – water, energy, and food – in isolation.

The argument brought forward in these two assemblies was that although problems are systemic, it is the world's poor who are most at risk from the scarcity and mismanagement of water, energy and food (Bazilian *et al.*, 2011:7897; Hoff, 2011:7; WWF, 2017:7). This study explored rural household WEF nexus security and assessed the coping strategies that women use to mitigate scarcity challenges within their households. The WEF nexus theory is considered an avenue for gaining insight into complex problem situations (Scott *et al.*, 2015:16; Mabhaudhi *et al.*, 2018:7). At the same time, the WEF nexus underscores the significance of sustainability under circumstances of notable limited resources availability (Hoff, 2011:7).

In this study, the term *WEF nexus* is used to refer to the general theory of water-energy-food nexus, while *WEF nexus security* is used to indicate the extent of availability, accessibility and utilisation of water, energy and food in the nexus context. *Normal* is where there is consistency and regularity is maintained e.g. when people have adequate supplies of WEF resources to meet their needs. *Crisis* is where social-ecological systems are in a state of collapse and human communities for example are unable to respond resiliently to threats, obstacles and challenges. *Livelihoods* are activities that are done by people to acquire basic needs. They are sources of income, goods, and services that are needed to secure the wellbeing of people.

1.2 Orientation and background to the study

Rural development lifts communities out of poverty and part of this development includes the proper planning and execution of policies, interventions and coping strategies by people to mitigate the effects of WEF insecurities in their everyday lives (Ashley & Maxwell, 2001:395; FAO, 2014:15). WEF nexus security is important in the development and well-being of people in rural

areas (FAO, 2014:5; Chirisa & Bandaiko, 2015:392). The scarcity of water, food and energy in rural communities of the developing world reduces the quality of life of people. WEF nexus security has moved to the top of the global agenda a result of never-ending scarcities associated with water, energy and food. According to FAO (2014:15), global projections indicate that the demand for fresh water, energy, and food will rise significantly in the coming decades. This increased demand is driven by the pressure of population growth, human mobility, economic development, international trade, urbanisation, diversifying diets, cultural and technological changes and climate change (Bazilian *et al.*, 2011:7899; Bizikova *et al.*, 2013:5; WEF, 2011a:4; IPCC, 2018:1). Since women are the key role players in rural households, this is why this study focuses on their coping strategies in terms of the WEF nexus security.

According to the FAO (2011:5), the majority of people who suffer from socio-economic insecurities are women and girls. The global sustainable development goals (SDGs) 2015 of the UN, which aimed to promote sustainable development and to incorporate new development ideas built on the millennium development goals (MDGs) and strengthened the need to empower women for social development (Hak *et al.*, 2016:565). SDGs 1, 2, 3 and 5 clearly emphasised the need for gender equality and for the empowerment of women (Griggs *et al.*, 2013:306; Hak *et al.*, 2016:566; Sachs, 2012:2206). Research through multiple decades recognised the value of women's contributions in socio-economic development as they play numerous vital roles in the household including management of resources, livelihoods and agriculture, which is a major source of food and income. In the gendered division of labour, women are left with the burden of water, energy, and food management in their homes. Hence, they are primarily responsible for water, energy, and food security, multiple livelihood strategies and the general well-being of their family (FAO *et al.*, 2010:17).

Rural women, as executive managers of households, employ several strategies to cope with any challenges that have a negative impact on household water, energy, and food security. Women are involved in both formal and informal activities such as agriculture, pottery, dressmaking, small livestock rearing operations, food-processing and preparation, working for wages, collecting fuels and water, trading and marketing of goods and services, family care and home maintenance. These activities all contribute towards improving availability, accessibility and supply of water, energy and food within households to improve the general well-being of their families and households (FAO, 2011:2). This observation influenced the researcher to make women the primary population of the study.

Zimbabwe and South Africa are both semi-arid countries with an average annual rainfall of 300-500mm (Conway *et al.*, 2015:837). Even though water is not scarce at national level, poor communities do not have access to sufficient, safe and good quality water, locally (Abdulla & Al-

Shareef, 2009:195; Kanda *et al.*, 2017:471; Kujinga *et al.*, 2014:187; Grey *et al.*, 2013:4). As a rule, poor rural people seldom have proper access to sufficient infrastructure for water resources (WaterAid, 2012:8; Mintz *et al.*, 2001:1565). According to Benson *et al.* (2015:761), security is not readily defined, remaining somewhat imprecise within the current nexus theory. Grey and Sadoff (2007:547) define water security as the availability of an adequate amount and quality of water for health, livelihoods, ecosystems and economies of people. In many parts of sub-Saharan Africa, including Zimbabwe and South Africa, people lack access to safe water (Manzungu, 2004:3; Mudombi & Muchie, 2013:2; Muller *et al.*, 2009:8). This is due to poor water supply services and management; poor management of water resources; exclusions because of age, gender, disability, social status and the inability to pay for the services (WaterAid, 2012:10). The WaterAid water security framework for households, points to the constraints surrounding water sources. For example, the diminishing number of water points like boreholes, hand-pumps and public taps has increased the vulnerability of the world's poor (WaterAid, 2012:13). To cope with these challenges, individuals usually travel long distances to unprotected, contaminated and seasonally unreliable water sources. In the process, communities use children to fetch water; they limit the water rations per person and per activity; schedule water-requiring chores such as the washing of clothes; and reduce the activities that require water in order to meet their daily needs (WaterAid, 2012:10). In consideration of the integrated interactions between water, energy and food, water stress have undeniable effects in both the food and energy security of such water-insecure households.

One of the major goals of developing countries in Africa, such as Zimbabwe and South Africa, is to ensure rural household food security, which will improve the general well-being of people (Sinyolo *et al.*, 2014:483). Therefore, the major concern is to ensure the availability of food at household level for those who are poor, vulnerable and socially marginalised (Backeberg & Sanewe, 2010:10). Food security is the condition in which individuals, at all times, have physical, social and economic access to sufficient, safe and healthy food to meet their dietary needs and food preferences for an active and healthy life (FAO, 1996:4).

Food security is still of great concern for many households in both South Africa and Zimbabwe. This insecurity is attributed to high poverty levels that exist in both countries especially for marginalised groups and people living in rural areas. The FAO (2011:13) asserts that 92% of the world's undernourished people live in developing countries. This number has increased from 840 million in 1996 to 925 million in 2010 (FAO, 2011:13). This motivates the need to find ways in which to reduce the impact of food scarcities. Household coping strategies found in other studies included reliance on food aid, inter-family assistance, remittances, food for work schemes, conducting varied livelihood strategies, agriculture, sale of assets, reduction in the number of

meals, child labour and sex work, to mention only some examples (FAO, 1996:4; Pinstруп-Andersen, 2009:5; Rosegrant & Cline, 2003:1917).

Energy security is of concern especially among poor households in developing countries. The World Energy Council, (WEC, 2007:14) conceptualised energy security in terms of availability concerning continuity of supply, quality and reliability of supply; accessibility as modern, affordable energy for all; and acceptability as terms of social and environmental goals. Hildyard *et al.* (2012:5), highlight how the term energy security is regarded by individuals as being able to afford heating and as having access to a means of cooking also in addition to being able to access fuels for their machines. The major setback is that, definitions for energy security are made at regional, national or even a global-level and are largely defined from political or economic perspectives (Pachauri, 2010:191). At the local level, there is a gap in available information on energy as nexus resource.

Poor households in developing countries intermittently lack access to sufficient sources and appliances of energy (Karekezi & Majoro, 2002:1016). Households remain dependent on energy sources for example unprocessed bio-mass, coal that is less efficient, cause pollution, are difficult to find, and poor in quality (Howells *et al.*, 2005:1834). In order to meet the basic needs, these types of fuel are usually a way to cope as they are cheaper but are inadequate. The alternative sources of energy to the afore-mentioned options are in most cases expensive for rural households. Attempts to cope with scarcities associated with energy in rural households include the use of multiple fuels, for example, electricity for lighting and wood for cooking (Pachauri, 2010:191). In rural Africa in particular, the demand for domestic energy is high and this has culminated in acute deforestation and desertification in many areas (WEC, 2007:19). In consideration of the above-mentioned review, the question of how rural women in Masvingo Province, Zimbabwe and those in Limpopo Province, South Africa cope with these complex issues becomes relevant.

Coping strategies refer to the things that people do when they cannot access their basic needs, for example, water, energy, and food (FAO, 1997:2). Maxwell and Caldwell (2008:12) state that there are regular responses that people resort to in an effort to manage shortages in the form of basic coping strategies. Snel and Staring (2001:44) define coping strategies as those strategically selected acts employed by households and individuals in poor socio-economic positions, to reduce expenses, or earn an income to purchase basics and keep up with the society's level of welfare

These coping strategies can be categorised into two. The first refers to the mechanisms employed to deal with short-term insufficiencies, the second act refers to the adaptive long-term

changes in the way households and individuals acquire sufficient food and/or income (Davies, 1993:4; HSRC, 2008:15). The literature on coping strategies suggests that at the household level, strategies for dealing with WEF insufficiencies include, *inter alia*, reduction and rationing of consumption, increased use of credit, reliance on wild food, remittances and inter-family assistance, alterations in living habits, sales of assets, food for work, and reliance on aid. WEF nexus security and attempts at putting in place coping mechanisms point to the complexity of each component in the nexus.

WEF nexus security has four major dimensions, namely: availability, access, stability of supply, and utilisation – implying that it is a complex phenomenon with different parts and is therefore difficult to understand (Cobuild, 2006:280). Therefore, complexity implies the state of having two or more things connected or related to each other in a complicated way. Measures to safeguard WEF nexus security have not always been successful, especially in the rural areas of developing countries (Mabhaudhi *et al.*, 2018:7). The increasing threat to WEF nexus security requires appropriate measures to achieve diminution in insecurities threatening development, especially those of rural women. The nexus approach is proposed as one such measure as it embraces the concepts of resilience and adaptation in terms of panarchy theory (Gunderson & Holling, 2002:25). Resilience and adaptation are essential (Mpandeli *et al.*, 2018). By understanding what resilience and adaptation means, it is possible to recognise and contribute to striking a balance between the different goals, interests and needs of people as well as the environment in which they find themselves. There are complex interactions and feedback between human and natural systems (FAO, 2014:8). That is why the nexus theory was chosen as the central framework for the proposed study.

The literature at hand shows that there are a number of frameworks in the broad field of WEF nexus proposed by the World Economic Forum (WEF), the Bonn 2011 Conference and other scholars (Bazilian *et al.*, 2011:7897; Biggs *et al.*, 2015:390; Bizikova *et al.*, 2013:4; Mayor *et al.*, 2015:793; Rasul & Sharma, 2015:683; WEF, 2011b:26). Some institutions and academic research groups, such as the Stockholm Environment Institute (SEI), Stockholm International Water Institute (SIWI), the International Food Policy Research Institute (IFPRI), the University of Montreal, and the World Bank, share the same view. Their frameworks accentuate the need to come up with an integrated approach to WEF nexus security. The frameworks also illustrate the existence of a consensus that there is an undeniable relationship and interdependency of WEF resources and the need to seek solutions in an integrated perspective.

The framework models by SIWI, WEF, IFPRI, WB among others were formulated against the backdrop of a need to improve knowledge of the nature of the relationship between the WEF elements and the effects of how changes, stresses and shocks in one sector affects other sectors.

Though the frameworks all strive to clarify nexus issues, the framework built by the International Institute for Sustainable Development (IISD) gives an in-depth understanding of the nexus by disintegrating the concept of water, energy and food into individual sectors. Bizikova *et al.* (2013: 13) argue that the main goal of the IISD framework is to analyse the security of water, energy and food. The first step in implementing the framework, to seek solutions, is to understand each security component in itself and literally 'unpack' it to individually understand how water security, food security or energy security might be achieved and maintained in future. The temporal perspective is important to avoid trading-off security today for security tomorrow, and pushing externalities to the future (Bizikova *et al.*, 2013:13).

As already indicated, the IISD model embraces the core elements of WEF nexus security. These elements include: 1) utilisation, which focusses on how resources are used; 2) access, which focusses on ability, opportunity and the right to use the resources; and 3) availability, which focusses on how obtainable these resources are, especially to rural women. According to Bizikova *et al.* (2013:14), the links within the WEF nexus can only be assessed by identifying the critical elements and understanding the utilisation, access and availability of these resources.

The IISD framework compensates for the other frameworks' limitations, which makes it useful for the study of communities and groups of individuals. The IISD framework emphasises accessibility, utilisation and availability of WEF nexus, human built systems, ecosystem goods and services. Attention is given to a place-based focus, making the WEF nexus an ideal framework for the study of rural communities in Zimbabwe and South Africa. Due to the perennial challenges of securing water, energy and food for increasing populations, there is a need to look at coping strategies, especially those of women in rural households. By drawing a comparison of rural communities in Zimbabwe and South Africa from the WEF nexus perspective, potentially important insights can be uncovered. There is limited literature on rural women's coping strategies in WEF nexus security, with most of the existing literature tending to focus on national and regional levels, but not on the local level.

1.3 Problem statement

Against a background where a myriad of WEF nexus security challenges for women in rural areas exist, this study aimed to explore the coping strategies employed in dealing with those challenges. Research by Maxwell (2008) suggests that when confronted with water, energy and food security challenges, people in rural areas seem to resort to using certain coping strategies. Since WEF nexus insecurities are sometimes exacerbated by poor coping strategies (FAO, 1997:18), such as unwittingly applying strategies used by organisations and individuals in one sector to a different

sector, it is crucial to examine the coping mechanisms used by rural women in combating these insecurities.

Therefore, this study examined household coping strategies in terms of the WEF nexus security and the development context of rural women as a marginalised group in society. Findings from the study were anticipated to lead to a deeper understanding of the challenges leading to WEF nexus insecurity for rural households and how these can be resolved. Rural women face different WEF nexus challenges and situations, which vary from one locality to another. WEF nexus security is also varied, as choices and decisions of individuals who, in turn, are influenced by their situations and sources of livelihoods affect it. Therefore, this study will bring out common traits in the WEF nexus by drawing up similarities and dissimilarities in women's coping strategies in Zimbabwe and South Africa (FAO, 2014:10).

The chosen guiding theory for this study is the WEF nexus theory, which combines the concept of water, energy and food resources (Hoff, 2011:3). The theory is an integrative approach to examining challenges within the WEF nexus security (Hoff, 2011:3-7; Mpandeli, 2017:34). The IISD recommends the WEF nexus theory (Bizikova *et al.*, 2014:15) for studies, which explore the WEF nexus security and coping strategies, used in rural households. According to FAO (2014:4), the nexus approach leads to a better understanding of the complex and dynamic interrelationship between water, energy and food, thus engendering sustainable management of resources in general and promoting WEF nexus security in particular. The theory makes it possible for people to contemplate the impact of a decision in one sector, and its potential ramifications on other sectors. It is against this background that this study was undertaken to investigate the strategies of rural women in selected rural communities of Zimbabwe and South Africa and to determine their effect on the WEF nexus security. The findings of this study may be of use for researchers in southern Africa working on women and their households in rural areas.

The WEF nexus theory has a national or regional focus, which indicates an understudied niche area concerning localised communities. Theory has been used to find solutions for regional and global WEF insecurities; this left out local lower levels such as communities and households— a gap that this study aimed to address. It was anticipated that a focus on rural households in small communities within the framework of the WEF nexus would complement the findings of national and regional studies. This research aids in building a knowledge base that enables people to understand the linkages in the WEF nexus and how actions in one sector affect other sectors. Rural communities, which constitute the bulk of the Zimbabwean population (67%) and a notable percentage of South Africa's population (35.7%), have remained compromised in terms of access to and in some cases availability of water, energy and food security (Bazillian *et al.*, 2011:7897-9). Links between rural women and WEF nexus security cannot be ignored and are important for

purposes of rural household development. Bazillian *et al.* (2011:7897); FAO (2014:5) and Hoff (2011:7) have highlighted the need to add a perspective based on local communities and individuals at the bottom of the social pyramid in order to come up with a comprehensive understanding of WEF-related challenges and coping strategies. It is in this context that this study explored rural women's household coping strategies using the WEF nexus perspective in Zimbabwe and South Africa.

Research work by ADB, 2013b; Bizikova *et al.*, 2013; Hoff, 2011; Mohtar & Daher, 2012, try to explore how the nexus approach can be used to secure either one or more of the WEF sectors in the nexus at a national level. At the same time, scholars like Bazillian *et al.* (2011), have emphasised the need to involve the poorest and most vulnerable groups of society in the world when working on the WEF nexus security. However, the focus on local level interventions related to WEF nexus have remained minimal (Foran, 2015:656; Gulati *et al.*, 2013:151; Lawford *et al.*, 2013:608; Rasul, 2014:36). A number of researchers have shown that energy, food and water are important for human existence and development (ADB, 2013b; Bizikova *et al.*, 2013; Hoff, 2011; Mohtar & Daher, 2012). Access to these resources and their management is the basis for sustainable development. Hence, in an attempt to address the gap left by previous studies in their lack of focus at local levels, this study sought to localise, assess and compare the WEF nexus security coping strategies of women in two selected localities across national boundaries, namely in Zimbabwe and South Africa. These countries were chosen because they are from the same geographic region and are similar, this helps to maximise diversity and allows for exploration of the WEF nexus security and coping strategies. Each nation in this study is treated as the object of study. Comparing two countries in this study helps to identify the trans-national similarities and differences at a micro level.

Bazillian *et al.* (2011:7899) assert that there are billions of people who do not have access to good quality services related to water, energy and food. The number of disadvantaged people has remained relatively unchanged over an extended period. Moreover, this trend is predicted to persist (FAO, 2014:5). The projected trend of disadvantaged people without access to water energy and food underlines why a need to study the household WEF nexus security and the coping strategies of women in a typical rural setting is important. Understanding the WEF nexus security, in a holistic manner, would: enable equality in the allocation of resources; improve economic efficiency of rural women; lower environmental and health impacts; avail better developmental conditions; and will potentially lead to the optimal development of households in rural areas.

The perceived increase of the perennial challenges concerning water, energy and food security and the lack of solutions thereto, points to the urgency for strategically formulated interventions and actions or coping strategies.

1.4 Central theoretical statement

The WEF nexus is an integrative approach that combines major drivers of development, namely water, energy and food. Therefore, in this study it is used to understand the WEF nexus security dynamics, which potentially contribute to plans of action against the plight of rural women's households in Zimbabwe and South Africa. The study sought to find out if the WEF nexus approach could be used at household level to explore the interplay of water, energy and food in rural households in ensuring WEF nexus security.

The argument was that the WEF nexus theory can be used to understand the household WEF nexus security. It is important to study the WEF nexus within households as results can assist in the implementation of coping strategies to alleviate rural household WEF insecurity. It also helps women to determine how they should choose ways to respond to the WEF nexus security. Additionally, the study distinguishes between the similarities and differences in the rural settings of two different Southern African states districts for broader synergies in understanding the WEF nexus.

1.5 Contribution of the study

The findings of this thesis will redound to the benefit of governments and policy makers; development practitioners; service providers in the WEF nexus; societies and individuals who have a role to play in the sustainable management of WEF resources and security. The WEF nexus combines key resources that play a key role in social and economic development. The need to empower individuals and societies justifies the need for more effective sustainable development approaches. This study will promote an understanding of the WEF nexus security and the connections in a local context. Therefore, results of this study will contribute to: develop strategies for creating resilient households; promote sustainable resource use; promote rural development and empowering women with knowledge, and to potentially further enhance existing coping and adaptation strategies. For the researcher the study will help them to explore critical and complex issues of the WEF nexus in the local context that many researchers have not explored.

1.6 Overall aim of the study

The aim of this study was to make an academic assessment of the coping strategies of rural women in Masvingo Province, Zimbabwe and Limpopo Province, South Africa with reference to challenges linked to WEF nexus security. This can potentially guide policymaking, decision-making, resilience, adaptation and actions for intervention by the responsible authorities.

1.7 Research questions

The study was drawn from both non-empirical and empirical inquiry into the household WEF nexus security and the coping strategies of rural women. The first and second questions guided the non-empirical study and the third to the sixth questions guided the empirical research:

1. What is the context of the WEF nexus security and coping strategies of rural women in Zimbabwe and South Africa?
2. How applicable is the WEF nexus theory to rural households in Southern Africa?
3. What is the current WEF nexus security status of rural households in the Chivi district of Masvingo Province, Zimbabwe?
4. What is the current WEF nexus security status of rural households in the Vhembe district of Limpopo Province, South Africa?
5. What are the coping strategies used by rural women to the WEF nexus challenges in Zimbabwe and South Africa?
6. What recommendations can be made based on the use of the WEF nexus approach to assess the coping strategies of rural women in Zimbabwe and South Africa?

1.8 Research objectives

This study seeks to:

1. explain and Contextualise WEF nexus security and coping strategies of rural women in Zimbabwe and South Africa;
2. examine the applicability of the WEF nexus theory to rural households in Southern Africa;
3. explore the current WEF nexus security status of rural households in the Chivi district of Masvingo Province, Zimbabwe;
4. explore the current WEF nexus security status of rural households in the Vhembe district of Limpopo Province, South Africa;
5. compare the coping strategies of rural women to WEF nexus security in Zimbabwe and South Africa; and
6. make recommendations based on the WEF nexus approach to assess the coping strategies of rural women in Zimbabwe and South Africa.

1.9 Research Methodology

1.9.1 Introduction

This study examined household WEF nexus security and coping strategies of rural women. An exploratory study of two cases, one from Zimbabwe and another from South Africa was developed, based on literature, indicating that achieving WEF nexus security is a major challenges facing most developing countries (FAO, 2014:4). While the study compares coping strategies of women in rural areas in the two districts within these states, it is not primarily a comparative study. Instead, the objective was to explore how women in rural areas in the two countries cope with WEF nexus security challenges.

Two rural communities were chosen for the case study and rural women were the specific representative population. The study answered a set of research questions in order to contribute to the WEF nexus debate. The outcome of the case study enabled the researcher to determine WEF nexus interactions within households and the coping strategies used by rural women. As indicated earlier, the study attempted to bridge the gap by broadening the knowledge, on both the theoretical contributions to understanding household WEF nexus security, as well as the coping strategies of rural women by offering empirical and grounded evidence.

The bulk of the data for this qualitative study was drawn from a combination of case studies, ethnographic and phenomenological strategies based on participatory observation; focus group discussions; key-informant and in-depth interviews; the review of primary records; and visual data, as well as secondary documents. Murphree (1991:56) suggests that the methodological frameworks for studies of natural resources should include comparisons at various levels and be multi-disciplinary. That is why the study pursued a multiple-case study approach, so that generalisation can be validated. This study was, therefore, about locating contrasts between places, people, contexts, and rural areas in Zimbabwe and South Africa, while exploring coping strategies.

This research was conducted in two phases. In phase one, a more empirically focussed literature review was done to determine what has been done in related research work in the field. The review covered the global, regional, country and district level literature available on the topic. In phase two, empirical research was done in two identified localities where textual and/or visual data was collected for the purposes of analysis and interpretation. Pilot studies were also conducted to find information for successful data collection and to ensure that the areas chosen met with the required characteristics for investigation.

1.9.2 Phase one: Literature review

The aim of conducting a literature review was to gain a clear understanding of the WEF nexus, its interactions within its system and its interactions in the context of a rural household in Southern Africa. Furthermore, the literature review aimed to discover the coping strategies employed by rural women so far in Zimbabwe and South Africa. Given the fact that the current trends in WEF nexus theory is relatively new, a broad spectrum of potentially useful literature was reviewed to obtain an insight into existing research in a number of potentially WEF-related fields. The literature review included studies conducted on rural development, poverty and women and their coping strategies (Ashley & Maxwell, 2001:396; Mwabu & Thorbecke, 2004:17; O'Laughlin, 1998:3; Ogunlela & Mukhtar, 2009:21).

The literature review discussed issues of water security and how it influences rural development and reduces rural household poverty in Africa. Grey and Sadoff (2007:546), Manzungu (2004:4), Rasul (2014:36), as well as Rijsberman (2006:6) have in their studies, emphasised the importance of water in rural development. Energy security was discussed after looking at the works of scholars such as Barnes and Floor (2003:497), Kaygusuz (2011:937), Magadza (2000:194), Reddy *et al.* (2008:249), and Yergin (2006:123). They have done extensive work on the importance of energy security in rural development. The literature review incorporated the work of Gladwin *et al.* (2001:178); Lobell *et al.* (2008:608), Misselhorn (2005:34), Rosegrant and Cline (2003:1818) and Frankenberger *et al.* (2012:5), who discussed food security and the role of rural women in the governance of food. These authors have investigated the state of food security in rural areas, the challenges and issues associated with livelihoods and food governance. North-West University's library database was the major source of secondary materials, in both hard and soft form, for the purposes of the literature review.

As outlined above, a number of aspects directly related to the WEF nexus were investigated by the researcher, well in advance of the first formal fieldwork for securing empirical data. It provided valuable and relevant generic background information. It is clear, as evidenced by varied researches, that policy makers, researchers in the global context have increasingly embraced the complexity of relations between water, energy and food (Hoff, 2011:5; Karabulut *et al.*, 2018: 3875; Leese & Meisch, 2015:8 ; Martinez-Hernandez *et al.*, 2017: 1011; Wicaksono *et al.*, 2017: 442). These linkages have been overlooked in the past by narrowly focussed actions, investments and policies (Bizikova *et al.*, 2013:3). There is an undeniable inter-dependence on water, energy and food security (Chirisa & Bandaiko, 2015:392; Furst *et al.*, 2017:413; GIZ, 2016:78). They form a part of what is which are regarded as a vast array of global challenges. Increasing globalisation and a burgeoning global population heavily weigh down on resources. An expected rise in the demand for water, energy and food by 30-50% in 2030, without sound intervention

frameworks, can cause long-term insecurity. Water, energy and food insecurity have a negative impact on social and political stability, geo-political relations and environmental sustainability (WEF, 2011a:3; WWF, 2017:19). This means that overlooking the dependence, linkages, relationships and connections within the WEF nexus have serious consequences.

Various authors on the topic emphasise the relationship and links to the WEF nexus. There is an expressed importance in acknowledging these linkages for poor people who have limited access to resources in fast-growing regions (ADB, 2013b:6; Bazilian *et al.*, 2011:7898; FAO, 2014:5; Hoff, 2011:8; WEF, 2011a:29). The literature points out how water is important in energy production and even more so for agriculture as the main consumer of water (FAO, 2014:7). There is also the role of energy in water treatment and extraction, food preparation and transportation. Food is important in the cycle as it produces renewable energy. Typically, for example, plants play an important role in the water cycle (Bizikova *et al.*, 2013: 4; Bazillian *et al.*, 2011:7988; WEF, 2011:29). The existing literature emphasises the stress and shortfalls on water, energy and food resources. A refrain that frequently occurs in the literature is the fact that the larger the world's population, the more vulnerable we become to water, energy and food insecurity (Bazillian *et al.*, 2011:7897; FAO 2014:9; Hoff, 2011:9; Bizikova *et al.*, 2013:8). There is also general support for the view that there will be a growth in the demand of WEF nexus elements, which can be a result of population growth, urbanisation, varied diets, changing lifestyles and technological advancement. Bazillian *et al.* (2011:7898) assert that population growth will cause significant challenges to WEF nexus security because these resources are the key elements to the functionality of a society. They further argue that the WEF nexus is important, as it is useful in improving the well-being of poor and vulnerable populations by securing water, energy and food.

Scholars have thus far examined the challenges of WEF nexus individually and collectively within the nexus. They explored the relations, especially of water/energy and water/food, when attempting to develop frameworks. This puts the emphasis on water without undermining the other components of the WEF nexus. There is an emphasis on the lack of access to WEF nexus resources at a regional and global level (Bazilian *et al.*, 2011:7898; Bizikova *et al.*, 2013:6; Rasul & Sharma, 2015:682; Van Vuuren *et al.*, 2012:19; Mabhaudhi *et al.*, 2018: 46). Some authors tend to depart from viewing WEF nexus security as individual sectors. They acknowledge the connections where activities in one sector have an impact on the other. The literature, in general, tends to broadly focus on the regional and global level of achieving security in the WEF nexus (Bazillian *et al.*, 2011:7897; FAO 2014:9; Hoff, 2011:9; Gupta, 2017:223). However, it is evident from these sources, that the literature on coping strategies and the WEF nexus at local and individual levels is still an under-explored area of investigation. This is because very little, or

no research, has been published thus far on how women in rural communities respond to WEF nexus.

The preliminary literature review conducted relied extensively on the following key words: resilience, adaptation, coping strategies, water security, energy security, food security, WEF nexus, WEF nexus security, rural households, rural women, rural development, poverty and rural governance, South Africa, Zimbabwe, Masvingo Province, Limpopo Province and Southern Africa.

1.9.3 Phase two: Empirical research

1.9.3.1 Research paradigm

Mouton (2009:37) argues that methodological paradigms such as qualitative, quantitative and participatory action are not only methods of inquiry but have values and assumptions that guide their use in any research. They are indeed guided by theoretical assumptions and how they can be used. They, of course, have their own limitations. These characteristics guide researchers in choosing which paradigm to employ in their studies. In this study, an interpretivist research paradigm was employed. According to Maree (2007:59), the ultimate aim of interpretivist research is to offer a perspective of a situation and to analyse the situation under examination. The study used interactions to inquire and understand the household's water, energy and food nexus security and the manner in which rural women develop coping strategies. The information that they disclose was used to construct meaning concerning the interacting, integrative and interdisciplinary systems within the nexus. This multi-dimensional framework demands a variety of research methods and data sources. In consideration of the broadness of the WEF nexus, this study investigated utilisation, accessibility and availability of WEF nexus elements. Moreover, this study specifically focussed on rural women in Masvingo Province, Zimbabwe and Limpopo Province, South Africa.

The research design for this study is qualitative in nature. Nieuwenhuis (2010:70) defines research design as a plan or strategy, which moves from the underlying philosophical assumptions to specifying the selection of respondents, data gathering techniques to be used and the data analysis to be done. Qualitative research is defined by McMillan and Schumacher (2014:315), along with Creswell (2009:14), as an enquiry in which researchers collect data in face-to-face situations by interacting with selected persons in their natural settings. This involves studying a phenomenon in all its complexity. The use of multiple methods allows the researcher to secure an in-depth understanding of the phenomenon in question (Creswell, 2009:14). A qualitative methodology was chosen for this study. It sought answers from the experiences of

groups or individuals. The study focussed on rural women in rural communities of Zimbabwe and South Africa and was conducted in local settings in the two districts singled out for investigation. Qualitative methodology allows the researcher to share in the understandings and perceptions of others and to explain how people structure and give meaning to their daily experiences (Creswell, 2009:14; Nieuwenhuis, 2010:70). In this case, the rural people's perceptions on water, energy and food nexus security, as well as, their actions and interventions in trying to deal with problems were probed.

1.9.3.2 Research design

The study took a multi-method approach where multiple case studies and phenomenological categories were used to make inquiries on the topic. A hybrid design was selected because it increases validation and combines strengths of two strategies to enhance trustworthiness, credibility, transferability, dependability and conformability. Multi-method designs also allow the researcher to have ample room for manoeuvrability during the research process (May, 2001:96).

According to Leedy and Ormrod (2014:143), a case study is where a particular individual, programme or event is studied in depth for a period of time. Leedy and Ormrod (2014:143) further assert that case studies are suitable for hearing more about a little known or poorly understood situation. It allows for research into two or more cases to make comparisons, build a theory, or propose generalisations in a multiple case study. It allows for investigation on how individuals or programmes change over time, perhaps as a result of certain conditions or interventions. The study used phenomenology as another method of enquiry. Leedy and Ormrod (2005:139) define phenomenology as a study that attempts to understand people's perceptions, perspectives and understandings of a particular situation. Creswell (2009:8) argues that phenomenology aims to understand and interpret the meaning that subjects of study give to their lives. Phenomenology, in this study, was used to determine rural men and women's perceptions on water, energy and food security. Although this study's focus was on women, the views of men were relevant and important. Both male and female perspectives on issues, potentially related to the WEF nexus, ensured a balanced and detailed study. It would be unrealistic to only source for the views of women without considering males. Men, for example, may have valuable views on challenges women face – some may even relate to issues of which women themselves are not always aware. However, the male members *per se* in rural communities were not the prominent focus of the study.

1.9.3.3 Sampling

Nieuwenhuis (2010:79) defines sampling as the process used to select a portion of the population for study. The samples selected should be suitable for the purposes of analysis. Sampling

involves selecting a predetermined number of samples from a larger population. Sampling can be conducted through probability sampling or non-probability sampling techniques. Probability sampling gives all units in a population an equal chance to be chosen. Non-probability sampling methods which choose units of study for specific intents. This study used non-probability sampling in the selection of participants. This method samples the study population through accidental or purposive sampling methods. Accidental sampling method chooses the first person met, volunteers and those who are available for study purposes. The disadvantage of accidental sampling is that it is difficult to prove that samples chosen are representative of the populations for generalisation. Purposive sampling methods choose participants following a specific purpose in mind. Thus, the population of this study was limited to a sample purposefully selected from two rural communities.

1.9.3.3.1 Purposive sampling

According to Nieuwenhuis (2010:79) purposive sampling is taken as simply meaning that participants are selected because of some defining characteristics that make them the holders of the data needed for the study. This sampling method chooses study units with a purpose in mind. The researcher will have one or more specific groups of the population which fits the requirements of the study. There will be set criteria for the selection of samples. The advantage of purposive sampling is in its ability to reach a targeted sample quickly. It is ideal for getting opinions from the targeted populations. The study used purposive homogeneous sampling where participants, who have the same characteristics, were chosen. In this study, the chosen population were those permanently residing in rural areas. Participants were chosen based on age, background, gender and places of living, which are also indicators of homogeneous traits. The study used purposive expert sampling, by choosing respondents from organisations operating at local level dealing with securitisation of WEF nexus and the impact on rural women.

1.9.3.4 Research participants

Population refers to a set of entities in which all the measurements of interest to the researcher are represented (De Vos *et al.*, 2005:193). This study chose 50 participants as the target sample size from each case study area for the purposes of this research. A target sample size was made to help in the planning processes, although in nonprobability sampling methods one has to conduct interviews until data saturation has been reached. Guest *et al.*, (2006:60) argues that though data saturation is referred to as a point whereby no new information is being found, there are no clear guidelines set for researchers on required sample sizes to reach saturation. Guest *et al.*, (2006:79) recommended twelve interviews to suffice for studies which aim to understand perceptions and experiences among homogenous group of individuals. Creswell (1998:45) recommended between five to twenty five interviews for phenomenological studies and twenty to

thirty for grounded theory studies. Benard (2000:178) argues samples for participation in qualitative studies may range from thirty to sixty interviews.

The population for this study included rural men and women, community leaders (headmen and chiefs), local, district and provincial agencies, non-governmental and private organisations, international donor organisations and other relevant institutions. In fact, all stakeholders apart from civil society, with governance responsibilities related to water, energy and food at local level were relevant for the purposes of this study. It included officials at municipalities, agricultural extension workers and energy providers operating in rural communities. Therefore, the population for the study were both men and women who permanently reside in rural areas and who are above the age of 18.

The definition of a rural woman can be made by defining the two concepts of *rural* – areas away from towns and urban centres, in the country; and *woman* which means a female human being. However, characteristics for this study included both men and women. They were typically members who permanently reside in the selected rural communities under study. This helped to ensure that the study focussed on the subjects with grassroots experiences of the water, energy and food nexus in the identified research setting. Participants from local authorities and development organisations were those who had extensive practical experience of the operations of the WEF nexus in the respective communities in which they were officials. However, the essential focus remained on rural women. The researcher went into communities and found people who fit the essential criteria until the number of participants required for saturation of data had been reached. The researcher complied with the saturation target which was approximately 50 participants in each country (Nieuwenhuis, 2010:80). A rural community was chosen in both Zimbabwe and South Africa. One from Chivi district, Masvingo Province, Zimbabwe and another from Vhembe district, Limpopo Province, South Africa. These provinces were chosen because of their similarities in geographical and ecological endowments. They are both situated in typical Lowveld regions and are notable for less rain than the annual average in both Zimbabwe and South Africa.

Yin (2009:22) recommends conducting a pilot test in case study research to refine data collection plans and develop relevant lines of questions. For this study, the researcher developed a pilot test and the cases were chosen based on convenience, access and geographical proximity.

1.9.3.5 Data Collection Process

The data collection process was hybridised as it makes use of different research technologies. Data for the study was collected through focus group discussions, observations, In-depth semi-structured interviews, archival documents, as well as visual materials. These are tools that are

used in case studies, phenomenological and ethnographical studies. A multi-method approach was used to produce a detailed analysis of household water, energy and food security and the coping strategies of rural women. Mertens (2010:352) explains that observations aim at gathering accurate information about how programmes or processes operate. It involves taking note of behaviour and activities of individuals at the research site: the researcher records the behaviour and activities relevant to the proposed study in an unstructured or semi-structured way (Cresswell & Maietta, 2002:185). Using observations as a data collection technique is ideal because the researcher has first-hand experience with participants and can record information when it is still happening.

Nieuwenhuis (2010:87) defines interviews as a two-way conversation in which the researcher asks participants questions in order to collect data and to learn about the ideas, beliefs, views, opinions and behaviours of the participant. The primary aim is to get rich, descriptive data that will enable the understanding of relevant issues from the participant's construction. Cresswell and Maietta (2002:186) assert that interviews are useful because they can provide historical information, get the full range and depth of problems and be flexible. However, they can take a lot of time and information may be difficult to compare; they are also costly, and the researcher needs to plan to curb these challenges.

Focus group discussions are carefully planned discussion opportunities, designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment. They allow for group interactions and create a process of sharing and comparing among participants. According to De Vos *et al.* (2005:301) focus group discussions produce large amounts of data in a short period and they close the gap between people, expose reality and investigate the most complex behaviours. Focus group discussions were used in this study to gain a fuller and deeper understanding of challenges faced by rural women and their coping strategies. However, in some areas, grouping people together for a discussion may be difficult. The researcher used visual materials such as photographs because they are especially useful for validation. Visual materials were good for this study as they capture attention visually and are especially useful for validation since they document non-verbal behaviour and communication and can provide a permanent record (Banks, 2008:57). The researcher had to identify participants for each group. These groups did not have more than 15 members (May, 2001:126). A digital recorder and camera were used to capture data.

Mertens (2010:225) states that qualitative researchers study things in their natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meaning people bring to them. The most important part was to gain entrance in to the communities/sites of research and in this study; the researcher used an introductory letter from the university and proceeded to get

permission from provincial/district administrators, chiefs and headman in the chosen communities to conduct the research in their area of jurisdiction. Among these leaders, some were asked to act as gatekeepers for the study and the researcher was the instrument used for data collection (May, 2001:60).

In this study, the researcher observed the roles of women in their normal settings, particularly looking at the availability and accessibility of resources at their disposal and took field notes. Observations were repeated to validate findings. The researcher prepared an interview guide for interviews. Interviews usually take time. Thus, breaks were considered, and the researcher gave the participants a stronger role. The researcher recorded the proceedings of interviews to ensure that valuable data would not be lost while making notes. Comprehensive field notes were documented of all discussions and engagements with respondents. These sources were documented and ordered into a personal archive of the researcher which was used for reference purposes. The researcher used version 8 of Endnote for referencing. References are provided according to North-West University's guidelines for the Harvard referencing style.

1.9.3.6 Data analysis and interpretation

Rubin and Rubin (1995:226) recommend that data analysis should begin while the interviews are still underway. This shows that data collection and analysis in qualitative research go hand-in-hand. Data was analysed thematically. The researcher recorded data, transcribed and grouped the information found accordingly. To make the information more meaningful to the reader, data was reduced to narrative descriptions, tables, bar graphs, pie charts, maps and pictures. Narrative descriptions were used to explain given scenarios and relationships. Tables condensed numerical data for easier understanding. Diagrams, maps and pictures gave the data that was collected a pictorial appeal and shows evidence of observed aspects.

1.10 Ethical considerations

Ethical approval for this study was acquired from the Research Ethics Regulatory Committee (RERC) of the North-West University pertaining specifically to the School of Basic Sciences at the Vaal Triangle Campus. The researcher sought clearance from the district and municipal authorities in the chosen areas and provided an introductory and consent letter to all the respondents who participated in the study. This ensured that respondents' participation was voluntary. There was no use of force, or any unscrupulous methods to compel individuals to participate in the study. Respondents were asked to complete a consent form agreeing to their participation in the research. The researcher adhered to the following ethical considerations as listed below.

- The right to non-participation: respondents were not coerced into participating in the research.
- Informed consent: all prospective research participants were fully informed about the procedures and risks involved in research and they gave their consent to participate.
- The right to protection from discomfort or harm: all research participants were protected from any circumstance, which was likely to cause them any form of discomfort and/or physical or emotional harm – though in this research it was most unlikely to cause any harm or discomfort.
- The right to anonymity: the researcher ensured that the identities of respondents remained anonymous.
- The right to confidentiality: the research data will not be made available for other uses other than those agreed upon with the respondents. Confidentiality was ensured by using code names on all interview sheets.
- The right to privacy: responses from the interviews were identified with a code number. For the focus group discussions, ground rules were negotiated to ensure that privacy would be respected. The results are not linked to identities. Reporting of findings was anonymous by not associating findings to the identities of respondents.
- Audio-recorded data: recording was done using a voice recorder, the data recorded was transcribed. The transcripts and recordings are stored on a password-protected computer. The camera was used to take pictures of certain infrastructures, features and processes discussed and these were used to validate data.
- Only the researcher and promoters have access to the data. Data has been kept safe and secure by locking hard copies in locked cupboards in the researcher's office.
- Data will be securely stored for at least five years.
- Interviews: the interviews were semi-structured. The interviewer used a general interview guide and a list of topics and questions. Interviews were conducted within the communities to avoid transport costs. A suitable location to conduct the interviews was identified based on suggestion from the local leaders.
- Observations required the researcher to live within the societies being researched for at least three months in each community. Permission was sought from the district, municipal offices, as well as the traditional leaders of these societies.

In this research, the district administrators, chiefs, headmen and religious leaders of selected communities, were requested to act as gatekeepers for access to selected areas and helped the researcher to meet and work with the respondents for this study. The researcher provided a letter and proposal stating and describing in detail the need for the research, purpose, and its general outline. The letter, informed the authorities of the benefits intended by the research.

1.11 Limitations of the study

The sampled study population increased elements of bias; both the sample size and profile present a disadvantage of not including respondents with varied profiles. The sampling method targeted women in rural areas who are permanent residents and this may create bias, as some women with relevant information would be left out. The sample size of 50 respondents in each case study area may not be sufficient to generalise findings. In some cases, the targeted population of top officials were not available for interviews, which made the researcher to work with junior officials who may not have all the relevant information. The research was also limited by lack of adequate funding which hindered the researcher from covering a larger case study area and include more respondents.

1.12 Chapter division

Chapter 1

Title: Contextualising WEF nexus security and coping strategies of rural women in Zimbabwe and South Africa

The chapter contextualises WEF nexus security and the coping strategies of rural women using the WEF nexus theory. It is an introduction to the study as it provides background and context to household water, energy and food security; problems related to WEF nexus security; importance of the study and what has been done in South Africa and Zimbabwe in terms of the WEF nexus security. The chapter provided the background to the broad methodology followed in the study.

Chapter 2

Title: Theorising WEF nexus and resilience in rural Southern Africa

The chapter provides an analysis of the main conceptual frameworks to determine the interrelationship of WEF nexus security, household coping strategies and rural women. It presents the key concepts on which the study is built and how these concepts are interpreted and used.

Chapter 3

Title: Methodology: empirical case studies on WEF nexus and coping strategies of rural women

The chapter describes the methodology and research procedure followed in the two case studies chosen. The chapter gives an exposition of the characteristics of the study areas, the research participants and distinguishes the similarities and the differences in the case study areas.

Chapter 4

Title: The WEF nexus security status of rural households in the Chivi District of Masvingo Province, Zimbabwe

Chapter 4 provides the data interpretation and analysis for Chivi district. The chapter makes an in-depth analysis of the current WEF nexus security within rural households in the Chivi district of Zimbabwe. It examined the utilisation, reliability, accessibility and availability of water, energy and food within the households. The chapter explored the linkages and interactions of the WEF nexus elements in rural households. The challenges and roles of women were discussed as the main managers of WEF nexus resource elements in the home.

Chapter 5

Title: The WEF nexus security status of rural households in the Vhembe District, Limpopo Province, South Africa

Chapter 5 provides the data interpretation and analysis for Vhembe district. The chapter offers an in-depth understanding of the current WEF nexus security within rural households in South Africa. The broad themes of the WEF nexus security were discussed looking at the availability, accessibility, and utilisation, security of supply, the challenges faced and the coping strategies thereof. The chapter explored and described the connections of the WEF nexus in rural households. It explored the roles and challenges women face in rural areas.

Chapter 6

Title: Comparing the coping strategies of rural women for water, energy and food security

Chapter 6 gives a comparative analysis of the WEF nexus challenges and the coping strategies of rural women in both case study areas. This chapter described the similarities and the differences found in the two case studies on WEF nexus. It observed WEF nexus insecurity causes and challenges faced by women and strategies used in dealing with the challenges. The

chapter draws a synthesis of the similarities in these rural households and the differences when dealing with the WEF nexus challenges.

Chapter 7

Title: Summary, Conclusions and Recommendations

This chapter synthesised and reviewed the key findings of the study in a thematic manner that allowed for reflection relating to research objectives and findings. It provides the summary, conclusion and recommendations.

1.13 Conclusion

Chapter one gave an overview of the study. It provided the introduction, rationale, orientation and background information on the study. The chapter discussed the statement of the problem and the research questions guiding this research. The overall aims and objectives were given. A discussion was given introducing the study methodology including the research paradigm, research methods, data collection strategies, sampling, data analysis, interpretation and the ethical considerations. The methodology is discussed in detail in Chapter 3. The next chapter is a literature review theorising WEF nexus and resilience in rural southern Africa

CHAPTER TWO

THEORISING WEF NEXUS AND RESILIENCE IN RURAL SOUTHERN AFRICA

2.1 Introduction

In order to gain familiarity with the WEF nexus concept and the coping strategies of rural women, an extensive review of literature was done. The developing states of the world continue to experience substantial challenges in meeting demands for water, energy and food needs of their growing populations. These challenges are exacerbated by climate change, population growth, changing diets, consumption habits and other factors (FAO, 2014:8). In many developing countries, the people in the rural areas face the brunt of these challenges with communities becoming more water, energy and food insecure. Two rural areas in Zimbabwe and South Africa are singled out for the purposes of this study (Masvingo-Chivi district and Vhembe district). Both have faced moderate to severe droughts which have lasted for a number of years (Bird & Shepherd, 2003; Frost *et al.*, 2007; Gerhardt & Nemarundwe, 2006; Mpandeli *et al.*, 2015; Ofoegbu *et al.*, 2016; Ziervogel & Drimie, 2008; IPCC, 2018). Drought had a marked negative impact on livelihoods, wellbeing, as well as water, energy and food security.

This chapter explored how the Water-Energy-Food (WEF) nexus can be used to understand the interactions of these resources. The chapter begins by giving an in-depth review of literature on the WEF nexus drivers, various frameworks brought forward and their recommendations on the benefits and implementation of the concept. In the literature review, the focus is on how the WEF nexus has been used in different disciplines, as a theory on its own, and where authors/scholars combined it with other development theories to maximise its potential. The major recommendation from a broad spectrum of studies has been the need for good management of resources and the creation of resilient societies. A resilient socio-ecological system requires positive coping and adaptation techniques that have less or no negative impact in the long run. Building sustainable and resilient societies in rural areas involves efficient use of available resources with coordinated efforts to maximise synergies and minimise trade-offs. In this context, coping strategies are ways in which rural households become resilient to the ongoing challenges of WEF nexus security and build on the resources available to them to achieve sustainable resource use and development. The chapter reviewed literature on social resilience and coping strategies for WEF nexus security and highlight the various mechanisms adopted in rural areas. Therefore, where the WEF nexus theory aids in the understanding of household WEF nexus security (synergies and trade-offs),

social resilience theory helps in the understanding of how coping strategies are adopted, maintained and their impact in the long run.

2.2 The Water-Energy-Food nexus

The WEF nexus approach was mooted at the Bonn 2011 Nexus Conference as essential for sustainable development. According to the United Nations, the approach with its emphasis on understanding the linkages and interactions between water, energy and food offers views on how to implement integrated solutions of managing resources for sustainability (UN, 2016:8). Water, energy and food are important for the survival of people and they enhance global socio-economic development (FAO, 2014:5).

Water, energy and food are undeniably linked in a nexus. It is important to consider all the aspects in the nexus in order to minimise negative effects, as action in one sector has an impact on the other (Hoff, 2011:17). In the nexus, water is required for energy production as hydro-electric power, or as an input in bio-fuel production processes and treatment of wastewater (Vanham, 2016:299). Water is used largely for agricultural activities, food production, processing, household cooking and hygiene purposes (Stevens & Gallagher, 2015:22; Taniguchi *et al.*, 2013:435) and other non-agricultural activities, for example brickmaking, pottery and beer brewing in most rural communities. Water in itself is also regarded as a foodstuff. If it is safe for consumption, it adds to a healthy and balanced diet as the key requirement for the wellbeing of people and the ultimate hygiene of households (FAO, 2008b:10). Furthermore, it has become evident that for a number of decades the agricultural sector has been consuming as much as 90% of the available global fresh water (Zhang & Vesselinov, 2017:1).

Food production relies heavily on water and energy. Food requires energy in the food production sector and the food sector consumes about 30% of global energy (FAO, 2014:6). Energy consumption in the food sector relies largely on fossil fuels. As the demand for food rises, so will the demand for more energy to meet food production needs. Food security requires energy across a vast spectrum of activities. Take for example, surface and groundwater extraction and distribution in irrigation agriculture operations, food preparation, and preservation; and the multitude of food-related activities in households (Scott *et al.*, 2015:16; van Vuuren *et al.*, 2012:19; Weitz *et al.*, 2014:48).

Energy also forms a major input in non-farming activities in rural communities that are essential for the wellbeing of families. Examples include the transportation of humans, goods and services. A prime example is the use of locally harvested indigenous and exotic trees for firewood in processes of brickmaking, pottery, beer brewing and food preparation (Ncube, 2012:10;

Oberhauser *et al.*, 2004:206). The household uses of energy are generally energy intensive and uneconomic cooking and heating operations lead to the unsustainability of maintaining local resource use, especially in developing countries (Muller-Kraenner, 2015:5; Kaygusuz, 2011:937). These relations are explained in Figure 2.1.

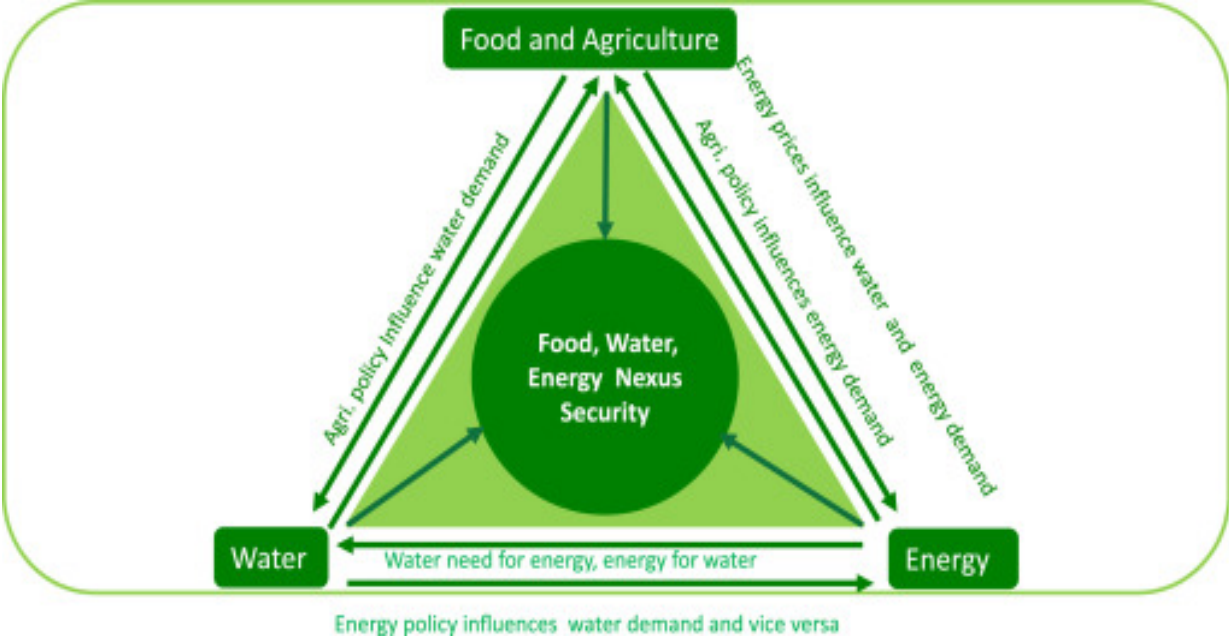


Figure 2.1: Dynamic inextricable links among the food, water, and energy sectors

Source: Rasul, 2016:15

2.3 Understanding the nexus

A nexus is a connection, or series of connections within a particular situation or system that is subject to constant change. The WEF nexus emerged in recent years as a framework or approach to stem challenges arising from factors such as global environmental change, population growth, urbanisation and slow economic growth (WEF, 2011a:29). These assert considerable pressure on natural resources and social ecological systems in many parts of the world. Future projections suggest that the global consumptions of water, energy and food will increase by approximately 10% to 60% by 2030-2050. The growing stresses on the available water supply will lead to increased competition for the available resources. This has an unpredictable impact on human wellbeing, livelihoods and the environment (ADB, 2013b:4; Allan *et al.*, 2015:301; Bazilian *et al.*, 2011:7897; Biggs *et al.*, 2015:390; Bizikova *et al.*, 2013:1; FAO, 2014:1; Foran, 2015:655). Water, food and energy are regarded as the most important collectively grouped resources for human welfare. Between the three components of the nexus there are boundless complex interactions (Hussey & Pittock, 2012:2; Karabulut *et al.*, 2016:278; Lawford *et al.*, 2013:607; Leese & Meisch, 2015:697). As a result of on-going speculation on the increasing demand for water, energy and

food, the problem has been deposited in the research, management and governance space for experts to come up with a lasting solution and intervention that would ensure secure and safe sources of water, energy and food for growing populations (ADB, 2013b:3; Allan *et al.*, 2015:302; Bazilian *et al.*, 2011:7898; Endo *et al.*, 2015:5807; FAO, 2014:2; Hoff, 2011:5).

The complex interactions of the global resources system are best described with the WEF nexus (FAO, 2014:3). Nexus interactions have proven to be complex and so dynamic that it is imperative not to study them in isolation. The emergence of the natural resources nexus concepts can be traced back to the 1980s when the United Nations University started focusing on food-energy challenges in developing countries (Sachs & Silk, 1990:89). Conferences on the food-energy nexus were held in Brazil in 1984 and India in 1986 to develop and illustrate linkages on food-energy and ecosystems. At the time, there were also strategies to model approaches that would address challenges experienced in the realm of food and energy production. At the time considerable attention was given to technical and policy solutions (Scott *et al.*, 2015:17).

Subsequently, a combination of different resources came up for research scrutiny. Increasingly, experts in the field of research, management and governance started recommending interventions. Scholars such as Scott *et al.* (2015:18) looked at the land and water challenges to electricity generation, and at the energy and environmental needs for water on top of industrial and urban agricultural needs. Gleick (1994) focussed on the interactions between water and energy.

Focus on what is currently the WEF nexus was broadened in the past two decades (Postel, 1998; Rosegrant *et al.*, 2002; Slifko *et al.*, 2000). The water-energy nexus (Davidson *et al.*, 2003; Gleick, 1994), paved way for a food-land nexus (Gerbens-Leenes & Nonhebel, 2005; Tranter *et al.*, 2007), and water for agriculture (Chaves & Oliveira, 2004; Pimentel *et al.*, 1997; Turrall *et al.*, 2011). These foci paid special attention to policy making and legal dimensions for the expansion of nexus resources conception. There is thus also a growing group of researchers introducing climate change as a component of the WEF nexus (Beck & Walker, 2013; Conway *et al.*, 2015; Hermann *et al.*, 2012; Rasul & Sharma, 2015; WEF, 2011b). The need to integrate climate change in the WEF nexus became more relevant following the need to limit global warming to 1.5°C than 2°C, to ensure and promote equity, sustainability and reduce the negative effects of climate change (IPCC, 2018:2). The reduction of global warming plays a key role in social and ecological resilience, giving systems capacity to adapt to adverse climatic changes that threaten WEF nexus security (IPCC, 2018:2).

The formal acceptance of the WEF nexus came about after 2008 in India, as a result of a special focus on the development of ground water irrigation (Scott *et al.*, 2015:20). More studies followed

in various contexts. These included theories related to adaptation, resilience, climate change, land use and security. Institutions such as the Food and Agriculture Organisation (FAO), Stockholm International Water Institute (SIWI), International Institute for Sustainable Development (IISD), Asian Development Bank (ADB), and the United Nations Economic Commission for Europe are among the institutions that currently recognise the importance of the WEF nexus. Conferences were organised with special focus on the WEF nexus. The Bonn 2011 nexus conference, World Economic Forum 2011, Nexus 2014, The Stockholm World Water Week 2012, to mention a few. The WEF nexus concept in the water sector was formally established by the formation of the Bonn WEF Security Nexus Resource Platform conference in 2011 (Bazilian *et al.*, 2011; Bizikova *et al.*, 2013; FAO, 2014; Hoff, 2011; Scott *et al.*, 2015). The major push for the new approach came after there was increasing consensus that water is the major component that links together food and energy. Water security thus is important in improving both the energy and the food sector, human and economic development, as well as a stable supply of energy and food.

The nexus approach was established for its capacity to focus on achieving water, energy and food security for human wellbeing while advocating for ecologically sustainable uses of these globally scarce and essential resources (Bizikova *et al.*, 2013:3). It is a concept that highlights interdependencies between achieving water, energy and food security with special understanding of synergies and trade-offs involved in the nexus security (Biggs *et al.*, 2015:389). The WEF nexus approach represents a departure from frequently used sectoral approaches to solutions that competed to encompass integrative, coherent and cross-sectoral perspectives for sustainable development (FAO, 2014:6). It is a concept that challenges existing structures, policies and procedures at global, regional, national and community levels (Hoff, 2011:5). The water, energy and food supply securities depend on ecosystems and on each other. The three resources, food (land), water, and energy are part of this ecosystem and must be used and protected in a balanced manner (Hoff, 2011:9). Diagrammatically the WEF nexus security framework is indicated in Figure 2.2.

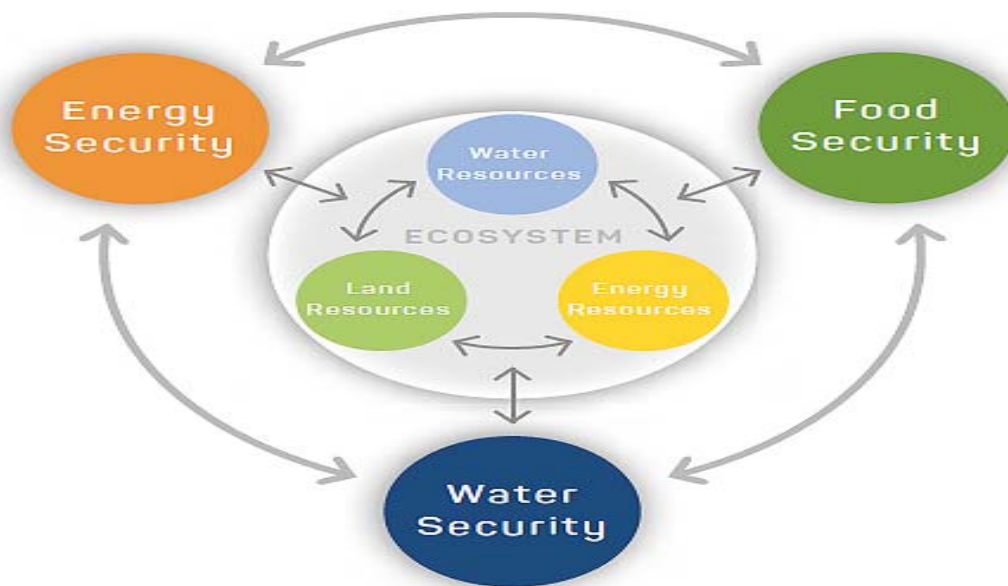


Figure 2.2: The WEF nexus framework in a security context

Source: The Water, Energy & Food Security Resource Platform (www.water-energy-food.org)

2.4 WEF nexus approaches and dynamics

It has become a global mandate to solve a set of complex and interrelated problems that pose significant threats to human wellbeing (Bazilian *et al.*, 2011:7897; Benson *et al.*, 2015:757; Biggs *et al.*, 2015:391; Scott *et al.*, 2015:16). Most of these are related to WEF resource production, distribution and use. These resources can also be regarded as the pillars of global security and human wellbeing (Bazilian *et al.*, 2011). This has forced scholars, organisations, researchers, governance and policy makers to look for a holistic approach to solve challenges arising.

The approaches to the WEF nexus that have been posited have mainly relied on the perspective of the respective proposers of the concept. Most have been along three lines of bias: water-based, energy-based and food-security-based perspectives (Bizikova *et al.*, 2013; FAO, 2014; Grey & Sadoff, 2007; Gulati *et al.*, 2013; Hoff, 2011; Mushtaq *et al.*, 2009; WEF, 2011a; ADB, 2013a). The use of the concept of security has contributed significantly to neutralising individual bias and preference. The WEF nexus comfortably acknowledges the links between water, energy and food resources in management, planning and implementation. They are in effect a collective response to global challenges and economic crises (WEF, 2011a:28). Substantial attention has been given to the development of frameworks that contribute to the description of WEF nexus. In the field of

research, the concept has been put to use in case studies to identify policies and actions (Bizikova *et al.*, 2013:4).

The WEF nexus concept marked a paradigm shift from sectoral interventions to more integrated and holistic interventions. It merely required an acknowledgement of the interconnectedness of water, energy and food (Bizikova *et al.*, 2013:3). These connections were identified by acknowledging the need for water in both food and energy production, energy is also important for food processing and transportation and food is important in the production of energy sources for humans and domestic animals (WEF, 2011a:29). It can therefore be posited that the major accent of WEF nexus frameworks is on the need for the integration of WEF nexus elements, because decisions made for one sector may compromise security of the other sectors. The outcome can have a negative effect on the principle of sustainability (ADB, 2013b:3; Allan *et al.*, 2015:304; Biggs *et al.*, 2015:393; Foran, 2015:657; Gulati *et al.*, 2013:152; Rasul, 2014:37).

Literature reviewed on WEF nexus has shown a number of frameworks designed to understand and define the WEF nexus elements, relations and inter-linkages. Scholars argued that an appropriate framework should be able to address the unsustainable patterns of growth, causes of insecurities and identify plausible avenues for intervention (Hoff, 2011:4; WEF, 2011a:28). A good framework is one that is holistic and resilient, to reduce potential negative consequences. Frameworks reviewed were those propounded by Hoff (2011), WEF (2011), ISSD (2013) and FAO (2014). Although, there have been a number of frameworks proposed across a broad spectrum of choices, those mentioned were chosen because of their varied and useful contribution to our contemporary understanding of the WEF nexus concept.

2.4.1 The Bonn 2011 WEF nexus framework

According to Hoff (2011), the Bonn 2011 nexus conference on the WEF nexus security came up with a nexus-oriented approach to promote security of access to basic services. It better understands the inter-relationship of the WEF nexus elements focusing on the influence of climate policies, trade and investments (Hoff, 2011:4). It is a water-centred approach and follows on water supply, energy and food security. The Bonn 2011 framework promotes WEF nexus security for all with equitable and sustainable growth, resilience and productive ecosystems.

The Bonn 2011 WEF nexus framework came up with three goals or areas of action to focus on within the WEF nexus framework:

- Investing to sustain the ecosystem – by protecting the ecosystem, e.g. the adoption of green agriculture (Hoff, 2011:14).

- Creating more with less – by promoting resource use efficiency, increasing productivity of water and land as major inputs (Hoff, 2011:14).
- Accelerating access, integrating the poorest – by improving the living conditions and livelihood opportunities for people at the bottom of the pyramid through increasing access for investments and innovations, therefore, allowing for the participation of the poor in the WEF nexus (Hoff, 2011:15).

The framework further explains the interactions that occur within the nexus context and argued that with the adoption of the above framework, the results would see a change in resource use (Hoff, 2011:28). The framework was argued to have a probable panacean capacity for sustainably improving WEF nexus security. Among the recommendations made included: using refuse as a resource in multipurpose systems; heightening resource capacity; governance, institutional and policy intelligibility; gaining from fruitful ecosystems; motivating development by using economic incentives; promoting homogeneous poverty mitigation and green growth; as well as raising awareness and capacity building (Hoff, 2011:36).

2.4.2 The World Economic Forum WEF nexus framework 2011

The World Economic Forum (WEF) in 2011 came up with another approach to the WEF nexus security. The main aim of the framework was to help decision makers understand the WEF nexus and its associated challenges (WEF, 2011a:28). The framework aimed to motivate well-informed responses to challenges arising from WEF nexus insecurity. The WEF nexus was described as a major global risk that should be acted upon, just as any other of its kind. The approach considers environmental pressures, economic and population growth as major drivers for water, energy and food insecurity.

It was explained that environmental pressures, such as climate change, cause alterations in rainfall. It has a profound impact on crop production. The WEF 2011 framework argued that the WEF nexus spontaneously brought into focus various challenges to the ecosystem, such as, flooding, loss of biodiversity, air pollution, earthquakes, and droughts (Bizikova *et al.*, 2013:8; WEF, 2011a:28). Population and economic growth are said to influence more resource-concentrated expending methods through an improvement of living conditions. Deficient governance methods influence conflicts and cause economic discrepancies that also increase the WEF insecurities risk (WEF, 2011a:29).

The framework explains the major trends on WEF nexus linkages. They stress that since the demand for resources was projected to increase by 2030, there exists the need for complete changes in resource-use effectiveness by productive use of water and the exploitation of new

sources of food and energy (Bizikova *et al.*, 2013:8; WEF, 2011a:30). The framework suggested that there should be regionally focussed infrastructural development such as investment in regional electrical power grids. The framework also suggested market-driven pricing of resources, which should be carefully implemented to ensure that impoverished consumers would not be disadvantaged (WEF, 2011a:30).

The WEF 2011 framework further recommended engagement, empowerment and incentivising local consumers in communities to encourage them to become guardians of resources (WEF, 2011a:31). The framework also argued for the need for research and investment, financial and technological, to address the WEF nexus security. There was the need for instruments that would address the WEF nexus security risk across sectors by not particularly targeting one section in isolation (WEF, 2011a:31).

2.4.3 The Food and Agriculture Organisation WEF nexus framework 2014

The Food and Agriculture Organisation (FAO) in 2014 also embraced the WEF nexus as a new approach in support of food security and sustainable agriculture. They agreed on the complexity and dynamics of interrelationships within the WEF nexus (FAO, 2014:5). The FAO also focussed on the need to better understand these relations for better and efficient resource use. They argued for the need of cross-sectoral coordination on decision-making processes targeting WEF nexus security (FAO, 2014:7; Flammini *et al.*, 2014:11).

The FAO has a mandate to achieve food security for all. This mandate is an entry point for the FAO to function at the level of the WEF nexus security (Hamdy *et al.*, 2014:7). The Organisation adopted the WEF nexus to push for mitigation of poverty and hunger for all people and sustainable resource use and management (FAO, 2014:3). The FAO WEF nexus framework focusses mainly on sustainability by balancing on different goals, interests, needs for people and the ecosystem (FAO, 2014:7). The framework addresses complex interactions between humans and the ecosystem.

The FAO's 2014 WEF nexus framework also emphasised that the interactions between water energy and food are driven by changes in populations, trade, markets and prices, urbanisation, industrial and technological developments, and preferences in diets, climate change, governance and socio-cultural norms (FAO, 2014:10). They argued that these drivers have an acute impact on resources security. The approach emphasises the goals and interests related to WEF nexus, drivers or forces of change related to WEF nexus security (FAO, 2014:8). The approach also includes the resources base in trying to understand and manage these complex resources.

The framework is inclusive of all key points of the FAO's perceptions of the WEF nexus. It includes important elements for understanding and managing the WEF nexus. They include: a) the goals and interests related to water, energy and food; b) the resource base on which the nexus relies; c) the major drivers or pushers for interactions of water, energy and food; and d) a number of recommendations for managing the nexus (FAO, 2014:10).

The framework proposed by the FAO stressed three working areas for successfully implementing the WEF nexus. These areas are: evidence; scenario development; and response options (FAO, 2014:10). The framework strongly recommends continuous stakeholder dialogue to manage, understand and assess nexus interactions, by highlighting the synergies and trade-offs on resource use. Stakeholder dialogue was singled out as being effective for developing and making decisions on response options for efficient use and the sustainable management of available resources (FAO, 2014:16).

The FAO argues in favour of the need for reliable, relevant and appropriate data-based evidence through research to explore, assess, analyse and understand the WEF nexus' interactions (FAO, 2014:14). It was further argued that analysis of data derived can be used to inform the decision-makers on how to respond to challenges (Flammini *et al.*, 2014:14).

The second area, scenario development, is aimed at exploring and understanding the interrelations between water, energy and food (FAO, 2014:14). Taking note of the interactions and engagements can enable stakeholders to be fully informed on current situations and assess the implications of specific decisions. The framework pushes for creating scenarios argued to be of value in decision making for development, management and planning for transitions and rethinking of good strategies for complex and uncertain issues within the WEF nexus (FAO, 2014:15).

The third working area, response options, focussed on designing and executing new policies, investments, mandates and incentives, capacity building and training, as well as, technical interventions (FAO, 2014:16). The response options included the comparison and evaluation of various interventions. These options are informed by evidence-based assessments and developed through stakeholders' dialogue. The FAO approach argues that the WEF nexus can be helpful in the reduction of negative implications of sectoral based approaches to WEF nexus security (FAO, 2014:17).

2.4.4 The IISD WEF nexus framework 2013

The IISD framework mainly focussed on ecosystems management. The framework tried to cover the major gaps that were found in the existing WEF nexus security frameworks. The IISD WEF nexus concept argues that goods and services that come from the ecosystem are benefits that can only be found if the systems are fully functional (Bizikova *et al.*, 2013:6). These goods and services are the key elements of the WEF nexus security and play a pivotal role in the securitisation of WEF resources. Ecosystem, goods and services are important for the quality and quantity of supply and maintenance of the WEF nexus (Bizikova *et al.*, 2013:5). The major goal of the framework is ensuring water, energy and food security. This can be achieved by understanding foremost how water security, food security and energy security can be achieved individually for future sustainability. The authors of the IISD report argue that the importance of unpacking the nexus elements and working on it individually is to avoid pushing the effects to the future and compromising future sustainability and security of resources (Bizikova *et al.*, 2013:8).

The IISD framework came up with cornerstones for their framework by suggesting major elements perceived as of paramount importance to assure WEF nexus security in communities. The framework emphasises implementation where it provides a map for communities and interested parties on suitable investments and policies for the future (Bizikova *et al.*, 2013:10). They also made the ecosystem goods and services their take-off point for the implementation of WEF nexus security supported by a fully and well-functioning ecosystem. The emphasis was on how the ecosystem influences the water, energy and food supply. Therefore, it is imperative to find effective ways of restoring and managing the ecosystems' goods and services (Bizikova *et al.*, 2013:13).

The framework focussed on three main aspects: utilisation, access, and availability. Various aspects influence the framework components therefore, the authors of the reports looked at each component linked to the WEF nexus (Bizikova *et al.*, 2013). The IISD's WEF nexus framework borrowed its format of assessing components from the climate resilience and food security framework of the IISD's climate resilience and food security framework (2013) which focussed on food security with stress on utilisation, access, availability, supporting resources and services and supporting organisations and policies (Tyler *et al.*, 2013:10).

The framework also included the impact of the support systems to securitisation of resources. It looked at supporting resources and services where land, water, energy and technology were singled out, among numerous other factors. This also further shows how inextricable water, energy and food are. Food security was explained in terms of the negative consequences if these components were absent (Bizikova *et al.*, 2013; Tyler *et al.*, 2013). The framework also looked at

supporting organisations and policies, which cannot be excluded when aiming to achieve sustainable development and security of resources. This was done by creating concentric food system rings with the household at the centre (Tyler *et al.*, 2013:11). This was done because most insecurities have a greater impact on households where they could culminate in hunger, poor living conditions and reduced access to social services especially those that require payments, such as health facilities and education, as well as, general decline in human welfare (Bizikova *et al.*, 2013:13). This is further explained in a resilience model in Figure 2.3.

**Spinwheel 1:
Community Food
Security Analysis**

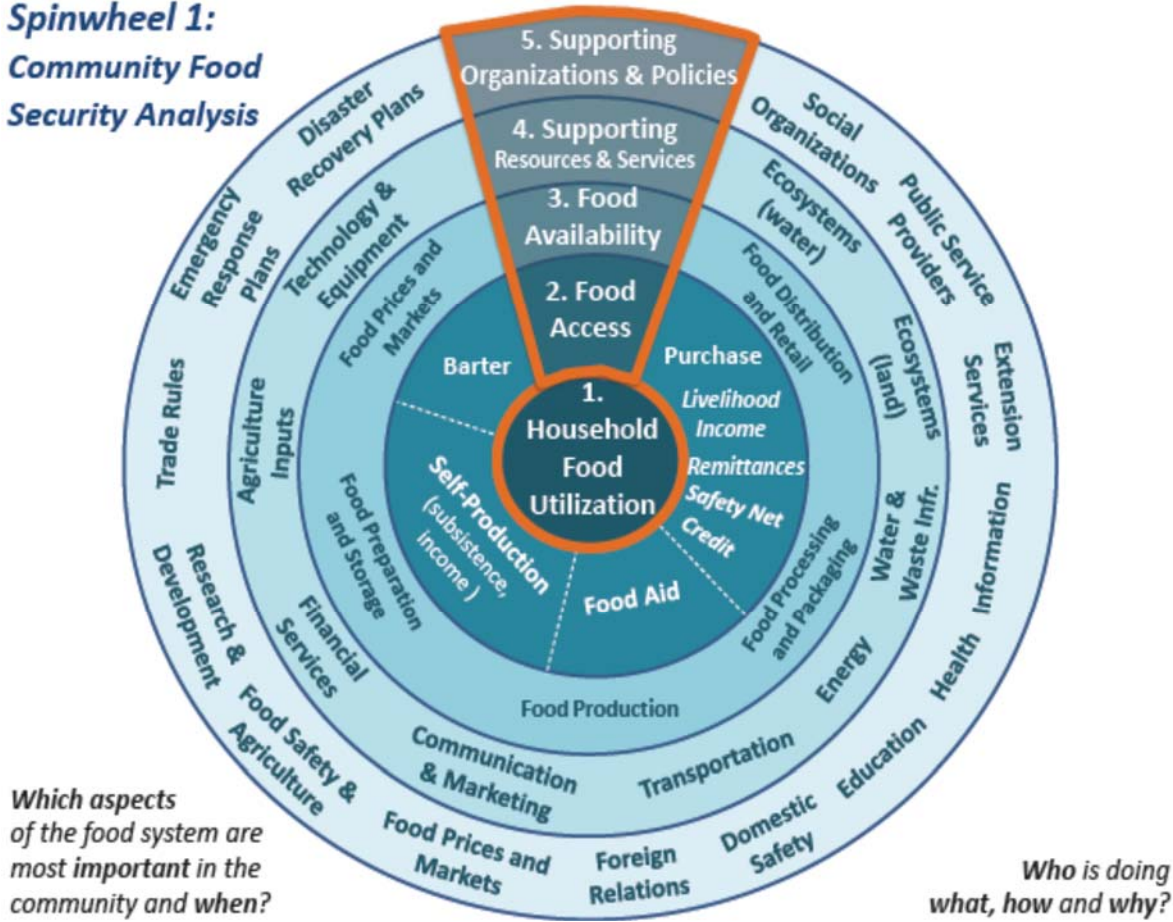


Figure 2.3: The IISD climate resilience and food security framework adopted by the IISD WEF nexus security framework

Source: Tyler *et al.*(2013:10)

This framework focussed only on climate resilience and food security. However, the WEF nexus team took this framework and further applied it to water and energy security. The framework began by defining key securities as core elements of WEF (Bizikova *et al.*, 2013:13). They also centralised the issue of utilisation in all three sectors and this made it applicable to households as main consumers or utilisers of resources (Bizikova *et al.*, 2013:13). It led to some interesting permutations. The second layer of analysis is on resources access, where it is possible to

determine how households and communities access their water, energy and food resources (Bizikova *et al.*, 2013:12). The IISD framework further purports that access is in turn influenced by availability of these resources by functional supporting services such as the ecosystems' goods and services as well as human systems supporting services (Bizikova *et al.*, 2013:13). Circular diagrams were used to show figuratively how the framework works as shown in Figure 2.4.

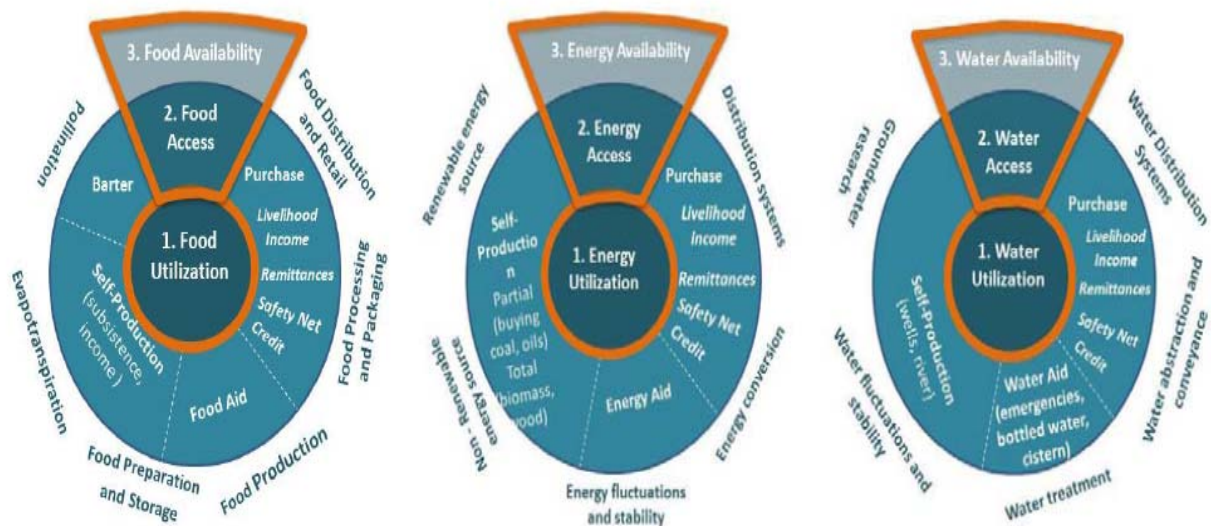


Figure 2.4: Key securities in the WEF nexus concept

Source: Bizikova *et al.* (2013:14)

Bizikova argues that the need to look independently at these securities is to identify different aspects of use, access and availability of the WEF nexus. The use of circular rings was introduced to help with different combinations of elements influencing water, energy and food security and uses (Bizikova *et al.*, 2013:14). It enables decision makers and analysts to combine and explore elements for clarification especially on relationships. However, the framework was further developed (fourth ring) to include the natural and the built environmental systems that have an influence on the WEF nexus security. This addition to the framework enables analysts to identify different ecological aspects that affect the WEF independently or collectively (Bizikova *et al.*, 2013:14).

The designers of the IISD framework then added a fifth ring, which included all the other rings but represents human and institutional support for WEF nexus security (Bizikova *et al.*, 2013:14). The elements of this ring include policies, governance and management systems. The WEF nexus framework was however driven to focus on issues that had a bearing on two or more of the WEF nexus securities (Bizikova *et al.*, 2013:15). This allowed for a deeper analysis of the linkages and

relationships of the WEF nexus. The objective was to identify ways to optimise water, energy and food security.

The framework with its focus on utilisation, access and availability is ideal for analysis of household WEF nexus security statuses (Bizikova *et al.*, 2013:17). It is a theory that is ideal to guide decision makers in communities and households at grassroots levels, to come up with ideal measures for the optimisation of WEF nexus security, by allowing them to understand their challenges and choose their priorities. The IISD framework asserts the best solutions are ecosystem-based and major investments should be focussed towards land in order to deliver increased water energy and food security (Bizikova *et al.*, 2013:20). The framework further explains the factors that have an influence on WEF nexus security individually and collectively, which may have negative future WEF nexus security consequences if not handled properly. It explains how both the natural and built systems of the ecosystem provide a service to the WEF nexus security and allows for exploration of effective measures to counter community WEF nexus insecurity.

2.5 Working towards WEF nexus implementation

The WEF nexus has been proposed as a helpful approach that can be important in the process of achieving resource security and creating resilient systems (Al-Saidi & Elagib, 2017; Kurian, 2017; Stevens & Gallagher, 2015; Taniguchi *et al.*, 2013). According to Wichelns (2017), authors of the WEF nexus made such suggestions without supporting conceptual frameworks, empirical evidence or citations from literature, and without that support it is not sensible to render the WEF nexus as a sufficient or necessary tool for success (Wichelns, 2017:117). The assertion is that many studies on resource interactions were done without necessarily using the nexus approach (Wichelns, 2017:119). This section reviews studies that implemented the WEF nexus theory. The WEF nexus gained popularity in the early 2010s, mainly because of the evident challenges arising from resource insufficiency, insistent poverty, and food insecurity in developing countries, as well as greater awareness and scientific evidence on climate change trends (FAO, 2014:9; Hoff, 2011:32; WEF, 2011a:28).

The WEF nexus lacks a clear and implementable approach, mainly because it does not include many development notions, such as livelihoods, labour and many other inputs that ensure resource use sustainability and development (Wichelns, 2017:118). Existing literature shows a varied depiction of the WEF nexus, with authors coming up with exclusive perspectives on interactions of resources and suggestions on interventions to achieve the desired result (Wichelns, 2017:118).

A review of the theories brought forward by various players in different disciplines showed the complexity of the WEF nexus and its inextricable linkages (Bazilian *et al.*, 2011:6; Bizikova *et al.*, 2013:8; FAO, 2014:5; Hoff, 2011:4). Frameworks were designed to aid the process of development by promoting security through the involvement of all key elements (Rasul & Sharma, 2015:685; Ringler *et al.*, 2013:619; Scott *et al.*, 2015:18; Siddiqi & Anadon, 2011:4530; Vanham, 2016:300). These key elements include: an awareness in the relevant communities that need to be sensitised to the need for behaviour change; role players in the economy who need effective strategies for economic growth; and stakeholders in the environmental sector responsible for promoting the ecosystem's goods and services (Bizikova *et al.*, 2013:10). The emergent theories acknowledged the need for detailed implementation of the strategies for long term and future WEF nexus sustainability (WEF, 2011a:5).

The proposed WEF nexus frameworks pushed for an enlightened and explicit approach that: builds on the systems approach; helps players understand synergies and trade-offs within the system; promotes change in strategies that would aid the change towards sustainability (Mayor *et al.*, 2015:800; Middleton *et al.*, 2015:630; Mohtar & Daher, 2012:2; Pittock *et al.*, 2015:59; Rasul, 2016:16; Ringler *et al.*, 2013:618; WEF, 2011a:7). The argument is that the framework should provide entry points that focus on a more sustainable future. The frameworks were also formulated to advise on policies, strategies and investments that should be prioritised for a sustainable developed future (Hoff, 2011:36). The WEF nexus also prioritises the engagement of stakeholders, so as to find effective ways of mitigating risks associated with the nexus through community empowerment, finding sustainable solutions and sharing ways to minimise effects (Allan *et al.*, 2015:308; Bazilian *et al.*, 2011:7899; Bizikova *et al.*, 2013:13; Endo *et al.*, 2015:5823; FAO, 2014:15; Finley & Seiber, 2014:6257; Granit *et al.*, 2012:425; Hoff, 2011:12). It prioritises the enhancement of policy making, coordination and implementation so as to come up with solutions that will build all the sectors of the WEF nexus.

The available literature shows that water, energy and food are inextricably linked, and that utilisation, access and availability of these resources have a significant impact on sustainable development and growth (Allan *et al.*, 2015; Benson *et al.*, 2015; Hussey & Pittock, 2012; Karabulut *et al.*, 2016; Keskinen *et al.*, 2016; Lawford *et al.*, 2013). The shift to the WEF nexus was driven by increasing livelihood insecurity, social well-being insecurity, and the spontaneous undermining of sustainable development. The WEF nexus became a sectoral response for a useful strategy on policy making (Bizikova *et al.*, 2013:7; Leck *et al.*, 2015:446). The linkages of the WEF nexus can however be traced and analysed at different levels, and the impact is felt on the global level down to the household level.

It is imperative to understand that relationships within the nexus are dynamic. Decision makers need to consider the interdependence within this trio and come up with policies that do not focus on one sector to avoid transferring problems from one sector to another sector (Rasul, 2016:16). South Asian literature revealed that there is an increase in competition for resources and the increasing pressure on the environment. However, that region faces a huge challenge on minimising potential conflicts of interest between WEF nexus resources and promoting interactions in resource management (Rasul, 2016:15). The dynamic nature of the WEF nexus is influenced by factors such as high population growth, rapid urbanisation, fast economic progress and industrialisation, which cause hikes in demand for resources, changes in diets, as well as intensifying their use causing huge consequences for the environment and security of resources.

Scholars argue that for an effective operationalisation of the WEF nexus, there is a need to follow bottom-up pathways of knowledge. They add that both bottom-up and top-down approaches have different ways of viewing evidence, which would aid understanding and outcomes (Leck *et al.*, 2015; Leese & Meisch, 2015; Mohtar & Daher, 2012). The argument is also on how studies of the WEF nexus represent a top-down approach which fails to acknowledge the WEF nexus' importance at household and community levels, and more so in rural settings– the typical bottom-up process (Allouche *et al.*, 2014:23).

Various studies adopted the two-sector nexus linking to try to understand the linkages and interdependencies within the WEF nexus. These analyses primarily adopted grouped water and energy linkages (Gheewala *et al.*, 2011; Gleick, 1994; Hardy *et al.*, 2012; Hermann *et al.*, 2012; Hildyard *et al.*, 2012; Howells *et al.*, 2013; Hussey & Pittock, 2012; Khan & Hanjra, 2009; Mukherji, 2007; Mushtaq *et al.*, 2009; Pachauri, 2010; Perrone *et al.*, 2011), water and food relations (Mudimu, 2002; Pimentel *et al.*, 1997; Postel, 1998; Rosegrant *et al.*, 2002; Rosegrant & Cline, 2003; Sinyolo *et al.*, 2014; Tranter *et al.*, 2007; Turrall *et al.*, 2011; Tyler *et al.*, 2013) and the food and energy linkages (Barnes & Floor, 2003; Kaygusuz, 2011; Mukherji, 2007; Reddy *et al.*, 2008; Sachs & Silk, 1990). Importantly these linkages vary broadly in spectrum from global levels down to the village household level (Ringler *et al.*, 2013:617).

In South Asia, WEF nexus security is a continued challenge in this region's countries. Frameworks were suggested for use at the national level to improve resource use and come up with effective policies for the eradication of WEF insecurities (Rasul, 2014:16). The WEF nexus security is perceived inversely in different basins. Research focusing on national and transboundary basins support the view that the WEF nexus is an effective solution to water security and sustainability (Lawford *et al.*, 2013).

Endo (2015) reviewed the current state of research on the WEF nexus and found that only four types of research were done on the WEF nexus with categories falling under water and food nexus, water-energy-food nexus, water and energy nexus and water-energy-food-climate nexus (Endo *et al.*, 2015:5808). The paper argues that unlike other scholarly disciplines like biodiversity, WEF nexus still lacks a clear definition as well as critical reviews for better understanding. The claim was that due to the complexity of the WEF nexus it has proven to be difficult, since the concept involves multiple disciplines and results can be explained in both inter- and transdisciplinary terms (Endo *et al.*, 2015:5807). Most frameworks propose the need for a unified social ecological framework with much more measurable targets. Most of the frameworks standing alone would be difficult to implement for research or intervention at grassroots levels and community levels unless they can be made to incorporate or include resilience. In most cases, sustainability is said to be evident when a community is resilient and can adapt to changes that occur across different systems (Charles, 2006; Endo *et al.*, 2015:5807; Folke *et al.*, 2002:437; Gunderson & Holling, 2002:29; Holling, 1973:3).

The objective of this study is to use the WEF nexus theory to explore the nexus in a security context. The WEF nexus theory was modelled for macro-level nexus interactions. For the purposes of this study, it is useful to combine the WEF nexus theory and the resilience theory, to allow for implementation at micro levels. The objective is to understand the WEF nexus at the local level. This micro level focus it will be useful to integrate WEF nexus theory at various scales, in conjunction with resilience theory.

2.6 WEF nexus in southern Africa

Although there has been a growth in the literature on WEF nexus studies in southern Africa, it remains limited, specialised and inaccessible for a generic understanding of southern African trends in WEF nexus resource developments. Moreover, there is need for more diversified research on the concept – both at the micro and macro level in southern Africa. In Zimbabwe, one WEF nexus study focussed on understanding and enhancing a project to promote the availability of hydroelectric power for food security (Pittock *et al.*, 2015). The argument was that hydroelectric schemes, intended for rural communities, failed to take a nexus approach, where considerations for solutions in one problem like energy, should be stretched to include water and food so as to capitalise on synergies and manage trade-offs (Pittock *et al.*, 2015:64). In another study's findings the authors argued that if no clear links are identified within the WEF nexus, then important drivers for sustainable development will be missed, risking the securitisation of these resources in the process (Stevens & Gallagher, 2015:22).

In local communities in Zimbabwe, micro-hydropower schemes were itemised as an important feature, which added value to communities (Pittock *et al.*, 2015:64). In Mutare, the Chipendeke hydro-electric scheme motivated neighbouring communities to think along similar lines. Such a scheme, it has been argued, can have had a positive impact by supplying community services and households, as well as improving agricultural activities form the backbone of rural communities' livelihoods (Pittock *et al.*, 2015:64). The scheme has also been used to power the irrigation scheme, which enhanced agricultural production. The study had an energy perspective but emphasised the importance of integrated approaches towards sustainable development.

In South Africa, a study by Gulati *et al.* (2013), from a food security perspective, discussed the influence of energy and water pricing on the cost of food in the country. The research acknowledged the importance of the interdependence of WEF nexus resources, how the rising need for one resource may increase the need for the other resources, and how the cost of one resource may influence the production of others (Gulati *et al.*, 2013:151). The research concludes by stating the need to have a detailed understanding of the WEF nexus as this will inform policy options and other interventions made by government and other stakeholders (Gulati *et al.*, 2013:162). Recommendations included development of infrastructure for improved agriculture, increasing investments in research and development initiatives among others (Gulati *et al.*, 2013:162).

Another study by Conway *et al.* (2015), on the WEF nexus from a climate perspective, looked at climate and Southern Africa's water, energy and food nexus. The major argument was that climate changes cannot be ignored in trying to ensure WEF nexus security as it plays a major role (Conway *et al.*, 2015:837). The need to focus on how climatic changes interact with the WEF nexus and the challenges it poses for resource security were stressed (Conway *et al.*, 2015:838). The research concluded that climate plays a significant role in ascertaining water availability, food production and some aspects of energy production (Conway *et al.*, 2015:844), and that there is need to have an understanding of the relationship and trends associated with climate change and WEF nexus security. The need to share insights into where challenges arose in the past is highly recommended so as to formulate successful approaches in the future (Conway *et al.*, 2015:844).

Furthermore, Water research commission (WRC) in South Africa has a number of studies done and reports issued on the WEF nexus. These studies are done in a bid to champion WEF nexus planning, management to promote sustainable development. According to Mpandeli (2017:35), there is a need for South Africa to adopt sustainable development approaches such as the WEF nexus in order to deal with the ongoing challenges of water, energy and food insecurity for its populations. He argues that the WEF nexus is an approach that promotes coordinated efforts from all sectors. In another study, Mpandeli *et al.* (2018) looked at how the WEF nexus can help

promote adaptation to climate change. The WEF nexus draws on holistic, socio-ecological systems perspectives that equates the importance of all the WEF nexus elements (Mpandeli *et al.*, 2018: 15). They argue that finding good climate change adaptation strategies will aid in the management of trade-offs and fluctuations hindering WEF nexus security (Mpandeli *et al.*, 2018: 15). The WRC has a goal to promote the WEF nexus in South Africa and it is in this light that it promotes research on the WEF nexus as one of its special focus (Mabhaudhi *et al.*, 2018:1). The report on assessing the state of the WEF nexus in South Africa (Mabhaudhi *et al.*, 2018), states the need to shift from sectoral approaches to more integrated approaches of dealing with challenges. The report states that the use of WEF nexus in South Africa faces challenges of: silo approaches; poor education, urbanisation and poverty; culture and politics; climate change; access to and distribution of data (Mabhaudhi *et al.*, 2018: 21-23). However, they emphasised importance of the WEF nexus to the development of South Africa and suggest that there is need to make modifications on the approaches and frameworks to formulate one that is specific to the country and research focus (Mabhaudhi *et al.*, 2018: 46).

2.7 Applying the WEF nexus theory

Existing literature reviewed showed that most frameworks on WEF nexus focussed on one or more of the following areas: understanding the WEF nexus; links and trade-offs between these elements; understanding the changes that occur in each element and the consequences which they might have on other elements; and the potential influence on policy-making towards formulation of policies that enhance water, energy and food security (Gupta, 2017; Karabulut *et al.*, 2018; Leese & Meisch, 2015; Martinez-Hernandez *et al.*, 2017; Wicaksono *et al.*, 2017; WWF., 2017). The diversity of these frameworks also shows the complexity of the WEF nexus not only in its combination of the major resources but also in its implementation (Dupar & Oates, 2012). Groups of institutional and individual researchers came up with various framework designs that suited their predisposed positions. These frameworks were useful in guiding policy making and improvement of resource use at political and institutional levels (Mabhaudhi *et al.*, 2018:37). However, these frameworks did not, in general, make a substantial contribution towards guiding resource management at community and household levels. There has been a call for research to focus especially on understanding the nexus and building an environment conducive to promote coordination (Mayor *et al.*, 2015; Mpandeli, 2017).

Studies that have been done using the WEF nexus have reported how useful the framework is for better resource use strategies, for connecting, coordinating and reinforcing WEF nexus management policies (Chirisa & Bandaoko, 2015; Furst *et al.*, 2017; GIZ, 2016; Mayor *et al.*, 2015). An understanding of the nexus also allows researchers to look at the factors that affect the

water energy and food nexus security especially in developing countries. It then becomes possible to formulate mitigation measures by coordination, stakeholder involvement, discussions on existing and potential measures for sustainable resource use and efficiency (Gulati *et al.*, 2013; Hamdy *et al.*, 2014; Mabhaudhi *et al.*, 2017).

Various studies with a great variety of objectives have been conducted that successfully used the WEF nexus theory. However, these studies looked at the broader picture of the WEF nexus security on global, regional and national level (FAO, 2014; Foran, 2015; Khan & Hanjra, 2009; Leck *et al.*, 2015; Middleton *et al.*, 2015; Mohtar & Daher, 2012; Rasul, 2014; Rasul & Sharma, 2015; Scott *et al.*, 2015; Siddiqi & Anadon, 2011). Other studies mainly focussed on transboundary basins and river basins to help river basin planners and managers to exploit synergies and minimise trade-offs in order to maintain sustainability (Foran, 2015; Granit *et al.*, 2012; Karabulut *et al.*, 2016; Keskinen *et al.*, 2016; Keskinen *et al.*, 2015; Kibaroglu & Gürsoy, 2015; Lawford *et al.*, 2013; Mayor *et al.*, 2015). Even though there is wide support for the WEF nexus, there is still a lack of understanding on how to implement the theory in conducting assessments as well as taking action especially in developing countries of the world (Gain *et al.*, 2015; Mabhaudhi *et al.*, 2016).

The literature available on frameworks were mainly designed for the top of the ladder decision makers who worry about intervention and WEF nexus security on a broader scale (Finley & Seiber, 2014; Foran, 2015; Gain *et al.*, 2015; Leck *et al.*, 2015; Middleton *et al.*, 2015; Mohtar & Daher, 2012; Rasul, 2016; Rasul & Sharma, 2015). Although the framework for the purpose of the Bonn 2011 conference allows for the inclusion of people at the bottom of the pyramid, it does not cover how the framework can be implemented to benefit a single household or community especially those in the rural areas (Hoff, 2011). Even though the FAO's framework provides an opportunity for a narrow analysis on resources and the nexus, it mainly aims to understand the major relations and consequences that could emanate within the framework (FAO, 2014). It lacks a direct focus on the rural household collective.

Most frameworks on security matters related to water energy and food focus on broad levels (Mohtar & Daher, 2012; Scott *et al.*, 2015; Siddiqi & Anadon, 2011; Taniguchi *et al.*, 2013; WEF, 2011a; Weitz *et al.*, 2014). Some are focussed on solving challenges in one area by taking into consideration interactions with other factors. These should typically be water, energy, or food, ecosystem, sustainability, and adaptation centred approaches (ICIMOD, 2012; Jeswani *et al.*, 2015; Jobbins *et al.*, 2015; Karabulut *et al.*, 2016; Lawford *et al.*, 2013; Pittock *et al.*, 2015; van Vuuren *et al.*, 2012; Vanham, 2016).

The WEF nexus, though it has become very popular for its inclusiveness and relevance to eradicating challenges faced in the WEF nexus security (Biggs *et al.*, 2015:390), lacks the ability to be used on its own for the benefit of communities at grassroots level (Allan *et al.*, 2015). In particular, it is necessary to include the poor and marginalised population, as well as households in rural communities. According to the literature, the nexus approach lacks the ability to be used on its own, as it is difficult to be understood in isolation (Mayor *et al.*, 2015:790). The WEF nexus approach is better if used as a complement to individual approaches for WEF nexus security to enhance the exploration of the interconnections among these three resources (Mayor *et al.*, 2015:790). Mayor *et al.* (2015:793), their framework for implementation includes approaches for aiming to achieve sustainable water, energy and food security.

According to Mayor *et al.* (2015:793), WEF nexus elements are different resources, which require different specialties of management; therefore, an appropriate environment should be made to integrate different sectoral expertise, experiences and cumulative knowledge. The framework above collectively include the sectoral effort to promote WEF nexus security such as Integrated Water Resource Management (IWRM), and food and energy policies. Mayor states that:

The WEF nexus can be considered as a framework that helps connect, coordinate and reinforce individual water, energy and food management policies by paying special attention to the identification, understanding, and characterization of interconnections and trade-offs, in order to build aligned and coherent strategies/actions that permit synergies. This should be applicable both within the political sphere, at either national, regional or local scales, and at a business or even household scale, where resource management and optimization is also required (Mayor et al., 2015:806).

The IWRM provides a holistic framework of water resources management and has gained global recognition. IWRM calls for integration, optimal governance, and participation in decision making, resource-use management across sectors and managing water demand. Agriculture, food and energy policies, as a rule, formulated an aim to promote resources availability and promote equitable access for all. These policies are formulated at national level. An ideal WEF nexus focus combines the three resources management and would typically lead to the formulation of strategies to reduce risks.

Attention has been given to explore the need to incorporate the sustainable livelihoods concept in the WEF nexus context. It was said to be invaluable, as it would increase the understanding of interactions of humans and the ecosystem (Biggs *et al.*, 2014:390). The concept of environmental livelihood security was thus explored to help formulate an integrated WEF nexus livelihoods

framework for examining environmental livelihood security of a particular system (Biggs *et al.*, 2015:389). The framework they came up with focussed on the natural resource supply and the demands by humans to promote sustainability (Biggs *et al.*, 2015:389). The framework combined sustainable livelihoods with the WEF nexus for a better implementable and applicable integrated framework.

The framework is intended to measure and monitor the sustainability of the environmental livelihood security by assessing the WEF nexus requirements for livelihoods of different systems and levels (Biggs *et al.*, 2014:394; Biggs *et al.*, 2015:389). They propose that successfully integrating sustainable livelihoods with the WEF nexus requires identification of inter-relations between the WEF nexus securities. It is also necessary to look at the capacities of the ecosystems and the assets of human populations in a system (Biggs *et al.*, 2015:393). Their proposed framework integrates the WEF nexus theory and sustainable livelihoods theory to address the gap within the nexus frameworks to acknowledge the importance of livelihoods on achieving WEF nexus security and sustainable development (Biggs *et al.*, 2015:393). The concept theorised by Biggs *et al.* (2015) looks at the challenges of maintaining food security for all, universal access to water and energy to enhance economic growth environmental sustainability, and maintaining livelihoods (Biggs *et al.*, 2015:392).

2.7.1 WEF nexus and resilience theory

Studies that combine the WEF nexus with cultural theory, adaptation, sustainable livelihoods, as well as life cycle analysis are becoming more common placed. They appear to achieve the best interventions for WEF nexus security (Allan *et al.*, 2015:301; Bazilian *et al.*, 2011:7898; Beck & Walker, 2013:627; Mayor *et al.*, 2015:792; Mohtar & Daher, 2012:2). The frameworks, developed by a variety of researchers, point to the importance of the ecosystem's preservation for sustainability. However, there is a lack on how to build on resilience for challenges arising, especially in cohorts of rural households. It is in this space where resilience theory, which is said to be an integral part of sustainable development in communities (Beck & Walker, 2013:627) can play an important role in resolving some problems. Social ecological resilience values the importance of human beings in the sustainable uses of environmental resources, it emphasises how inextricable the relations are between people and the ecosystem and how they both depend on each other for survival (Holling, 1973:28; Klein *et al.*, 2003:37; Maleksaeidi & Karami, 2013:263; Perrings, 2006:418).

According to Klein *et al.* (2003:37) and Perrings (2006:420), any coping or adaptation strategies should be resilient to achieve sustainable development objectives. Social resilience dwells on the ability of people to adapt and even potentially predict events ahead and plan for interventions that

cause the least potential damage to livelihoods (Perrings, 2006:420). Therefore, resilience is important in our understanding of the WEF nexus. It points to sustainable ways of dealing with any disruption that may arise. Major challenges in the WEF nexus context need resilient and innovative strategies for dealing with challenges. For example, challenges faced by rural women in achieving household WEF nexus security, call for coping strategies that underscore adaptation to the objectives of growth and development. These coping strategies should minimise the over-exploitation of available local resources. Resilience, in a panarchy context, calls for remembrance of past situations and the response to challenges, to introduce better coping strategies (Maleksaeidi & Karami, 2013:264). Resilience builds on the capacity to withstand shocks and stresses that occur within the WEF nexus. Resilient capacity would typically imply the ability to improve, withstand and recover from challenges (Maleksaeidi & Karami, 2013:266).

In this study, resilience is an important additional element to explore the coping strategies of rural women in WEF nexus contexts. Building resilience enhances the socio-ecological systems to cope with surprises as well as maintain sustainability (Walker *et al.*, 2004:5). It is ideal to also look at the resilience of social systems to disturbances, as it is the main idea influencing the formulation of coping strategies (Carpenter & Gunderson, 2001:453). Resilience is also the main factor behind sustaining the development of societies. Resilience provides insight into implementing strategies, remembering previous ways and strategies used in similar situations to try and manage the local resources effectively and build resilience to critical situations of potential collapse (Lin, 2011; Maleksaeidi & Karami, 2013; Nelson & Stathers, 2009; Neubert *et al.*, 2011).

The concept of resilience is a broad concept based on three pillars: impact (vulnerabilities), adaptation, and coping. Resilience was originally formulated for the understanding of ecological processes. Since then our understanding of resilience has developed to the extent that it is applied to social problems as well. Resilience looks at various coping and adaptive mechanisms used by humans to meet challenges they face. Most of these are coping mechanisms that can be measured through indicators of activities within the community to cushion shocks and stresses that arise in everyday life. It is most useful when observed in a WEF nexus security context. In this study, the focus has been to explore coping strategies of rural women in dealing with water-energy-food security challenges, which include risks, shocks and stresses. Though the study deals with household coping mechanisms to challenges in the local social ecology, it acknowledges the importance of the WEF nexus as an important tool for understanding the integrated nature of natural resources in the system. The study explored the water, energy and food security situation in rural areas looking at the availability, accessibility and utilisation of these resources in households. The resource components of the WEF nexus are subject to varied impacts that negatively affect their stability and sustainability. To fully explore these challenges,

the study looks at the types of impacts occurring and the responses that are used to cushion disruptions on the environment and the impact it has on the wellbeing of rural households.

For the purposes of this study the WEF nexus theory and resilience framework are combined on a linear line of development. The objective is to understand the WEF nexus in a security context, and the challenges and coping strategies that occur within the interactive system. However, to effectively look at challenges and coping strategies there is a need to merge the WEF nexus and the resilience theory for an implementable remedial framework of action at a micro level. The interactive concepts in each theory is acknowledged and collectively the theories come up with a potential framework that can be used to explore WEF nexus interactions on micro level.

2.7.2 Social resilience theory and panarchy

There are various challenges that women face in the WEF nexus security context in rural areas—most of which have pushed them to seek ways or strategies for cushioning and reducing the impact of potentially extreme hardship on their lives. These are employed to minimise and cushion the impact of various challenges they are exposed to. Collectively, the term “coping strategies” makes sense in this study. Coping strategies include all forms of interventions, responses, innovations and action plans that alleviate or reduce the impact of whatever can be classified as challenges. These coping strategies can be for short term “coping” or long term “adaptation” which, in the light of being successful, may form resilient systems. Holling (1973) first used resilience as a theoretical term in the discipline of ecology and its use has gained relevant momentum. It has become an important concept in social development. Complexity theory, systems theory and an agent-based modelling community of ideologies, contributed to the emergence of resilience theory (Perrings, 2006; Rockström, 2003). The argument was developed from an understanding that humans depend largely on the environment for survival and cannot be separated from the environment (Nelson & Stathers, 2009:82).

Originally Holling used resilience theory was first used by Holling to explore non-linear changes occurring in ecosystems (Holling, 1973:3). Holling (1973:2) defined resilience as a degree of the tenacity of systems and of their capability to absorb modification and disruption and yet conserve the same relationships between humans and the state of potential variables. Resilience is the ability of a system to cushion disturbances and still maintain its major function and organisation. Resilience also entails the ability of a structure to return to its normal state after a disturbance, or the amount of shocks and stresses a system can handle before the alteration of its state (Holling, 1973; Klein *et al.*, 2003; Neubert *et al.*, 2011). Other scholars subsequently have defined resilience as the degree to which a system builds the ability to learn and adapt (Perrings, 2006:418; Rockström, 2003:870). They argue that the environment is not a balanced system, has

some unpredictable shocks, and stresses such as droughts and floods that cause serious challenges and setbacks (Charles, 2006:418).

This study sees social resilience as the ability of a system to cope with everyday challenges, shocks and stresses, and adapting to situations for survival (Walker *et al.*, 2004). For the purposes of this study, a specific definition rests on three responsive pillars: impacts, coping, and adaptation. Following the trends of disruptive occurrences, resilience can be well explained as happening in cycles or on a linear scale. When disturbing events such as droughts occur, there are follows up on the trends of how former, current and anticipated scenarios deal with these challenges. This helps to promote the systems' ability to successfully adapt to changed circumstances (Plummer & Armitage, 2007; Vonck & Notteboom, 2016; Walker *et al.*, 2004). However, if systems show cyclical repetitive disruptive tendencies, coping, and adaptation, the processes system can best be described as panarchies of varying proportions.

Social resilience is closely linked to ecological resilience which was a broad concept developed to understand interactions within ecosystems. It includes humans and the environment as part of the system. The social aspect was added to effectively create an awareness that humans form part of the ecosystem – a state of human consciousness that is all too often forgotten or ignored. Gunderson and Holling (2002:44) explained the concept of ecological resilience as having four major aspects. The first aspect is the amount of shocks and stresses that the system can absorb without losing its ability to recover. Secondly, the ability of the system to resist alterations or changes due to shocks and stresses. Thirdly, panarchy which focusses on the cross-scale effects within the system and fourthly, there is the state of a system and the likely alterations to a society (Gunderson & Holling, 2002:44). These four aspects are relevant to measure the vulnerability and the resilience capacity of a system. In addition, the concept of resilience, when used in social ecological contexts, highly integrates the notion of adaptation, transformability, learning and self-organisation and the capability to endure disruption (Folke *et al.*, 2002:438).

Social resilience has been defined as the ability of human populations to survive shocks and stresses placed upon their social infrastructures (Adger, 2000:348). Social resilience also involves processes of natural resource uses, the system's ability and adaptation capacity to cushion disturbances, while retaining self-organisation and enhancing recovery (Adger, 2000:350; Carpenter *et al.*, 2001:767; Nelson & Stathers, 2009:83). It was simply put to mean the resistance to disruption and change in order to sustain available resources. Resilience relies mainly on the need for persistence, which supports the notion of sustainable development. The objective is to create and sustain flourishing socio-economic and ecological systems for posterity (Folke, 2006:255).

Panarchy is a conceptual framework that was created to account for dual and contradictory characteristics of complex systems (Berkes & Ross, 2016:187; Gotts, 2007:24). It studies the interaction of ecosystems and built institutions at different scale levels, exploring the dynamics of change and stability across disciplines and scales (Allen *et al.*, 2014). Panarchy suggests that change is episodic and pushed by interactions across levels, there are non-linear processes that reorganise resources across levels since different scale levels concentrate and potentially distribute resources in different ways. Ecosystems have productive capacities to maintain stability and destabilise processes that foster diversity, resilience and opportunity. Finally, management systems have to consider this dynamism within ecosystems and be flexible and adaptive (Gunderson & Holling, 2002).

Panarchy also suggests ecosystems go through four basic stages. These are:

- (r) exploitation where there is creation of new ideas and resources in this stage are readily available;
- (K) conservation where changes occur slowly, infrastructure and resources are preserved;
- (Ω) release where there is a rapid change within the system and all the resources that were locked up in the conservation phase become available for use; and
- (α) reorganisation phase is where growth happens which starts a whole new process where the system gain its stability but there will be evidence of changes having taken place.

Gunderson and Holling (2002:24) argue that all ecosystems pass through these stages of the adaptive cycle represented in Figure 2.5. The adaptive cycles are based on their potentialities that determine the limits of what can be done and what is feasible in terms of future options. Connectedness is another property that sets the limits of the system to control its own fate after exposure to challenges. Resilience determines the vulnerability of a system to challenges, which can break the system (Benson & Garmestani, 2011:1421; Berkes & Ross, 2016:186; Gotts, 2007:2; Gunderson & Holling, 2002:44). If the system is resilient it can withstand disturbances without collapsing, but non-resilient systems are easily toppled by small disturbances and pushed into a new state where restoration may sometimes be impossible or unfeasible.

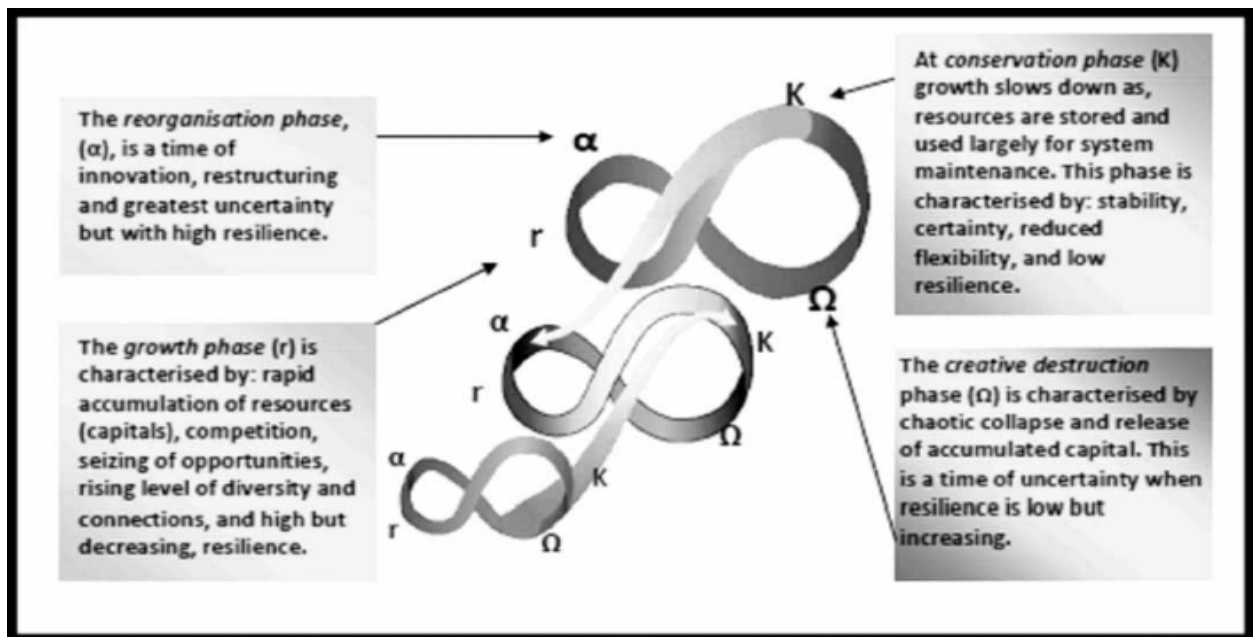


Figure 2.5: Panarchy: the adaptive cycle

Source: Davoudi *et al.* (2012:303)

Panarchy helps in the understanding of adaptive cycle's occurring across scales. The four phases of the adaptive cycle above (figure 2.5) provides an understanding of the changing times in the flow of events in an ecosystem and have three properties that are characteristic of each of the four phases (Allison and Hobbs, 2004:4). These properties include connectedness, potential and resilience. In the (α) reorganisation phase potential and resilience are high while connectedness is low; the (K) conservation phase, both potential and connectedness are high while resilience is low; the (Ω) release phase, potential and resilience are low while connectedness is high; and in the (r) exploitation potential and connectedness are low and resilience is high. These characteristics form part of structural changes that occur among system variables as the cycle moves through four phases (Allison and Hobbs, 2004:4). When all three properties of the adaptive cycle are low it means the system is in a poverty trap and these poverty traps are caused either by constant or recurring states of crisis.

According to Gunderson and Holling (2002) the need to understand the changes occurring in systems and their impacts can best be understood with a theory that transcends the boundaries of scale and discipline and must be able to improve the understanding of ecological, economic and institutional systems. In search of such a theory one has to bear in mind that it should be cross-scale, inter- and/or transdisciplinary and dynamic in nature. Gunderson and Holling (2002) conveniently use the term "panarchy". Panarchy explains situations, in which the economic, ecological, and institutional systems interact, and hierarchies and adaptive cycles, which form the basis of ecosystems and social-ecological systems across all scales (Gunderson & Holling, 2002).

Panarchy explores and explains the systems at play, interactions, inventions, and experiments bearing in mind that each system operates at its own pace, protected by larger, slower levels above and fuelled by faster, smaller cycles of innovation below (Allen *et al.*, 2014; Gunderson & Holling, 2002). The theory pushes for resilience, development and aims to understand complex interactions among systems.

Rural people are highly vulnerable and exposed to various security shocks and stresses in terms of the WEF nexus theory (Nyong & Kanaroglou, 2001:538; Quaye, 2008:335; Shariff & Khor, 2008:27). Their insecurity is highly likely to increase in future, if no action is taken to curb challenges, for example, climate change and ongoing poverty in many developing countries of the world (Allouche, 2011:6). The household is also vulnerable to various crises, which may be caused by natural disasters, economic meltdowns, sudden death, illnesses and disabilities (Allison and Hobbs, 2004:8). In the face of such crises, changes take place. It promotes coping for resilience and adaptation rather than coping to survive. Where the need to survive may push for short-term implementation of strategies to avert or reduce the impact of crises, resilience provides avenues for continuity and long term thinking (Gotts, 2007:8). Therefore, the strategies for resilience and adaptation in the face of these disturbances, are referred to in this study as coping strategies. The implementation of good coping strategies promote the recovery of systems in the aftermath of a crisis. The remembrance of past events will be evident and measures are taken to build on local knowledge and create more avenues for growth.

Coping strategies observed from literature in the African rural context includes changing household consumption patterns to ensure they get more value for less and that they can meet some of the basic needs (Maxwell & Caldwell, 2008). Coping mechanisms used also aim to reduce rural household expenditure – this strategy relies more on households trading off some needs in order to afford the other (Aasoglenang & Bonye, 2013:153). Rural households also endeavour to find diverse sources of income in order to meet various needs, as well as taking some savings and assets in order to afford the household needs (Aasoglenang & Bonye, 2013:154). Some rural households use migration as a coping strategy. It involves moving some family members to other places to reside or to find work in order to reduce the household burdens or demands (Maxwell & Caldwell, 2008:2). According to Maxwell and Caldwell (2008:3), the increase in coping strategies depicts the severity of the problem.

Various coping strategies have been employed for resilience against arising WEF nexus security challenges in rural communities across the world. Literature on the coping strategies to WEF nexus security challenges is sectoral. Coping is the involuntary response to unanticipated failures, shocks, stresses and disasters that disrupt the major sources of survival. According to Aasoglenang & Bonye, 2013; Jabeen *et al.*, 2010; Maxwell & Caldwell, 2008; Quinn *et al.*, 2011;

Snel & Staring, 2001, coping involves tactical ways of maintaining the standards or ensuring provision such as using savings, reliance on food stocks, remittances and gifts, selling assets, changing diets and consumption habits, social and community support, government support and donor aid. In order to understand the coping mechanisms of women in both countries, a sectoral review is outlined below, showing trends in water security, energy security, and food security and the coping strategies adopted.

2.7.3 WEF nexus resilience: A modified framework for rural communities

The WEF nexus resilience framework is modified broadly in line with the IISD framework. This study modified the framework to create an understanding of the WEF nexus in rural households. It is not to discredit previous frameworks but rather focuses on issues of WEF nexus and resilience as perceived by the researcher. It is modified to show the interplay of the concepts of panarchy and resilience within the WEF nexus. The study merges the two important theories that guide the concepts of this study. Both concepts are related to the vulnerabilities of systems in the world (panarchy) (Perrings, 2006; WEF, 2011a). The WEF nexus resources and rural households in this study are part of a social ecological system, which is susceptible to various shocks and stresses (Scott *et al.*, 2015). The nexus phenomenon of interaction between water, energy, and food, along with an awareness of resilience theory are combined to explore the household and the coping strategies of women in certain rural areas of southern Africa. As a rule, theories related to the WEF nexus and resilience are used for the integration and exploration of the interactions happening in global contexts for comprehending dramatic changes (Folke *et al.*, 2002; Gunderson & Holling, 2002; Leck *et al.*, 2015). These two theories and the thrust of this study are guided by a complex theory that focusses on understanding links that are relevant for sustainable development and governance. Various changes have occurred globally, these include climate change, population growth, increase in population, migration, rapid urbanisation, as well as changes in information and technology trends (Stevens & Gallagher, 2015; Wichelns, 2017). These changes have brought with them various effects and dramatic impacts on the global system, which have exposed vulnerabilities across systems and scales (Zhang & Vesselinov, 2017). There is a need to seek an understanding of the origins and the impacts of roles played by these changes in systems.

Panarchy in the WEF nexus

Panarchy describes the dynamics of organisations and structures of complex systems, (people and the environment), across scales in space and time. Gunderson and Holling (2002:27) argue, “No system can be understood or managed by focussing on it at a single scale”. There is a need to study interactions across scales and functions that occur on the various and multiple scales of

time, space and social organisation. Panarchy helps to examine the multiple connections occurring within the systems to see the interactions between change and persistence of certain aspects, the predictable and unpredictable occurrences between interconnected scales (Allen *et al.*, 2014; Cosens & Gunderson, 2018; Vonck & Notteboom, 2016). Panarchy connects adaptive cycles to show the multiple relations between systems on one level and phases on the next. In this context panarchy contributes to our understanding of interactions that occur within the WEF nexus, showing the multiple relations of these components on one level and various phases they pass through in a circular rather than linear way. Panarchy makes the study of social and ecological dynamics possible. It is ideal to explain the manner in which humans interact with their ecological environment in their access to and use of resources and coping with challenges thereof.

The study focused on the understanding of how ecosystems are organised and operate, and how human beings and the environment are part of the ecosystem (Gunderson & Holling 2002:26). Panarchy argues that change is episodic, and the environment is changing due to various disturbances, be they natural or human-induced. The disturbances occurring have an influence on the state of the environment and its future for a long time (Gunderson & Holling 2002:26). This can potentially create conditions that are either reversible or irreversible depending on interactions. Either things can return/recover to their previous self-sustaining state or they can collapse. Systems can either break down in the face of crises or challenges because of various anthropogenic policies and management that continuously assert demands on the environment for sustenance, leading to poor resilience systems (Berkes & Ross, 2016; Vonck & Notteboom, 2016), or they can adapt to disruptions and continue to flourish under different social ecological conditions.

The WEF nexus security is reliant on the environment for survival, where disturbances to the system cause changes, flip and change the system (Holling, 1973). This explains why resilience needs to be merged with the WEF nexus theory. Panarchy, which argues that: adaptation (resilience) occurs in cycles and not in linear format guides our understanding of what might be and give sense to it for future stability and development rather than focussing on what is only confined to the present (Gunderson & Holling 2002:32). The emphasis is on “not predicting the specifics of future possibilities but rather (defining) the conditions, limits or (expanding) those future possibilities” (Gunderson & Holling 2002:32). This backdrop calls for adaptive change, which requires of social ecological systems to be productive and maintain a shifting balance between stabilising and disruptive forces, promoting both sustainability and development (Gunderson & Holling 2002:32). Figure 2.6 gives a simplified diagram for understanding resilience as perceived by the researcher for the purposes of this study.

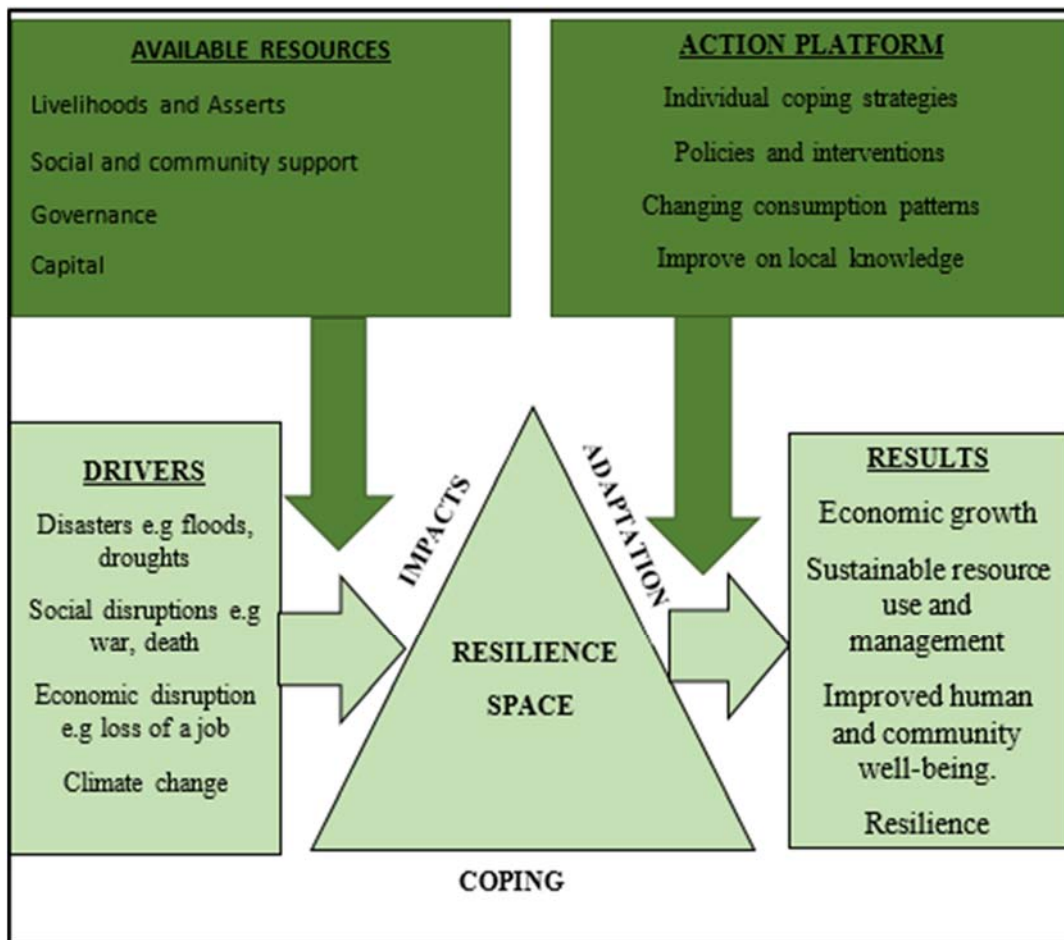


Figure 2.6: A simplified diagram for understanding resilience

This model enables us to understand the researcher’s perception of social resilience and the processes occurring across and within scales. These processes may be linear if the focus is on the management of one variable but may be circular if one looks at the interactions among dependant systems, e.g. humans and the ecological process. The model shows how the process starts with the occurrences of disruptive events or challenges (drivers), which may cause various challenges to any given social ecological system. These drivers push for change and have various negative effects on growth, development, sustainability and human wellbeing. When facing challenges, the resources available to the system determines its capacity to deal with, cushion, reduce or eliminate the effects of the disruption with no or minimum changes to the system’s original state.

Rural households in most developing countries such as Zimbabwe and South Africa have a long-standing history of challenges of WEF nexus security, which have affected negatively on the wellbeing of families and the development of the communities. In the adaptive cycle of panarchy, two possible results are possible for systems facing crises or disruption. Either the systems resist and adapt or they resist and collapse (Gotts, 2007:3). The resistance of these systems in

panarchy is through coping or adapting. The increasing challenges being faced by communities have had a negative on the environment and its natural resources on which humans rely. There is evidence of increasing demand, which leads to over-exploitation and mismanagement of resources (ADB, 2013b:3; Allan *et al.*, 2015:302; Bazilian *et al.*, 2011:7898). This compromises the environmental stability and sustainability for the future and to counter this there is need to formulate and build on viable coping strategies that promote growth and stability.

The resources available are context based and the examples given above best explain the resources needed for this context. The push factor for any system to look for coping mechanisms is the amount of impact disruptive events have on the system, this determines the earliest stage of resilience or building resilience. Coping strategies are formulated to try to reduce the effects of crises or challenges faced whilst maintaining the state of the system (Maxwell & Caldwell, 2008; Quinn *et al.*, 2011; Snel & Staring, 2001). A good example would be the occurrence of a natural disaster such as a drought in any given community, which leads to negative impacts such as, food shortages, hunger, and perhaps loss of livelihoods and livestock (Kinsey *et al.*, 1998; Nthenge, 2016; Oldewage-Theron *et al.*, 2006). This community may need to find ways to cope with the situation in the short term by borrowing from neighbours, using stocked grains, selling of assets and the diversification of livelihood options.

The model above gives an exemplary exposition of action platforms that can be explored to cope within the situation in the short term where the systems can survive and maintain their form. Adaptation strategies are usually permanent strategies that are taken to address the situation, though the components of the system may survive, there are permanent changes to the system, such as migrating to other areas due to floods or drought. If humans under circumstances of droughts or floods find coping strategies that help to alleviate the effects of disruption, there is evidence of resilience and adaptation to a given state of circumstances that may well be different than prior to the disruption.

According to Gunderson and Holling (2002:24), and Petrosillo *et al.* (2010:361), panarchy explores the interactions of the natural and human systems and show how human development and economic growth are dependent on the ecosystem and institutions through their interaction. It is a theory that was also formulated for macro-level interventions and studies. It can also be applied to smaller scale levels. The concept was developed after realising that all attempts to manage ecosystems where a single system was targeted, caused more harm to the ecosystem than intended (Allen *et al.*, 2014:580). This linear effort of management targeting single variables in the ecosystem sometimes resulted in upsetting the other variables in the system leading to changes in the systems, degradation and sometimes destruction of other variables in the ecosystem.

In this study, variables are under investigation. WEF nexus embraces and integrates the exploration and management of resources; understanding the interlinkages and interactions among them; and finding ways to manage these resources with minimum effects on the stability of the ecosystem and human development. It also allows for the exploration of management options available for dealing with variables that promote the sustainability and stability of ecosystems. Figure 2.7 gives WEF nexus model simplified for understanding the WEF nexus as perceived by the researcher.

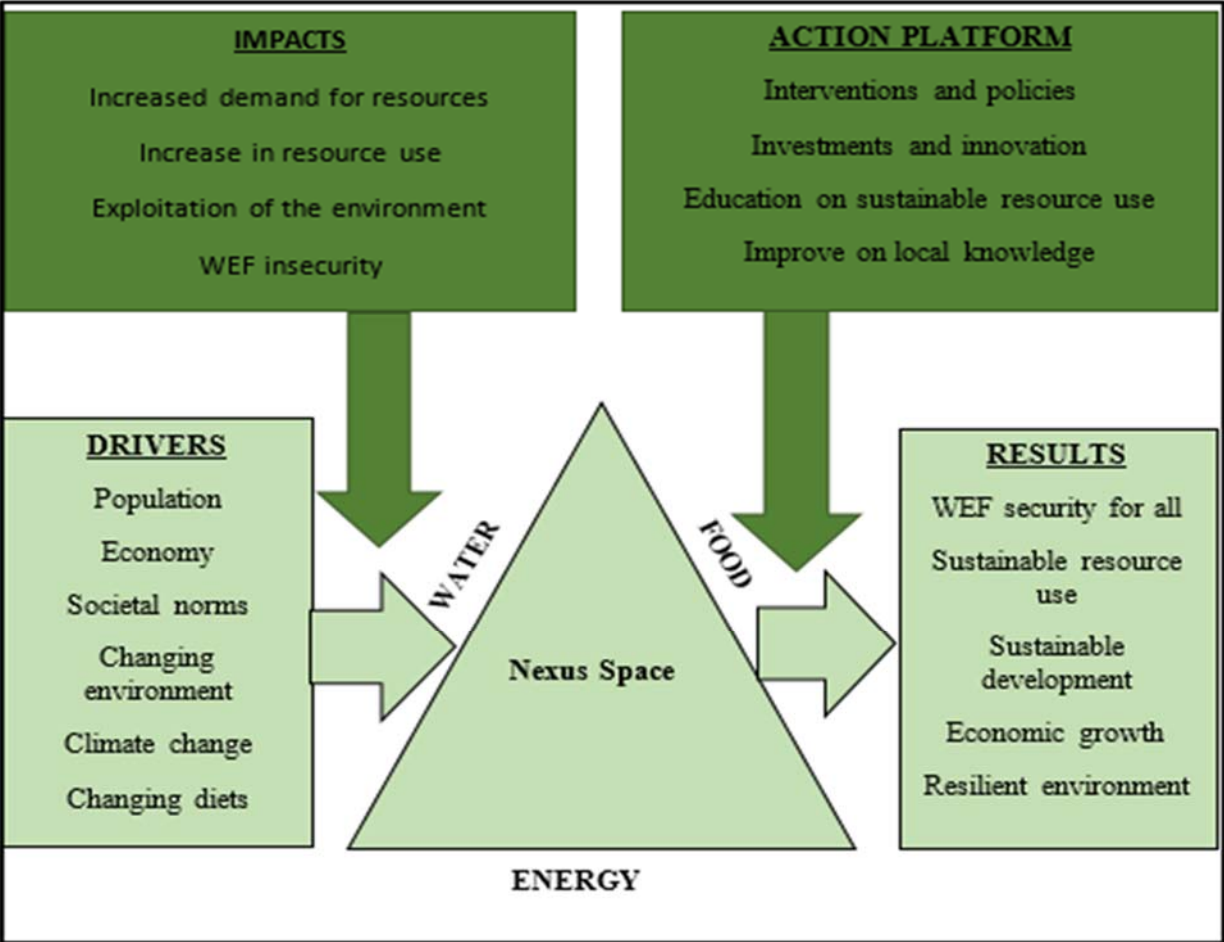


Figure 2.7: WEF nexus model simplified for understanding the WEF nexus

The model above was simplified to help in the understanding of WEF nexus components and interactions in a micro setting. The model does not replace any existing models nor discredit the frameworks brought forward. Its aim is to provide the researcher with entry points that have been garnered from other WEF nexus frameworks. The model grouped together the concepts that are valuable for the study of rural households. It is important to note that there are various frameworks brought forward as discussed above, which may make it difficult for researchers in specific contexts to use anyone of them. Studies in various discourses on WEF nexus have remodelled frameworks to suit their studies not entirely to replace or discredit the original concepts and

notions. The model above was influenced by the IISD framework (2013), which unpacks the nexus components to promote a better understanding.

Model in figure 2.7, recognises the key components of the WEF nexus and how an extensive understanding of the subject may produce positive outputs towards growth, development and sustainability of the WEF nexus. The major results termed herewith as outputs are major factors that may contribute towards human wellbeing and ecological sustainability. The model above shows the notions of panarchy, because the major resources for the nexus are ecological, and interactions and linkages occurring are cyclical and dependent on actions for continuity and sustainability. The WEF nexus models promoted by scholars all show the notion of resilience as they advised that certain courses of action, if taken, might improve the WEF nexus security or help people and the environment to be resilient towards various challenges.

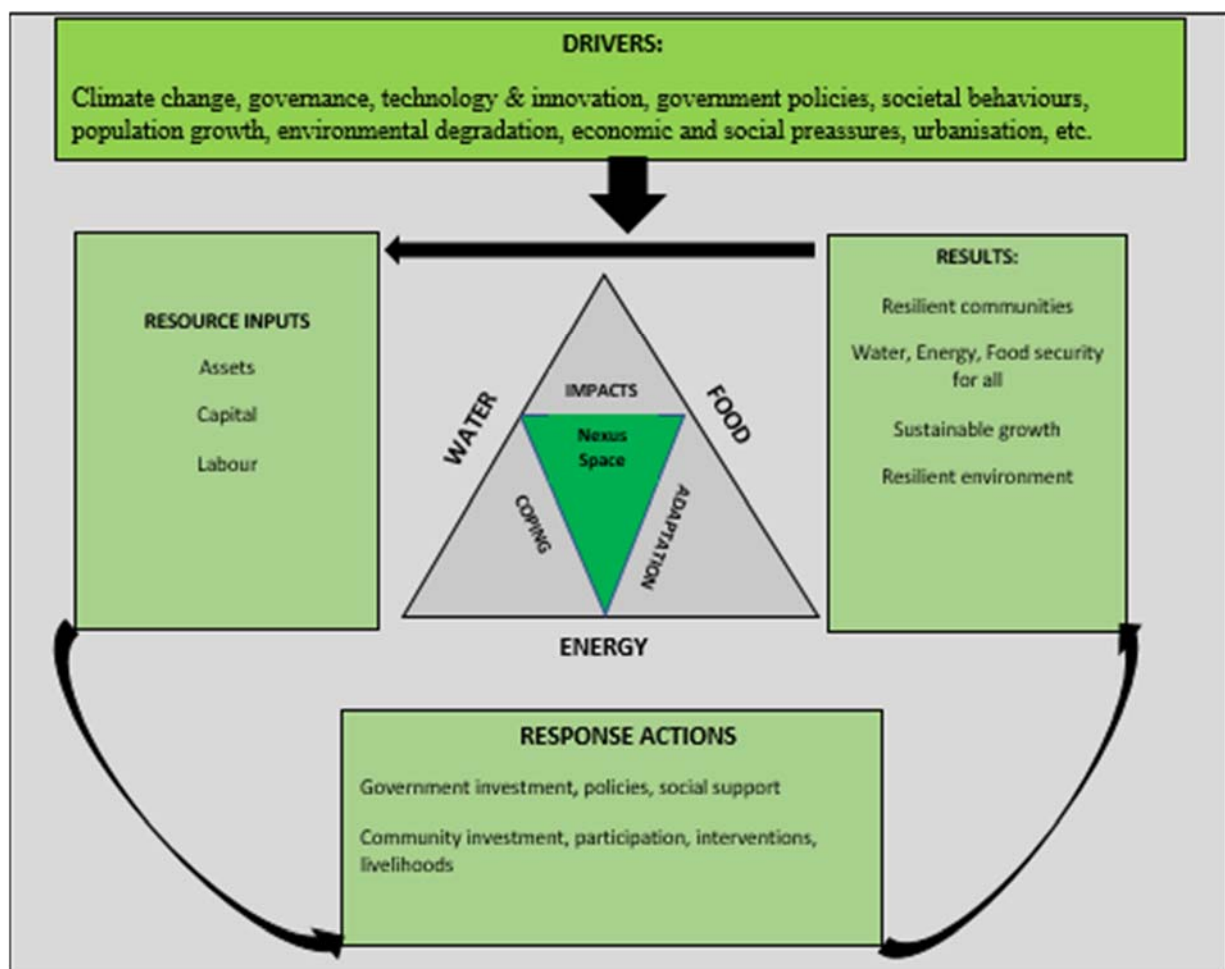


Figure 2.8: A modified WEF nexus resilience framework for understanding interactions in rural households

The model above recognises key components of WEF nexus and promotes an understanding of the subject may produce positive outputs towards growth, development and sustainability of the WEF nexus. The major results termed herewith as outputs are factors that may contribute towards

human wellbeing and ecological sustainability and/or resilience. The model above shows the notions of panarchy, because the major resources for the nexus are ecological, and interactions and linkages occurring are cyclical and dependent on actions for continuity and sustainability. The WEF nexus models promoted by scholars all show the notion of resilience as they advised that certain courses of action, if taken, might improve the WEF nexus security or help people and the environment to be resilient towards various challenges.

WEF nexus resilience offers a focused framework to explore the interactions of water, food and energy resources within local level households, changes occurring, management options by humans, nature of human needs of the WEF resources, and examine the resilience of both systems to changes and disturbances. Change is derived from exploitation or conservation of resources that are based on the potential and connectedness of systems under study (Gunderson & Holling 2002:38). Panarchy therefore is understood in this study as a focus on the:

Hierarchical structure in which systems of nature and humans, as well as combined human-nature systems and social-ecological systems are interlinked in never ending adaptive cycles of growth, accumulation and restructuring (Gunderson & Holling 2002:13).

The model points out the various interlinkages of various systems (natural and human) in various cycles of growth, accumulation, restructuring and renewal in the WEF nexus context. All the challenges occurring, and which are natural and human induced, have a huge impact on lives, livelihoods and the environment which call for action (Holling, 1973; Perrings, 2006). The interactions that occur on one scale may have an impact on the other, thus showing that systems should be understood by exploring their relations, connections and interlinkages because there are potential connections between phases and systems (Gotts, 2007). Panarchy therefore creates a backdrop for the WEF nexus resilience framework that was designed for this study. The focus in scale is on the micro level.

The models show the development of the WEF nexus framework for implementation at the household level. The study looked at the WEF nexus security situation of rural households in two different countries and implements the framework by looking at the current WEF nexus security situational cases in both countries. Attention is given to the challenges that impact on the WEF nexus security situation. These potential disrupters determine a course of action towards coping and adaptation, or demise. The framework is intended support the development of intervention strategies for creating resilient households, promoting sustainable resource use, promoting rural development and empowering women with knowledge, and how to potentially further enhance existing coping and adaptation strategies.

2.8 Sustainable development and security

The two research concepts of security and sustainability, that were once quite distinct, have come to be recognised as one because of the undeniable relationship between them (Granit *et al.*, 2015:4). It is difficult to separate sustainability and security because of the human-ecosystems' changing aspects, such as technology, climate change, increasing population, changing consumption patterns and the prevalence rate of poverty (WEF, 2011a:2). The concepts have more in common as they push for the elimination of various challenges that may cause harm to both humans and the ecosystem. Security is viewed as a precondition for the achievement of sustainable development (Granit *et al.*, 2015:5; Stewart, 2004:262).

2.8.1 Sustainable development

The terms sustainable development and sustainability have been used interchangeably in most studies. The notion of sustainability became prominent in 1992 on the global agenda of the first Earth summit in Rio de Janeiro (Granit *et al.*, 2015:6; Holden *et al.*, 2014:130). The term sustainable development has been used from as far back as the 1980s and especially at the mission of the Brundtland Report of 1987 that was an endeavour to unite countries in pursuing sustainable development (Granit *et al.*, 2015:6). Sustainable development is defined as development that caters for today's needs without compromising the ability of future generations to meet their own needs (WCED, 1987:43). Sustainability is the practice of maintaining human and natural production processes for an indefinite period (Von Hippel *et al.*, 2011:6724). Sustainability encourages the replenishment of used resources while maintaining the structure of the ecosystem (Holden *et al.*, 2014:131). Sustainable development therefore is about economic growth, social equality and environmental protection, all of which contribute to sustainability.

Sustainable development upholds the importance of both human and ecosystems as it pushes to ensure that there is human development while maintaining the ecosystem's ability to provide services needed by the societies and economies (Holden *et al.*, 2014; Olonisakin, 2003; WCED, 1987). This notion advocates for environmental protection in the use and management of natural resources for economic and social development (Biggs *et al.*, 2015:390). Indicators of sustainable development should be a stable relationship between people's activities and the environment, where human actions for the enjoyment of life, should not compromise the prospects of future generations to live in the same manner (Leese & Meisch, 2015; Olonisakin, 2003; Perrings, 2006; Pisano, 2012b). Sustainable development means that human activities will occur in a manner that respects the environment. People should not take more than what the environment can produce. The concept of sustainable development favours a balance between the human need to improve living conditions, well-being and the preservation of natural resources and ecosystems (Granit *et*

al., 2015:6). In the year 2000, the United Nations' Sustainable Development Goals (SDGs) were approved by member states of the international organisation in an effort to coordinate activities and work towards global sustainable development. These goals aimed at improving the status of the developing countries by lifting them out of poverty (Granit *et al.*, 2015:8). In 2015, the millennium development goals were replaced by the sustainable development goals, which were universal to all countries to ensure sustainability (Granit *et al.*, 2015:8).

2.8.2 Security in development

The term “security” emerged in the 1640s, at a time when the first modern states started emerging in Europe. The security concept was used around issues of state integrity and territorial boundaries and the types of referred security were termed “national security” or “hard security” (Baldwin, 2011:118; Granit *et al.*, 2015:8). These terms were used, primarily in a political context, to contribute to the understanding of threats to states and ways of safeguarding national sovereign interests. However, security subsequently evolved to include an awareness of safety in the fields of economy, society and environment, rather than merely contemplating warfare and the politics of governance (Biggs *et al.*, 2015:391). The concept was expanded to include issues that would threaten human security, such as resource scarcity, environmental degradation, climate change, increasing population and economic fluctuations, health woes, forced migration, violence, inequalities and death (Griggs *et al.*, 2013:307; Khagram *et al.*, 2003:3). The concept of “human security” pushes for improved access to resources that meet people’s daily needs. Human security is the absence of severe threats of economic, social or political manner. According to Sen (1999:8), human security is the reduction or removal of all insecurities that affect human lives. Human security embraces human rights, good governance, access to basic services such as education and health, improving access to opportunities and choices to release their potential, freedom from fear nor want and freedom of the next generation to have a safe, healthy and productive environment in the future (Biggs *et al.*, 2015; Granit *et al.*, 2015; Holden *et al.*, 2014; Khagram *et al.*, 2003; Von Hippel *et al.*, 2011).

In this study, security is the situation where there is increased equity and improved easy access to important resources that cater for the basic needs of any system. In this context of the WEF nexus security and coping strategies of rural women, security would relate to rural women having access to safe and adequate food, water and energy to enable them to maintain a healthy lifestyle, free from wants. The rural households should have enough resources at their disposal to improve their lives and livelihoods. Security in this context also makes provision to mandate good resource use and management and preservation of the environment to ensure provision in the future. Whatever coping mechanisms rural women use to reduce the impact of WEF nexus challenges should be considerate of maintaining the environment to ensure sustainability.

2.9 Role of Livelihoods in the WEF nexus security of rural households.

Livelihoods are ways in which individuals, households, and groups make a living and their attempts in providing for their basic needs, coping with uncertainties and their responses to arising opportunities (De Haan, 2017:27). According to Ellis (1998:4), livelihoods is a broad term, which encompasses income (cash or land), social institutions, relations and property required to support and sustain individual, household or community's standards of living. Scoones (2009:172) defines livelihoods as activities of people to provide in their basic needs. A livelihood is made up of capabilities, assets, and activities performed for a living. Assets in livelihoods are the resources, claims and accessible platforms that a typical household relies on for a living (Scoones, 2009:172). Capabilities are related to having the necessary capital and support such as social, human, environmental and financial capital that improve the lives of people (Maxwell & Caldwell, 2008:54). These forms of capital are defined as follows:

- Human capital – The ability of people to work for their basic needs human capitals include education, health and the people who can do the required work/activities (Batterbury, 2008:7).
- Social capital – Social resources and networks, community-based networks and support systems (Batterbury, 2008:7).
- Physical capital – Basic infrastructure for development. These include roads, water and sanitation, energy, livestock, tools and other tangible equipment (Batterbury, 2008:7).
- Natural capital – These are based on the natural resources available to the people. These are land, water, forests, soil, fisheries and other natural environmental attributes (Batterbury, 2008:7).
- Financial capital – These are the financial resources available to the people enabling them to access their daily needs. Financial capital includes credit, savings, wages, remittances, gifts, and trade (Batterbury, 2008:7).

These capitals are important for facilitating, sustaining, determining and permitting livelihood strategies that people can do to earn an income. They make a difference in livelihood options available especially for rural women (Ellis, 1998:5).

According to De Haan (2017:25), livelihoods are important as they promote the survival of societies, humans and communities. Livelihood activities are the avenues that rural women have to secure basic supplies of food, water, energy, clothing and services related to health, education,

and shelter. Sustainable livelihoods promote the capacity of people to acquire basic things that are adequate for their households without compromising their dignity (Aasoglenang & Bonye, 2013:139).

The sustainability of livelihoods of rural women is an important aspect in the WEF nexus and in the creation of sustainable resilient societies. Livelihoods are mainly determinants of the survival and wellbeing of households. Resilience frameworks suggest that for systems to cope with challenges, it should have substantive assets and resources that are capable of cushioning the impacts (Pereira *et al.*, 2009; Snel & Staring, 2001). Livelihood assets are those that people lay claim on for survival such as for food, work and other services needed for the wellbeing of people (Maxwell & Caldwell, 2008:3). These assets also enable people to work through and cope with various challenges arising. Livelihood strategies are important as they facilitate access to and use of assets to secure their daily needs. They improve well-being, cushion challenges and reduce poverty. In the areas under investigation, there is a variety of activities performed by rural women to access the basic needs of their households. These activities are in addition to, the basic activities to access WEF nexus components. Livelihoods, therefore, are an integral part of achieving security, sustainability, resilience, and development (Carr, 2013:77; De Haan, 2017:23; Scoones, 2009:171).

The attainment of WEF security relies heavily on the livelihood strategies available to the people. Livelihoods form the basis of creating resilience in households and communities and providing pathways out of poverty and crisis (Pisano, 2012b:6). The need for income, assets and social security cannot be undermined and these resources are attained through livelihoods. When critical conditions persist, there is a more concerted shift to coping strategies. Livelihoods are viable if people have assets to draw on, such as food stores, savings, the environment, land, livestock, tools, and other tangible resources. The cyclical resilience trends in panarchy, theoretically postulates that available resources are important in building resilience by promoting the growth of systems, stability, efficiency in resource use and management and the ability to adapt to potential changes for the better, or worse of their continued existence.

Livelihoods enable people to respond to changes and processes in the short or long-term by making adaptations. Unreliable livelihoods reduce the systems' capacity to cushion the challenges faced. Livelihoods create avenues to cope, adapt to and recover from challenges, to increase the household capabilities, assets and entitlements while protecting the natural resources (Marschke 2006:41). The achievement of WEF nexus security is reliant on the availability of livelihood options and resilience building for rural households. The panarchy cycles in resilience explains that when the systems face challenges they are pushed to a state of collapse (Ω or omega stage) and destruction, where challenges are faced and the capability of the system

to withstand and cope with challenges allows for reorganisation (α or alpha stage) (Maleksaeidi & Karami, 2013:263; Plummer & Armitage, 2007:63; Vonck & Notteboom, 2016:309). Most of the WEF nexus components are cost related. Household income is determined by the livelihoods pursued and their sustainability. This provides rural women with avenues of coping and adapting when faced with challenges. The study sought to find out which livelihood options women pursued in order to access resources and social support networks that are available to them. The focus was on how women raised income to pay for and buy supplies, and on how women procured food for their household.

2.10 Rural women and access to resources

Economic growth and human well-being are highly influenced by access to major economic resources that may improve the income of households or individuals. Women play a key role in the management and acquisition of household basic needs. We are aware of the important role they play in the acquisition of water, energy and food needed for household consumption (Charman, 2008; Chitja *et al.*, 2016; Cleaver & Elson, 1995). It implies that in order to achieve gender equality, empowerment of women and sustainable economic growth and development, there is a need to improve access for women to effectively take charge of key resources. The issue of inequality in the distribution of resources has made women more vulnerable to poverty, hunger, and underdevelopment (Charman, 2008; Chitja *et al.*, 2016; Gaidzanwa, 1995; Gladwin *et al.*, 2001). Women continue to lag behind men in key decision-making institutions, which increases gender inequality.

Women in developing countries do not have open access to key resources such as land, credit, housing and other productive resources (Posel & Rogan, 2009:26). They have limited access to technologies and services that would make their household burden easier. In some households, women are responsible for providing for all the needs of the family. These duties include sourcing for food, water and energy and sourcing for income that can help pay for other needs and services such as education and health (Aggarwal *et al.*, 2001:210). However, the limited access to resources limits the capacity of women to provide for their households. This inequity has an impact on agricultural production, the well-being of families and works to the detriment of the ideal of poverty reduction.

Land and property rights have been promoted in most global, regional and national policies e.g. the CEDAW, Millennium Development Goals (MDGs), and constitutions that have tried to change the situation of women (Chopra *et al.*, 2009:1023; UN General Assembly, 1979:3). However, these well-intended mandates and laws are undermined by socio-cultural values and norms and a lack of knowledge by women of their intrinsic human rights. There is consensus that improved

access to land for women contributes to improved household food security and income situation, especially in the rural areas (Aggarwal *et al.*, 2001:210; Ruel *et al.*, 2010:170). There is a need to increase: women's access to irrigation services and infrastructure; and increase women's participation in governance and management of water issues, land and property. Improved access to water and energy would reduce women's burden of fetching water and fuel, thereby reducing the amount of time they take to perform their chores, leaving them with more time for productive work (Aggarwal *et al.*, 2001:210).

Improvement of technologies would reduce the burden of water and energy collection for rural women and improves household health and wellbeing. Women need to have improved access to financial services that would help them to benefit fully from economic opportunities (Graham. J *et al.*, 2016:2; Gumede, 2013:13). There is also a need to ensure that women have access to social protection in order to enable them to cope with challenges that arise. The government should invest more in social security. Africa has made a huge effort in providing social security for children and the elderly but in other situations, there is still lack of grants for the unemployed and marginalised groups of people, especially women (Makiwane, 2010:193). Societies need to have access to resources that would enable them to cope with challenges for WEF nexus security. Resilient societies should have access to resources that enable them to cope with challenges that arise, to predict challenges and remember past occurrences, and to learn and come up with innovative and resilient ways to cope (Perrings, 2006:418; Pisano, 2012a:8).

This study narrowed down its focus to women in rural areas in order to fully explore the interactions between food, water, and energy in rural households. The relationship among these resources is traceable from production to consumption as well as in the ecosystem/environment. Women are the main managers of WEF nexus resources within households. They ensure family wellbeing. This assessment is not to undermine the role of men in the households. There are challenges noted and predicted globally, regionally and nationally that place humans at risk of WEF insecurity (WEF, 2011a:28). Broader predictions are that there is a need for the world to find effective responses to WEF resource security challenges. There is also the need for inventing coping strategies for the creation of stable, sustainable and developed systems (Al-Saidi & Elagib, 2017:1132; Endo *et al.*, 2015:5808). If the world does not recognise and manage the WEF nexus concerns as one, there is a high risk of insecurity; actions in one WEF nexus sector can have an impact on the existence of other sectors (Bizikova *et al.*, 2013:5; FAO, 2014:3; WEF, 2011a:28).

2.11 Conclusion

This chapter was an extensive review of literature on the WEF nexus, resilience, and sustainable development and livelihoods in dealing with the role of rural women at the helm of households in

southern Africa. Two localities have been identified and will feature prominently in the empirical discussions to follow. Literature on how to use the nexus theory to explore WEF nexus security challenges and coping strategies of women in charge of households in the rural areas is non-existent. No literature was found on how to apply the WEF nexus theory to household-level studies. Literature on the WEF nexus theory shows there is no consensus to a single framework or approach. Organisations, scholars and other researchers came up with different approaches within their development or scholarly discourse to secure a single resource or to build more relevant policies and interventions. In other research, WEF nexus theory was combined with other existing theories to make it more applicable. The approach that has been formulated for this study was drawn from the global conception of WEF nexus and was modified to enable the researcher to look at and understand the WEF nexus on a micro level and to bring in local and community views on the WEF nexus. This localisation of the theory help to shed more light on the continental views on WEF nexus and how challenges met are dealt with and the available resources to rural households that can be built upon to ensure the achievement of WEF nexus security for all.

This study made use of the WEF nexus theory and the social resilience theory. The WEF nexus theory is important for exploring the relationship among water, energy and food within rural households. It helps in the understanding of WEF nexus synergies and trade-offs occurring within households. These resources are inseparable, therefore, integrated resource use and management should be considered, in order to maximise synergies and minimise trade-offs. In a rural household setting, WEF nexus security is still a huge challenge and women as managers of water, food and energy at household level should be aware of the interactions of these resources and ways to cope with insecurities. The WEF nexus is a broad theory that integrates a number of concepts and frameworks therefore it can be used in a variety of contexts. It is a theory that upholds notions of sustainability, adaptation and resilience, which makes it ideal for this study.

The next chapters will discuss the methodology and empirical findings on the water, energy and food security situation in the rural areas of Chivi district and Vhembe district. The chapters will look at the availability, accessibility and utilisation of resources within rural households. The researcher explored factors affecting rural household water, energy and food security, such as challenges, shocks and stresses including the ways in which households have managed them.

CHAPTER THREE

METHODOLOGY: EMPIRICAL CASE STUDIES ON WEF NEXUS AND COPING STRATEGIES OF RURAL WOMEN

3.1 Introduction

This chapter sheds light on the methodological tenets and spatial sites in the Chivi district of Zimbabwe and Vhembe district in South Africa respectively, that have been selected for empirical case study research on rural women and their coping strategies in the household. The reader is informed on some of the challenges faced at the time of conducting the research fieldwork and the ethical considerations that guided the research. The first part of the chapter provides the methodology used for the research. Aspects of the methodology include the research designs, data collection, and sampling methods as well as the format of data analysis. A background exposition is given for each research area. Then follows provides a description of the two districts separately before providing a comparative synthesis of both areas. The description of each area includes the location, climatic conditions, livelihoods activities and characteristics of the chosen communities for each case study area. The chapter provides the distinctive socio-biographical data of respondents in each case study area. A comparative synthesis is done to understand the similarities and differences that emerged in the two case studies on the characteristics of participants. In addition, a comparative analysis of results found in the two cases was done to understand the similarities and differences between the case studies. The exposition of the similarities and differences was done using the text-by-text format by giving detailed descriptions of the similarities and the differences to help in the understanding of the case study areas, methodology, and characteristics associated with the population under study. Diagrams and tables are used that capture the key elements of the cases and give a description of the similarities and the differences revealed.

3.2 Research paradigm

A research paradigm is defined as a pattern that provides a model for examining problems and getting solutions (Creswell, 2009:9). A paradigm encompasses different concepts, variables and problems. It is part of a research culture following defined values, beliefs and assumptions (Nieuwenhuis, 2010:54). The paradigm reflects the philosophical thinking, usually shaped by beliefs and principles that shape how a researcher views actions and interactions of people (McMillan & Schumacher, 2014:5). A research paradigm provides a framework that is used to view the world and formulate meanings out of certain actions. It influences research particulars

such as methods, choice of participants, sampling, data collection, interpretation and analysis (Creswell, 2009:7; Nieuwenhuis, 2010:57)

The research paradigm for this study is interpretive and a qualitative methodology was used to process the data. The interpretivist methods aim to understand phenomena based on the meanings, the experiences and knowledge shared by a selected group of people. They gave their consent and were willing to share their personal views on matters related to the focus of the research project (Baxter & Jack, 2008:545; Bricki & Green, 2007; Creswell, 2009:8). Interpretivists seek for the explanation of reasons and meanings that cause various actions in societies. The interpretive paradigm upholds involvement, association and engagement, and the researcher becomes a participant observer in the research process (Creswell, 2009:8). In the paradigm the realities pertaining to issues are socially constructed, they are personal and independent to each individual or society. Interpretivists believe that realities are intangible and vary from place to place, from one context to another (Mertens, 2010:16). In this paradigm knowledge of and about issues is subjective. Personal experiences form the truths, beliefs, connections, relations, stories of the people. Group views are regarded as authentic knowledge (McMillan & Schumacher, 2014:7; Mertens, 2010:16).

According to Nieuwenhuis (2010:58) interpretive research design focusses on the subjective experiences of people. The researcher relied on data based on the experiences of rural women in their daily interaction with the WEF nexus resource components, the challenges they encountered, and the coping strategies they used to adapt and respond to contending issues. A considerable amount of time was spent in each case study area, and the researcher had direct contact with participants. The researcher conducted and interacted with respondents within their own communities and environments. The researcher wanted to understand the interactions and actions of people and to denote the reasons why they take certain actions, especially when dealing with the WEF nexus. The interpretivist paradigm helps in the understanding of socially constructed views, actions and responses to real situations (Maree, 2007:18; Nieuwenhuis, 2010:54; Patton & Cochran, 2002:36). According to Nieuwenhuis (2010:59), an interpretive research paradigm can be used following different methodologies. Philosophies of case studies, ethnography and phenomenology contributed the bulk of the data for this qualitative study.

3.3 Research methods

Research methods refers to the strategy of inquiry, which combines research design, data collection, interpretation and analysis (Creswell, 2009:8). There are two main strategies of inquiry, quantitative and qualitative. This study was guided by qualitative research methods which are ideal for the study of socio-cultural phenomena. This method of inquiry studies lives of people,

societies and communities within their natural setting (Creswell, 2009:8). It is a naturalistic strategy of inquiry that links meanings and interpretations of phenomena embracing the meanings specific groups of people attach to them. Qualitative research methods allow for exploration and discovery of issues about a certain phenomenon (Mertens, 2010:16).

Qualitative methodology was chosen for this study because it allows for the exploration of the WEF nexus security and coping strategies of women in the Chivi district and the Vhembe district. Qualitative research methods provide adequate insight into the understanding of perceptions and actions of various social experiences (Mertens, 2010:16). The purpose of the study is to find the similarities and differences in the WEF nexus experiences of rural households in Zimbabwe and South Africa. This study used a variety of tools to collect data and gather information on the WEF nexus security, challenges and coping strategies. The researcher was the main instrument of the study and acted as a participant observer. Qualitative research allows for objectivity and the construction of contextual findings that help in developing knowledge and understanding in the rural household WEF nexus context.

3.4 Research design

The study, as a whole, follows a qualitative hybrid research design which combined notions of ethnography, phenomenology and case studies. Ethnographic and phenomenological views were incorporated in the study because of their strengths to allow for an exploration of particular issues that have an effect on the lives of people (Yin, 2003b:15). However, the bulk of data collected in this study was guided by case study methodology, which provides tools for studying complex phenomena in specific local contexts (Algozzine & Hancock, 2006; Yin, 2009; Zainal, 2007). The purpose of the research design is to address the planning of strategies and scientific inquiry for investigation (Leedy & Omrod, 2014; Yin, 2009). A qualitative case study methodology is a valuable method to develop theory, evaluate programmes and help in the development of potential interventions (Baxter & Jack, 2008:544). The chosen research design enables the researcher to fully explore and reveal important aspects of the field under investigation.

A qualitative design was used in this study, which provided for sufficient opportunities to collect in-depth information on the WEF nexus' current security status, in respect of rural women and their coping strategies. A WEF nexus resilience model was used, which values the importance of understanding the WEF nexus, challenges and coping strategies that can be used to curb the impact of challenges on the lives of people whilst preserving the ecosystem. The model provides the understanding of the ways in which humans interact with the ecosystem and the manner in which the WEF nexus components, water, energy, and food, relate to the activities of rural households. The model combined resilience and the WEF nexus. Panarchy was used to explain

the interactions that occur between humans and ecosystems, and how human actions influence the sustainability and security of WEF nexus resources in the future.

This study is exploratory in nature with multiple case studies, which allows for comparison. Exploratory case studies are used in situations where the intervention under investigation does not have a single prescribed set of outcomes (Baxter & Jack, 2008:548; Yin, 2003a:45). Also, a multiple case study helps the researcher to explore situations in different contexts and find differences within and between cases (Algozzine & Hancock, 2006:8; Zainal, 2007:2). Qualitative research is important as it allows researchers to come to an understanding of aspects of social life. The data generated is primarily qualitative and not necessarily quantitative (Patton & Cochran, 2002:44). The method was chosen as it was found to provide an appropriate design for understanding WEF nexus security and coping strategies of rural women in rural areas.

3.5 Case studies

This study made use of the case study approach as described by Yin (2003a:23). Case study research promotes the understanding of complex issues and allows researchers to make close in-depth inquiries of the subject under study (Algozzine & Hancock, 2006:16). Case studies allow for an understanding of particular cases in all their complexity and investigate the dynamics of a system, e.g. families, communities, institutions, and practices (Algozzine & Hancock, 2006:10; Baxter & Jack, 2008:543). Case studies can be viewed both as a unit of analysis or as a research method with a systematic inquiry into an event and with the aim to explain the issues under study (Maree, 2007:75).

Case studies have been used in research for many years in different disciplines. The use of case studies promotes the examination of phenomena in real-life contexts (Streb, 2010:373; Yin, 2003b:3; Zainal, 2007:2). Case studies allow for the descriptive analysis of situations (Baxter & Jack, 2008:546). Case studies use data derived from interviews, group discussions, observation and other data, which best explain the situation under study (Zainal, 2007:4). These types of studies give researchers the opportunity to focus their attention on a specific topic in a separate field (Yin, 2003b:5). The case study designs are helpful in testing emerging theories and their successes.

A case study is an in-depth study of individuals, groups of people and units in order to generalise results broadly. This study used two case studies that cross-national boundaries but have very similar profiles, which increases the validity of the comparative analysis. Therefore, the study had multiple cases which are ideal for understanding the differences and the similarities between the cases (Baxter & Jack, 2008:550). Multiple-case studies provide researchers with a platform to explore differences within and between cases. The chosen cases with similar profiles allow for

prediction of similar or contrasting results across cases based on a theory (Yin, 2003b:41). Multiple-case studies are flexible in allowing the researcher to analyse data within each situation and across situations as done in this study (Yin, 2003b:41). The comparison of multiple-case studies enables the researcher to provide important contributions to the body of literature derived from the contrasts and the similarities between cases (Vannoni, 2014:332). In this study, a multiple-case study was chosen, because evidence derived from this design is strong and reliable (Baxter & Jack, 2008:550). There are various ways of reporting case studies which include chronological, comparative, linear, theory building, suspense, and non-sequenced (Yin, 2003b:44).

This chapter of the study focusses on two different case study areas in Zimbabwe and South Africa, which have similar characteristics. Two case study areas create a context for a comparative approach to identify similarities and differences. The case studies chosen were treated as single cases and the conclusions derived contribute to the broader interpretation, results, and conclusions of the study. Studies by Endo *et al.* (2015:5806), and Siddiqi and Anadon (2011:4530), adopted case study designs which allowed them to analyse various concepts in the WEF nexus. The two case studies chosen provide a background to compare and explore the differences in local responses, opportunities and challenges in terms of the WEF nexus.

This chapter looks at two rural areas, respectively in Zimbabwe and South Africa. The case studies were chosen to represent a different geographical location each and the potential similarities they share, and which are essential to draw a comparison. Zimbabwe and South Africa are both semi-arid countries with a mean annual rainfall of about 300-500 mm/a. The rural communities were chosen from Chivi district, Masvingo Province, Zimbabwe, and Vhembe district, Limpopo Province, South Africa. They are both typical Lowveld regions and receive less rain than the average annual rainfall estimates for both countries.

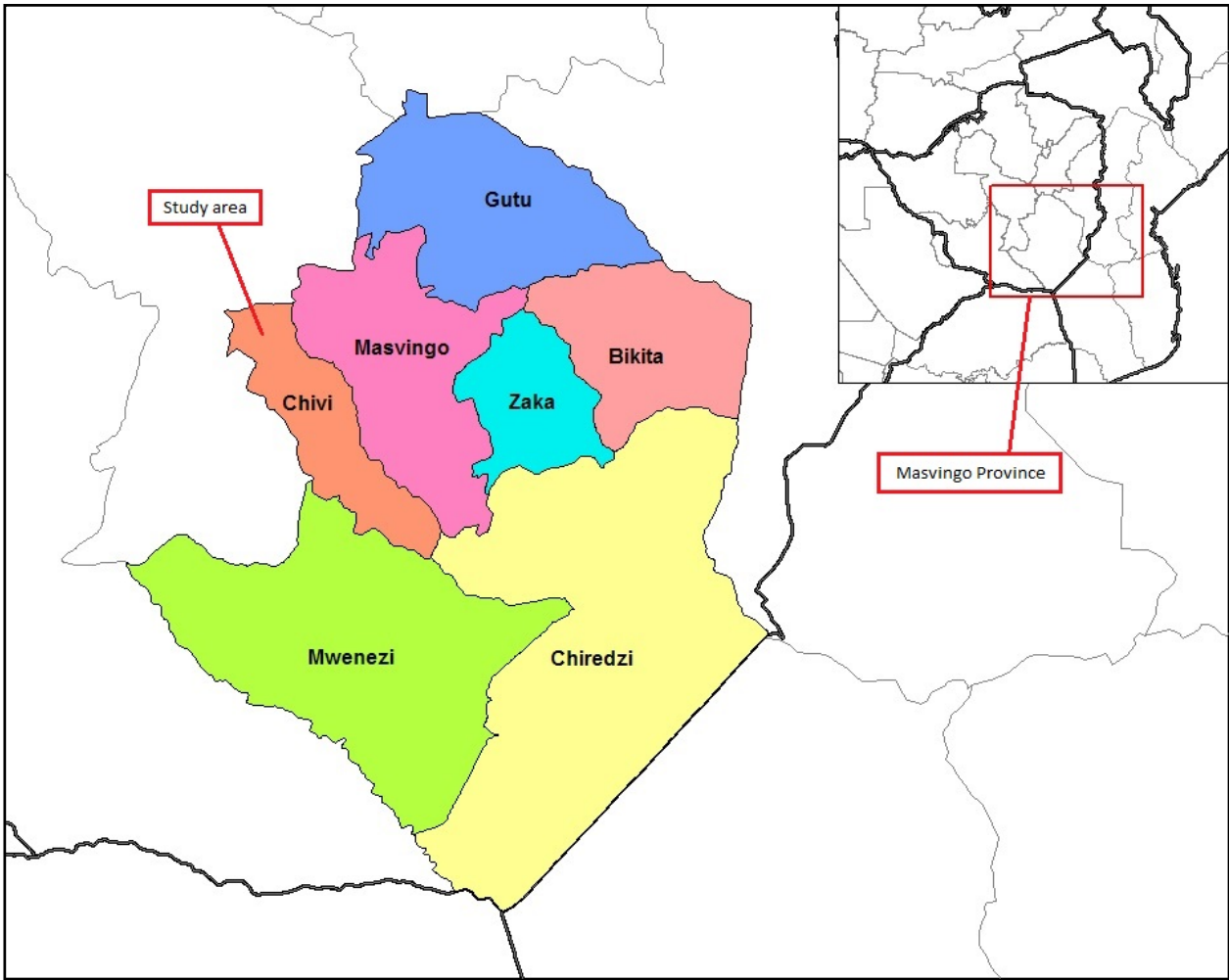
3.6 Description of the case study areas

This section provides a description of the two case study areas. The section uses findings from empirical inquiries and documents and relevant information from other scholarly documents. Views of rural women, men, and officials involved in the study in both areas were used in the description of study areas. An independent description of each area is given to articulate the aspects in each case study area.

The case study areas are situated in two countries. For example, the study was conducted in the rural areas of Zimbabwe, in Chivi district located in Masvingo Province; and the rural Vhembe district located in Limpopo Province, South Africa. The areas selected share some similarities.

3.6.1 Chivi District, Masvingo Province, Zimbabwe.

Zimbabwe is divided into regions based on the mean annual rainfall, combinations of soil, landforms and climatic characteristics. Chivi district is in the Masvingo Province of Zimbabwe. The area falls under Agro-ecological Region Five of Zimbabwe’s classified natural regions. The study area is located in a Lowveld area that is drier than most parts of the country (Mudzonga, 2012:4). Chivi is one of seven districts that make up the Masvingo Province. Chivi district is located about 70 km from the town of Masvingo. The district hosts 32 wards which have been divided into three political constituencies, Chivi North, Chivi South and Chivi Central (Mudzonga, 2012:4) (Map 3.1).



Map 3.1: Chivi District location in Masvingo Province.
Source: ZimVAC (2017:212)

3.6.1.1 Population

Chivi district, according to the most recent census (2012), has a population of 166 049 people, of which 90 170 are females, and 75 879 are males (ZIMSTAT, 2012:16). A total number of 161 755 people reside in the rural areas, while 4 292 are living in designated growth points distributed across the district. The district has a total number of 35 912 households and 19 741 of these are male-headed households. Of these, 16 171 are female-headed households (ZIMSTAT, 2012:16).

3.6.1.2 Characteristics of area under study

The study area houses 32 wards in three different constituencies. The district is sub-divided into three political constituencies: Chivi North has eight wards, Chivi South has nine wards and Chivi Central has 15 wards. Chivi district operates under the authority of a district administrator. Traditional leadership is constitutionally recognised in the district with chiefs and headman being the community leaders. In addition, there are electoral structures of leadership, with councillors overseeing the general administration of individual wards in areas under different traditional chiefs.

The study was carried out in wards 11, 13 and 30 in Chivi North and Central. The areas were identified after a preliminary pilot study to find suitable spaces for research fieldwork. Ward 11, 13 and 30 were selected due to their geographical proximity to the local growth point/town. Ward 30 is 15 km away from the growth point while the other areas are 40 to 50 km from the growth point in more remote areas. The objective in this selection was to secure a fair representation of the perspectives of respondents in various areas. The accessibility of the wards was an ascribing factor that determined the decision by the researcher for selecting them. The demographic characteristics of the selected localities used for the study are evident in Table 3.1. It shows the population composition of the wards chosen in Chivi district.

Table 3.1: The population composition of the wards chosen in Chivi district in 2012

Ward	Population						Households	
	MALES NO	%	FEMALES NO	%	TOTAL NO	%	TOTAL NO	AVERAGE SIZE %
11	1991	41.8	2774	58.2	4765	100	990	4.6
30	1905	44.3	2393	55.7	4298	100	1166	3.7
13	1617	44.5	2019	55.5	3636	100	841	4.3

Source: ZIMSTAT (2012:125)

3.6.1.3 Climate

Chivi district is situated in the drought-prone area of Zimbabwe, north of Mwenezi District and west of Masvingo District (Gandure *et al.*, 2010:232; Gerhardt & Nemarundwe, 2006:514; Mudzonga, 2012:6). The annual precipitation averages between 450 mm and 650 mm with temperatures reaching a maximum of 26-38°C in summer and a minimum of 15-18°C in winter (Gerhardt & Nemarundwe, 2006:233). The district receives relatively high rainfall in December and January as shown in Table 3.2. The district has been recording an onset of rainy season from mid to end December for the past five years and within this period the average district annual cumulative rainfall was recorded at 350 to 400 mm/a. The rainfall season was characterised by erratic rains, severe dry spells, and poor rainfall distribution, which had an impact on livelihoods (HJPA/CD/FN Interviews Officials, 2017).

Table 3.2: Chivi district average rainfall in mm

Season	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Cumulative/mm
2011/12	0	4	135	44.5	44.5	14.5	16	258.5
2012/13	38.8	11.3	39	22.8	228	34.6	7.6	382.1
2013/14	19.9	26.1	163.6	263.3	263.3	138	11.8	886
2014/15	0	22.2	218	40.8	40.8	43.3	25.8	390.9
2015/16	0	25.4	39.1	84.9	84.9	137.5	19.3	391.1
2016/17	3.2	79.6	171.5	275.4	594	0	0	1123.7

Source: HJPA/CD/FN Interviews Officials (2017)

The district has poor soils and vegetation and is situated in an area prone to erosion (Mudzonga, 2012:5). The economy of the district relies mainly on agrarian activities. Maize (Vernacular: *Chibage* / Botanical: *Zea mays*), finger millet (*Rukweza* / *Eleusine africana*), sorghum (*Mapfunde* / *Sorghum bicolor*), Bambara groundnuts (*Nyimo* / *Vigna subterranea*), peanuts (*Nzungu* / *Arachis hypogaea*) and cowpeas (*Nyemba* / *Vigna unguiculata*), are the major crops grown during the farming season (Mudzonga, 2012:5). Local residents practice gardening in some areas but are primarily confined to the off-season from March to September. The district has smallholder farmers, as the area is either communal or old settlement areas.

3.6.1.4 Livelihood systems and sources of income in rural Chivi District

Economically, the district mainly relies on agriculture e.g. crop cultivation and livestock rearing (ZimVAC, 2017:64). Large numbers of people live in the rural areas, which are essentially resettlement areas or communal areas. Therefore, local communities allow each household to have a piece of land for agriculture (ZimVAC, 2017:57). However, most agricultural activities rely on seasonal rainfalls for success and productivity. Consequently, most farmers are vulnerable to

climate variability. Good rainfall, in the rain season, is the major determinant of high crop yields (Mudombi & Muchie, 2013; Mudzonga, 2012; Simba *et al.*, 2012). Local residents have resorted to various means of raising income through the practice of diversifying livelihoods options and forms of employment.

Formally, the young and able-bodied resort to seasonal labour at large mining operations and farming estates where they earn money during off seasons (Bird & Shepherd, 2003; Carr, 2013; Chazovachii & Chuma, 2013; Mutopo, 2011). Some have resorted to gold panning, irrigation farming, fishing, pottery manufacturing, informal trading and piece jobs. Local wealth is derived mainly from employment and remittance opportunities (MHCW, 2008). Cross-border trading is on the increase. Local people flock to South Africa to sell their handicraft and agricultural produce such as *Nzungu* and *Nyimo*. They then purchase goods to sell in Zimbabwe. The district is in close proximity to South Africa. The fact that the Masvingo-Beitbridge highway passes through the district is a boon. Local people use the highway for trading purposes – especially sculptured artwork and pottery (Parliament of Zimbabwe, 2011). Local residents keep small livestock like goats and chickens to sell in emergencies. Small gardens are used to add to the daily food supply of families (Giller *et al.*, 2009; Muchadeyi *et al.*, 2004; Scoones & *et al.*, 1996). In 2002, the net income of local residents was calculated to be about US\$670 per annum per household in the rural areas. It represents an income of about US\$1.80 per household per day (Campbell *et al.*, 2002). There is reason to believe that little has changed since 2002.

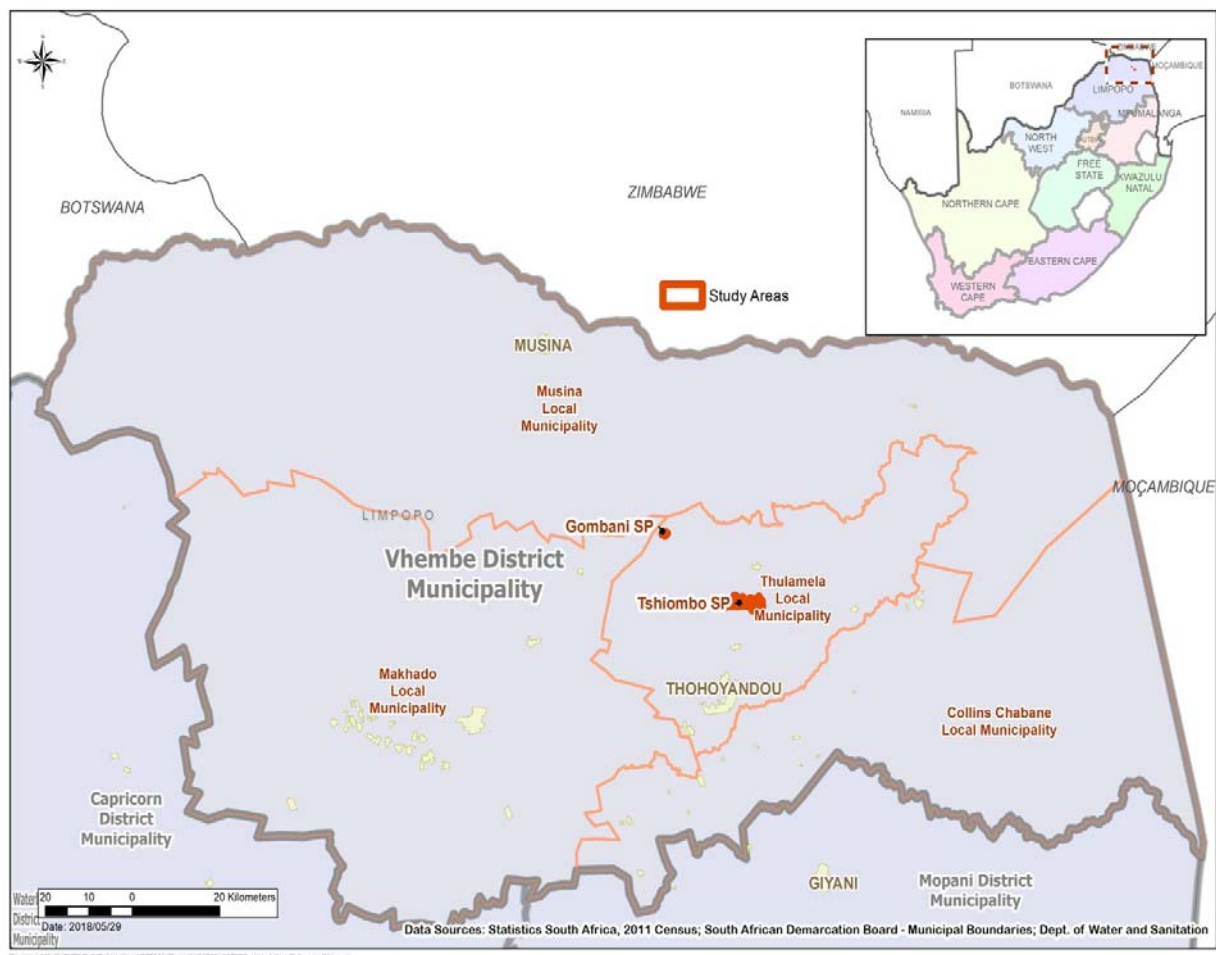
It is evident that people rely on a variety of economic activities as part of their coping and adaptation strategies to the vulnerabilities they are exposed to. Major stress factors are the lack of economic income and unpredictable climate conditions (potentially climate change), which easily translates into economic meltdown, food insecurity and poverty (Gandure *et al.*, 2010:515). To maintain reasonable livelihoods, people pursue specific strategies to cope and adapt to prevailing circumstances. These help them to alleviate potential suffering, caused by the challenges they experience. Local people tend to form community partnerships of support, such as saving groups. They change their consumption patterns of WEF nexus resources and adapt to situations in a manner that reduce the effects of WEF security challenges.

3.6.2 Vhembe district, Limpopo Province, South Africa

Vhembe district is one of the five districts of the Limpopo Province. The province is said to be one of South Africa's richest agricultural areas (Vhembe District Municipality, 2012:3). However, the Vhembe area is vulnerable to climate change as shown by long-term changes in both rainfall and temperatures (Vhembe District Municipality, 2016:7; Ziervogel *et al.*, 2006a:293). The district is

an extreme drought-prone area, receiving an estimated minimum of 50 mm and a maximum of 300 mm rain per year (Vhembe District Municipality, 2016:100).

Vhembe district has four local municipalities, namely: Musina, Makhado, Collins Chabane and Thulamela (Map 3.2). According to the national census of 2011, Vhembe shares borders with Botswana, Zimbabwe, and Mozambique. The whole district covers a surface area of 21 402km² (Vhembe District Municipality, 2011b:17). The study area is largely rural and highly vulnerable to climate variabilities, which impact on ecosystems, livelihoods, economic activities, infrastructure and utilities and the general wellbeing of people (Vhembe District Municipality, 2016:99). Vhembe is primarily rural, despite the fact that Thohoyandou – the most populous urban settlement in the larger region – is situated in Vhembe. Vhembe District Council is the main governance authority.



Map 3.2: Vhembe District, Limpopo Province

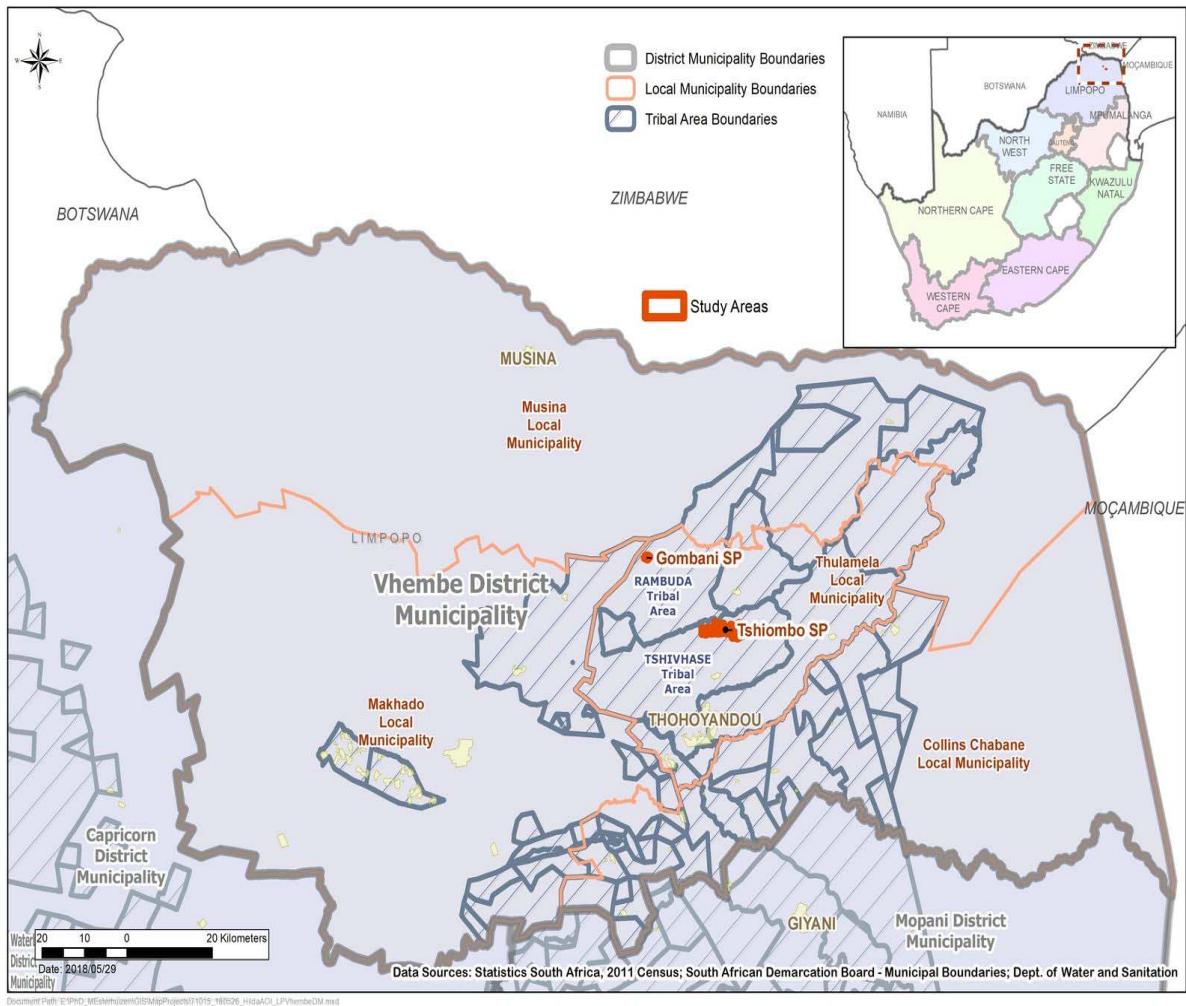
Source: StatsSA (2011a)

3.6.2.1 Population

Vhembe district, according to the most recent (2011) national census, has a population of 1 294 722 people (StatsSA, 2011b:10). The population of Vhembe has increased by a total number of 96 666 between 2001 and 2011 (Vhembe District Municipality, 2012:3; Vhembe District Municipality, 2016:1). Of the total population, 704 509 are women, 590 213 are men and 52% of this population is under the age of 20 (StatsSA, 2011b:14). The statistics show that there are more dependants than working-age people in the district (StatsSA, 2014:80).

3.6.2.2 Characteristics of area under study

The localities used for the study are situated in the jurisdictional area of Thulamela local municipality. The direct governance of rural areas in the whole district resort under the authority of the Vhembe district municipality. The researcher worked closely with the Vhembe district municipality. The authority is responsible for all WEF-related services in the district's rural areas. The two officially recognised settlement areas of Tshiombo and Gombani were singled out for the South African case study. Map 3.3 shows the boundaries and location of the study sites. Some participants in the project came from smaller villages in the two tribal areas.

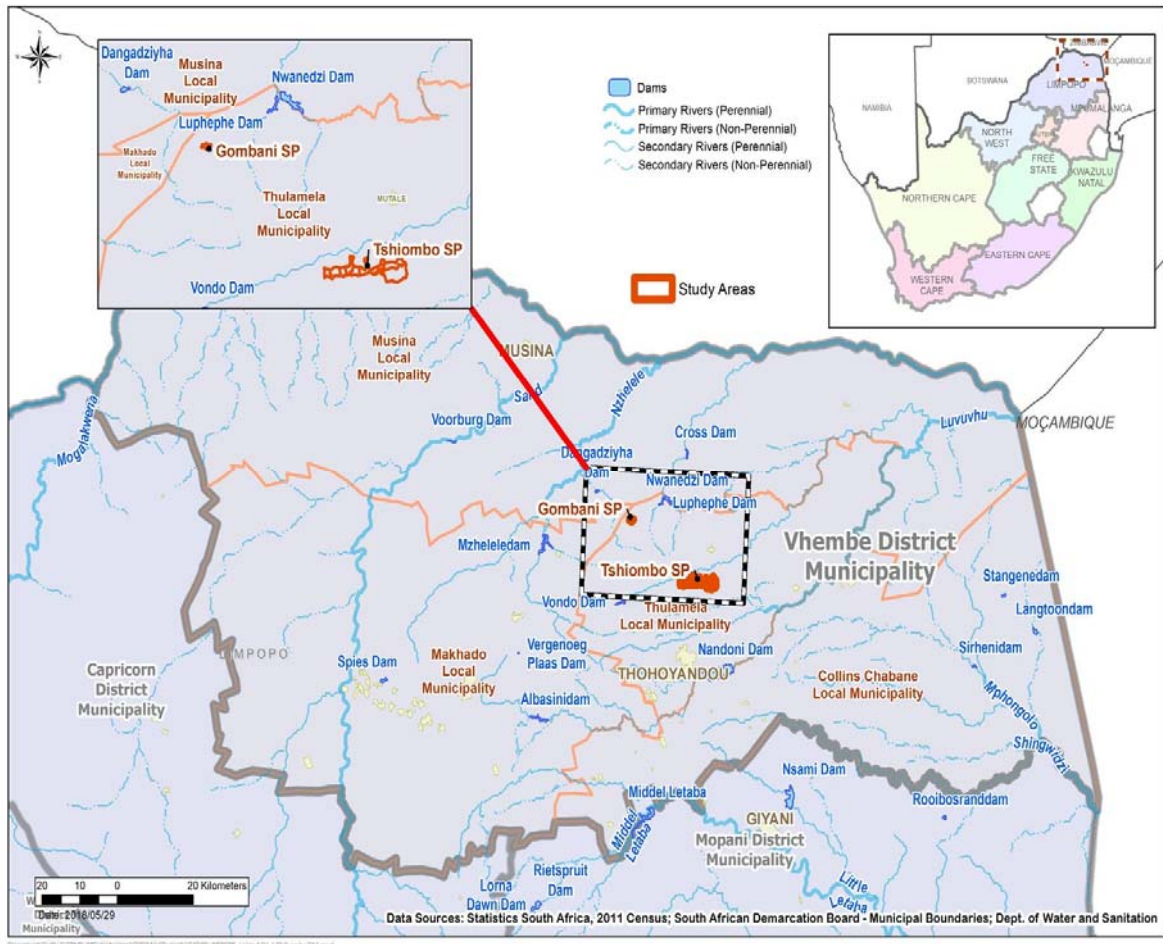


Map 3.3: The constitutional and tribal area boundaries with the marked sub-places used for research

Source: StatsSA (2011a).

Gombani and Tshiombo hinterlands were chosen because of their rural setting, as well as their proximity in relation to the bustling urban area of Thohoyandou in the south. The two areas have distinct characteristics. At Tshiombo, there are mainly schemes with irrigation that may be functional, or incapacitated, due to various issues. Gombani represents a rural area that is remote and removed from ready access to an urban centre, which would inevitably have a marked influence on infrastructural service delivery (e.g. water, sanitation, and electricity supply) as well as factors related to the WEF nexus. The fact that Tshiombo and Gombani have different characteristics ensured that information gathered was representative of perceptions of a large and diverse proportion of the rural women in the Vhembe district of Limpopo Province. The two contrasting settings of Tshiombo and Gombani (irrigation schemes viz-à-viz a traditional rural setting) are representative of some of the main features of the rural Vhembe district. Both areas have limited water resources. The Gombani area does not have a dam or a reliable perennial

river. Villagers rely solely on boreholes and seasonal rainfall for water. In Tshiombo, though they have water for irrigation from the Vhondo dam and Mutale River, some villages are far from both surface water resources. This state of affairs places a strain on water availability for both domestic and livelihood needs. The location of these areas limits mobility to markets and affect food and energy availability and access. Map 3.4 shows the water resources available in these areas.



Map 3.4: Vhembe District, Gombani and Tshiombo case study areas and the available water resources

Source: StatsSA (2011a)

The map shows the case study areas of Gombani and Tshiombo and water resources available for household needs. The map has a zoomed insert, which closely shows the chosen areas for this study. Even though both areas are in the rural areas in Tshiombo, they have a perennial river, the Mutale River. It is used for both domestic and irrigation purposes. In the case of Gombani, there is no perennial river close to the settlement and only secondary non-perennial sources are found in some villages. Many communities' streams only flow during the rainy season and hardly provide water for household uses.

3.6.2.3 Climate

A large part of Limpopo Province has a sub-tropical climate, which is ideal for agriculture. However, due to recent drought conditions (2015-17) and potentially climate change, many areas have become vulnerable, receiving low rainfall in the district and at times highly erratic rainstorms that cause floods (Ofoegbu *et al.*, 2016; Vhembe District Municipality, 2016; Ziervogel *et al.*, 2006a). The district is prone to droughts as it experiences high temperatures. Rainy days have become fewer and dry spells have increased, thereby affecting agriculture (Thomas *et al.*, 2007:304). Frequent droughts have occurred since 1980 (Thomas *et al.*, 2007:304).

Prevailing local conditions, ascribed to climate change, have had a profound impact on water security for domestic livelihoods. The rise in temperatures increase evaporation and coincide with shifts in rainfall patterns that disturb the farming seasons, leaving the population with many uncertainties with regard to food security, water security, as well as energy security. The district is highly reliant on agriculture and grows a wide and varied range of crops (Hoffman & Nkadimeng, 2016; Oni *et al.*, 2011; Thomas *et al.*, 2007). Being largely rural, land in the Vhembe district is primarily under the control of traditional tribal authorities. Each household owns a piece of land for settlement and agriculture. However, most of the people are not strictly agrarian in orientation (Vhembe District Municipality, 2011a:38). The local land tenure system is not conducive to commercial development, leaving most of the area underdeveloped and unproductive.

3.6.2.4 Livelihood systems and sources of income in rural Vhembe District

Agriculture is the main source of income and the main livelihood option for the district. Small-scale seasonal farming is common in all households. They grow maize and peanuts as primary crops (Mpandeli & Maponya, 2013:12; Oni *et al.*, 2010:2290; Raidimi, 2014:10). The province thrives on agriculture. Various crops such as tomatoes, maize, nuts, and fruits are grown on a commercial scale (Machethe *et al.*, 2004:7; Mpandeli, 2014:14). Due to the high population in the Limpopo Province, there is a need for more land suitable for agriculture. Currently most land is under tribal authorities (McCusker, 2004:49). The rapid population increase since the start of the new millennium asserts a lot of pressure on resources, especially water. Poor water resources in the district restricts the potential of irrigation farming. An estimated 72% of the surface area of the district is arable. Most areas are used for dry land farming and approximately 20% is for irrigation purposes (Vhembe District Municipality, 2011a:37). Livestock production, primarily poultry, goats, and cattle, is generally on a small scale in the rural areas of Vhembe (De Cock *et al.*, 2013; Kristjanson *et al.*, 2014; Nawrotzki *et al.*, 2014). The people extensively rely on social protection packages and grants from the government (Altman *et al.*, 2009; Makiwane, 2010). The government has been active in supporting the rural people in Vhembe through livelihood support interventions,

such as projects that create funding to subsidise farming inputs for small scale farmers. The policies put in place to promote rural areas such as the integrated development planning and the local economic development plans have promoted economic activities such as agriculture, mining and crafts making.

3.7 Research sampling method

Sampling in qualitative research considers the characteristics of respondents and the context of the study (May, 2001:92). Sampled cases chosen for qualitative research are few and studied in depth to get more information and deeper insight (Marshall, 1996:523). Sampling in qualitative research is guided by data collection methods chosen for the study (Byrne, 2001:494). The study used purposeful sampling to allow for selective respondents based on their relevance to the research area (Byrne, 2001; Marshall, 1996; Suri, 2011). Ritchie *et al.* (2013:96) point out that purposive sampling target a particular group of people with knowledge of the issues to be investigated. In this study, participants for the study were selected purposively based on the context in which there were engagements with respondents in the area under investigation. Purposive sampling was used to select respondents. This type of sampling allows the researcher to choose subjects with specific experiences (Suri, 2011:70). Some subjects chosen were allowed to recommend more potential candidates for the study (Marshall, 1996:523).

In Chivi district, 30 women were purposively chosen including women that were involved in irrigation farming. Five women were chosen for individual interviews in ward 13 and five were chosen from wards 11 and 30. Three groups were gathered for discussion and the ten women chosen for one-on-one interviews were selected purposively from these groups. Two focus group discussions were conducted with a total number of ten men, purposively chosen for their perspectives on and involvement with the WEF nexus in their communities. They were residents of the communities selected for the purposes of the research project. Men were important to validate the information gathered from the women. To obtain the officials in the WEF nexus' perspectives, ten officials were chosen purposively. In some cases, the researcher worked on referrals for other officials. These respondents were chosen from various governmental departments and NGOs that worked on the WEF nexus or those that intended to make the WEF nexus secure selection of respondents was done with the assistance of gatekeepers and ward focal persons from various departments.

In Vhembe district, the study purposively sampled 30 rural women, ten rural men, as well as, ten officials working in the local WEF nexus sectors and traditional leaders. Rural women and men were from various village communities around the nodes of Tshiombo and Gombani. The representative population of respondents sampled was 13 women and five men living in

Tshiombo; and 17 women and five men living at Gombani. The official gatekeepers, who offered to render service in the preliminary phase of the research project, as well as local residents in the research fieldwork areas, introduced and helped the researcher to meet and engage with local residents. Respondents were selected based on their knowledge that would confirm or be at variance with the insights shared by the other (female) participants. It was important to get the views of men and their perceptions of aspects on the WEF nexus and some of the roles and responsibilities of women in the domestic and community setting.

3.8 Demographic data of respondents

Demographics are the characteristics of the population chosen for a study. Demographic information of participants shows if the respondents chosen are a representative sample of the target population. Demographic information helps to enable the generalisation of results when the target population is appropriate and there is a wide range of information that can be collected including race, marital status, education, profession, age, and gender.

The respondents of this study represented rural women, men and officials. Rural women are the prime focus of this study; therefore, demographical information taken and presented herein is primarily for women. Women participated in both interviews and focus group discussions. This study is about the perceptions or views of rural women on the WEF nexus security and the coping strategies they employ when challenges arise. This enabled the researcher to get more views on the topic. Women participants chosen for this study were economically active and played a prominent role in the acquisition and management of water, food, and energy within their respective households. These women fully shoulder the responsibility for the acquisition of food and the management of available resources for their households.

3.8.1 Chivi District, Masvingo Province, Zimbabwe

The respondents of the study consisted of three groups. The main subjects, which are the focus of the study, comprised 30 women permanently residing in the rural areas. The remaining two groups comprised of stakeholders and men. The participants participated in interviews and focus group discussions. All participants were within the 18-70-year old group. The women respondents were from different households, which means that each woman represented a different household. The majority of participants are economically active and permanently reside in the rural areas.

3.8.1.1 Age

The majority of women chosen for this study were economically active. There are 20% of women in the 20-35 years range, 20% were in the 36-45 years range, 30% of women were in the 46-55 years range, and the remaining 30% were 56 years and above (Table 3.3).

Table 3.3: Distribution of rural women respondents in Chivi district by age

WARD	AGE RANGE = YEARS								TOTALS	
	20-35		36-45		46-55		56+		No	%
	No	%	No	%	No	%	No	%		
11	0	0	4	13.3	4	13.3	2	6.7	10	33.3
13	1	3.3	1	3.3	6	20	2	6.7	10	33.3
30	5	16.7	3	10	2	6.7	0	0	10	33.3
Totals	6	20	8	26.7	12	40	4	13.3	30	100

Source: HJPA/CD/FGDs Field Notes Chivi (2017)

Table 3.3 shows the distribution of women across the three wards with an equal number of women in each ward. However, in wards 11 and 13, the dominating age group is 36 years and upwards with 13.3% of respondents being between the ages of 55 and above. Most women were in the 46-55-age range and this is mainly because most energetic young women have relocated to neighbouring South Africa to seek jobs so that they can send money back home.

In ward 30, the dominant age group was the economically active younger people (26%) between the ages of 20-45 years. The reason is that this ward is closer to the main road and the Chivi growth point, which may be conducive to the execution and choice of livelihood options.

3.8.1.2 Marital status

Respondents gave information on their marital status. Of the 30 respondents, 60% were married, 20% widowed and 20% divorced/separated. The data shows that the widowed women were within the age groups 46 and above, whilst there is a number of older women who separated from their husbands. The younger women in the 18-45-year age group were mostly married (Table 3.4).

Table 3.4: Marital status of respondents by age groups

Age Group	Marital Status							
	Married		Widowed		Separated		Total	
	No	%	No	%	No	%	No	%
20-35	6	20	0	0	0	0	6	20
36-45	4	13.3	2	6.7	2	6.7	8	26.7
46-55	7	23.3	3	10	2	6.7	12	40
56+	1	3.3	1	3.3	2	6.7	4	13.3
Totals	18	60	6	20	6	20	30	100

Source: HJPA/CD/FGDs Field Notes Chivi (2017)

3.8.1.3 Education

The majority of women had some basic formal school education. However, few managed to get to the Ordinary level (Form four). It is imperative to note that the researcher used categories to explore education levels; these included those who never had any formal education, those who attended the primary level and those who attended the secondary level, also known as the Zimbabwe Junior Certificate (ZJC) and Ordinary levels. The ZJC group comprises women who attended form one and two, and Ordinary levels those who did form three and four regardless of them getting a certificate or not. Table 3.5 shows the distribution of respondents by age group and level of education.

Table 3.5: The distribution of respondents by age group and level of education

Age Group	Formal Education Level											
	None		Primary		Secondary Junior Level		Secondary Senior Level		Tertiary		Totals	
	No	%	No	%	No	%	No	%	No	%	No	%
20-35	0	0	1	3.3	0	0	5	16.7	0	0	6	20
36-45	2	6.7	2	6.7	2	6.7	2	6.7	0	0	8	26.7
46-55	2	6.7	6	20	2	6.7	2	6.7	0	0	12	40
56+	1	3.3	3	10	0	0	0	0	0	0	4	13.3
Totals	5	16.7	12	40	4	13.3	0	30	0	0	30	100

Source: HJPA/CD/FGDs Field Notes Chivi (2017)

The data shows that 40% of respondents attended primary school, 43% managed to get to secondary school, while 13.3% went up to ZJC and 30% managed to get to Ordinary level. Approximately 16% of the population did not get any formal education. None of the respondents interviewed had any tertiary education and none had professional qualifications. Respondents

cited that their varying educational standards were caused by various factors. One respondent cited that:

During the time of the liberation struggle, it was difficult for young girls to go to school because most of us we became assistants to the freedom fighters (Chimbwidos), we had to see to the welfare of the comrades (HJPA/CD/W3 04022017 Interview, 2017).

Another respondent said that:

Our parents did not have enough money to send girls to school; only a few households can afford to send all their children to school (HJPA/CD/W7 12022017 Interview, 2017).

In another interview, one woman said:

Women were mainly nurtured for marriage and fathers always thought it was a waste of resources to send girls to school (HJPA/CD/W5 04022017 Interview, 2017).

However, after the attainment of independence, the Zimbabwean government declared education a basic human right and made primary education free in order to achieve universal education for all (Ansell, 2002:92). The major challenges to achieving these goals were the economic meltdown in Zimbabwe, which led to the inability of most people to afford the costs of education. Several studies have found that the level of education and marital statuses of people relate to WEF nexus insecurity (Beverly *et al.*, 2003; Desalu *et al.*, 2012; Hanjra *et al.*, 2009; Rahut *et al.*, 2015). Though the country has the highest literacy rate in Africa this study found that people in the rural areas still struggle to gain access to educational opportunities (Ansell, 2002; Gudhlanga *et al.*, 2012; Kanyongo, 2005; Shabaya & Konadu-Agyemang, 2010).

3.8.1.4 Household composition

The study collected data on the composition of households by gender of the household heads and the size of the household as presented in Table 3.6. The data shows that though Zimbabwe has patriarchal societies, most households in Chivi rural are female-headed. The study revealed that in most households, the males have migrated to South Africa to seek employment in order to send money back home. Some males have gone to urban areas to seek employment and left women temporarily in charge of households. The data shows that 43.3% of households sampled were male-headed whilst 56.7% were female-headed (Table 3.6).

Table 3.6: Distribution of household heads according to gender

Characteristic	Number of households	Percentage rate (%)
Sex of household head		
Male	13	43.3
Female	17	56.7
Totals	30	100

Source: HJPA/CD/FGDs Field Notes Chivi (2017)

The study found that children make up the majority of the household population. In the study, one respondent with a household composed of 10 people explained:

I am staying with my grandchildren, all my children and their wives are staying in South Africa and they asked me to look after their children while they work and send money for various needs (HJPA/CD/W4 04022017 Interview, 2017).

Most respondents explained how all the able-bodied youths left the rural area in search of employment. The most popular destination is South Africa. They left children of all ages behind with either grandmothers or wives to take care of their homes and families. Male-headed households consisted of elderly people for whom travelling would be a huge burden, or young newly married couples. The impact of household size is mainly on the distribution of resources in the home. Table 3.7 shows the household sizes of the respondents (HJPA/CD/FGDs Field Notes Chivi, 2017).

Table 3.7: Distribution of rural households' population composition

Number of people	Number of households	Total percentage %
0-3	0	0
4-6	17	56.7
7-9	10	33.3
10+	3	10
Totals	30	100

Source: HJPA/CD/FGDs Field Notes Chivi (2017)

The study found that 56.7% of households had between four to six members, whilst 33.3% had seven to nine members. Only 10 % of households sampled had a household size of 10 or more people. The size of the households in the WEF nexus context have an impact on the distribution and management of resources. Households with more people can lead to increased requirements of resources but may mean stable human capital for labour in various chores, such as fetching water or firewood. The effects of household size are always subjective and vary from household to household. According to Matshe (2004:183), a household with more people increases its capacity to vary income generating activities and increase the household income if there are more adults.

3.8.2 Vhembe district, Limpopo Province, South Africa.

The women were from various villages but met with the researcher at central points in Tshiombo and Gombani. Thus, these focal points were used in categorising the respondents.

3.8.2.1 Age

The age of the respondents is important to understand views on particular problems. The ages of persons influence the level of maturity and responses they make to rural life problems, challenges, and opportunities.

Table 3.8: Distribution of women participants according to age group

WARD	AGE RANGE = YEARS								TOTALS	
	20-35		36-45		46-55		56 Plus		No	%
	No	%	No	%	No	%	No	%		
Tshiombo	1	3.3	6	20	5	16.7	1	3.3	13	43.3
Gombani	4	13.3	3	10	3	10	7	23.3	17	56.7
Total	5	16.7	9	30	8	26.7	8	26.7	30	100

Source: HJPA/VD/FNFGDs Vhembe (2017)

The majority of women who participated in this study are economically active women. All age groups represented enabled the researcher to get varied views and perceptions of rural women. 16.7 % are in the 20-35-year age group. These young women are still strong and able-bodied enough to perform even difficult tasks. Furthermore, 30% were between the ages of 36 and 45. Most women in this age range were from Tshiombo. The majority had access to irrigable land and actively participated in farming. The age range 46-55 made up 26.7% of the population. These women were mainly around Tshiombo, and this can be because of irrigation schemes in the area. About 26.7% made up the age group of 56 years and above, and most women in this group were in villages around the Gombani area. The reason why older women are found mostly in areas like Gombani was that most of these women consider their rural homes a place to rest and retire to (HJPA/VD/FGD2 Women 23052017, 2017). The remoteness of the Gombani area have contributed by providing these women a place of quietness and serenity without the fast pace of urban areas (HJPA/VD/FGD1 Women 18052017, 2017).

3.8.2.2 Marital status

Information on the marital status of women respondents was collected. This information was necessary for understanding some of the actions and decisions taken by women within the WEF nexus context. Table 3.9 shows the marital status of respondents by age group.

Table 3.9: Marital status of respondents by age group

AGE GROUP	MARITAL STATUS							
	Married		Widowed		Separated		Total	
	No	%	No	%	No	%	No	%
20-35	1	3.3	-	-	4	13.3	5	16.7
36-45	7	23.3	-	-	2	6.7	9	30
46-55	6	20	1	3.3	1	3.3	8	26.7
56+	3	10	3	10	2	6.7	8	26.7
Total	17	56.7	4	13.3	9	30	30	100

Source: HJPA/VD/FNFGDs Vhembe (2017)

Data collected showed that 56.7%, which is the majority of women, were married; 13.3% were widowed and 30% were unmarried. The category in the age group 56 and above consisted of widows. The majority of married women were in the 36-45-age range. One’s marital status has a bearing especially on decision-making, access to resources, social structure, responsibility and platforms for actions. The marriage institution means different things in different cultures and social circles. For some, it empowers women in terms of access to resources, sharing burdens and having a voice in the community. For others, marriage confines women to being dependent on men as decision-makers; they are restricted from performing some activities, or joining some groups because of the values of marriage institutions (HJPA/VD/FNFGDs Vhembe, 2017). In this study, marital status is key to understanding responsibilities, views, and perceptions of rural women.

3.8.2.3 Education

Data was collected to find out the levels of education of these women. Education is important as it makes people look at things differently, change their attitudes and perceptions, views and even change decision-making processes (Martineau, 1997:383). Education improves people’s understanding of the grain of certain phenomena and changing worldviews. Education influences the decisions individuals take when dealing with WEF nexus security challenges. This made the researcher investigate the levels of education of respondents. Table 3.1 shows the distribution of respondents according to their age group and educational level.

Table 3.10: Level of education of respondents by age

AGE GROUP	FORMAL EDUCATION LEVEL									
	None		General Education Training Grade 0-9		Further Education Training Grade 10-12		Higher Education Tertiary		Total	
	No	%	No	%	No	%	No	%	No	%
20-35	-	-	1	3.3	4	13.3	-	-	5	16.7
36-45	-	-	2	6.7	7	23.3	-	-	9	30
46-55	-	-	6	20	2	6.7	-	-	8	26.7
56+	2	6.7	4	13.3	2	6.7	-	-	8	26.7
Total	2	6.7	13	43.3	15	50	-	-	30	100

Source: HJPA/VD/FNFGDs Vhembe (2017)

Data collected showed that 50% of the respondents managed to get Further Education Training (FET), or Grade 10-12. It was found that of the 15 women who had FET, four reached Grade 10; six of them got up to Grade 11 and five completed Grade 12. The reasons for not completing the whole FET were asked and respondents said that these women were affected by distance to school, early pregnancies, lack of adequate resources, and motivation (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). The reasons given revealed that due to poor living standards in the rural areas, most young girls are misled into thinking that the child grant from the government means easy money (HJPA/VD/W10 04062017 Interview, 2017). This traps most people in an infinite cycle of poverty. Lack of knowledge puts them in a situation where they choose coping strategies that create and expose them to increased WEF nexus security challenges. This makes societies less resilient and even exposes them to more challenges as explained by the infinite cycle of panarchy.

The study found that 43.3% of the chosen women respondents had access to General Education Training (GET), known as primary education. The women in this educational category had completed Grade 6-8 (HJPA/VD/FNFGDs Vhembe, 2017). This shows there is a higher rate of those with primary education than secondary education among these respondents. No women with tertiary education participated in the study. The researcher explored why there were no women with higher education training and the responses given showed that those that managed to complete Grade 12 or higher preferred to migrate to urban areas in search of jobs and become permanent residents of urban centres (HJPA/VD/W2 25052017 Interview, 2017; HJPA/VD/W6 03062017 Interview, 2017). The ones with Grade 12 certificates among the respondents said they

were still living in the area because they could get a job close to home and preferred working from home (HJPA/VD/W3 25052017 Interview, 2017). Others are still living in the area because of marital obligations that prevent them from leaving their families in search of jobs. Some of them managed to have access to irrigation land and took up farming as a full-time business or occupation (HJPA/VD/FGD1 Women 18052017, 2017).

Only two respondents had no formal education at all. Both women were in their 70s and explained that in their prime years, education was not so important. Thus, they never attended school (HJPA/VD/FGD2 Women 23052017, 2017). They said they learned to count and make simple sums so that they could transact. They said they learned basic letter reading but they could not read the details. These respondents can be considered as the typical residual effect of the former system of apartheid that prevailed in South Africa between 1948 and 1994. Subsequently, the government has taken positive measures to introduce policies to provide education grants for all children in schools. Children from poor backgrounds, as well as orphans and vulnerable children, were exempted from paying school fees (Arendse, 2011:97). These initiatives, however, benefited recent generations, but older generations have remained disadvantaged and many dropped out of school.

The education level of respondents showed that most women were literate and received basic education training. The results show that rural people are restricted in terms of access to education, especially secondary education that enables them to get professional training.

3.8.2.4 Household composition

This study sought information on the make-up of rural households in terms of size and leadership. In most cases, South African rural societies are predominantly patriarchal which gives men power, control and domination in roles of leadership, social privilege and control over resources (Bentley, 2004:258). This seemed to have changed in practice, as households can also be female-headed. The study revealed that though patriarchy is still common, it is normal to find most households headed by women, especially in the rural areas. Reasons for women becoming household heads ranged from the women being widowed, divorced, separated and in some cases, the male head would be away from home (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). Migration is common, with most men going to work in urban areas and sending money back home to build their homes. The Venda people, it emerged from this study, value their rural home base. They go to great pains to make concerted efforts to build houses at home in preparation for their retirement.

Though most of the women revealed that they were married, some women explained that their husbands did not stay at home, but visited regularly. This situation leaves the women in complete charge of households and decision-making (HJPA/VD/W4 26052017 Interview, 2017). The highest number recorded in this study for a household size is 11 people, where one woman explained that she was staying with her daughters who had their children. The lowest number recorded is one person, an elderly woman of 75 years who lives alone (Table 3.11).

Table 3.11: Distribution of households according to the number of household members

CHARACTERISTIC	NO OF HOUSEHOLDS (HHS)	PERCENTAGE RATE (%)
0-3	4	13.3
4-6	19	63.3
7-9	6	20
10+	1	3.3
Total	30	100

Source: HJPA/VD/FNFGDs Vhembe (2017).

Table 3.11 shows the participants’ household composition. The total households represented were 30, of which: four households had a maximum of three people; 19 households had a maximum range of six people with the largest number of households falling in this category; six households had approximately seven to nine people; while only one household recorded having 11 members (HJPA/VD/FNFGDs Vhembe, 2017). The number of household members with the capacity to work would increase the human capital of a household, which is very important when it comes to performing work. However, larger households faced increasing challenges for WEF security in times of disasters or shortages that commonly occur in times of droughts and floods. Therefore, even though having human capital help in fostering resilience, it may be a cause for concern. It implies an increased burden on the household unit. Household size has a bearing on resource sharing and utilisation. Households with more people need more resources and this might lead to insecurity or scarcity of resources depending on the age of the people. A household with more people who are adults means they have more human capital to work for adequate resources. Conversely, more children mean a larger burden to the household head who must acquire enough resources for all. This does not mean that households with fewer people are WEF secure. The issue of security is determined by whether these people have access to resources. Table 3.12 shows the composition of households in this study.

One woman explained that most young men, once they complete their education, move to towns in search of jobs (HJPA/VD/W4 26052017 Interview, 2017). In villages around Tshiombo, they reported that migration was not common because most households had access to irrigation where most people worked to earn a living. Table 3.12 shows the distribution of households by gender of household head.

Table 3.12: Distribution of household head by gender

GENDER OF HH/HEAD	NO OF HOUSEHOLDS (HHS)	PERCENTAGE RATE (%)
Male	12	40
Female	18	60
Total	30	100

Source: (HJPA/VD/FNFGDs Vhembe, 2017)

Table 3.12 shows that 60% of the households surveyed are female-headed. The reasons included divorce, the death of male heads, and migration of males to urban centers in search of jobs. The remaining 40% of the households were male-headed, and the majority of these male-headed households were in Tshiombo (HJPA/VD/FNFGDs Vhembe, 2017). The focus group discussions with men ascertained that male heads in this area were active in irrigation, which was a source of income for them. Therefore, for those with access to irrigation, there was less need to migrate (HJPA/VD/FGD1 Men 19052017, 2017).

Data collected showed that 60% of households represented were female-headed and 40% male-headed. When asked if there was a difference in access to resources between male-headed and female-headed households, the respondents explained that economically there was no difference as they could all have access to most resources in the same way. However, having a male head gave a woman a favourable social standing in the area and being married provided the woman with other social benefits, such as respect (HJPA/VD/FNFGDs Vhembe, 2017).

3.8.3 A comparative synthesised description of the study population

This study constituted 100 participants with 50 participants in each case-study area. The women constituted the larger number of respondents (60) and women were the focus of the study as they are the managers of WEF nexus resources in the household. The remaining participants were 20 men (ten from each case study area), and 20 officials (including men and women, ten from each case study area). Though men and officials were included, the main representatives of the study were women; therefore, demographic information collected was from women only. Women were the focus of the study in order to demarcate the group of people to be studied and help as a boundary for the study. The women chosen for this study varied in their socio-biographical background. The socio-biographical background sometimes helps in ascertaining why particular groups of people make certain decisions. Age, marital status, gender roles and levels of education can influence these decisions. Providing the backdrop of the respondent's data helps to enlighten some of the choices they make in coping with challenges and may aid in the understanding of factors that influence decisions.

3.8.3.1 Age

The study also looked at the ages of respondents. The age of a respondent have an influence on the decisions they make in the management of WEF nexus resources.

Table 3.13: Distribution of women by age

Age group	Chivi district	Vhembe district	Total number
20-35	6	5	11
36-45	8	9	17
46-55	12	8	20
56+	4	8	12
Total	30	30	60

Source: (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017)

The study revealed that women in this study are economically active. In Chivi district, 26 of the respondents fell within the 20-55-years age groups that are economically active, similarly, in Vhembe 22 respondents were within the 20-55-years age groups. However, in Vhembe there were eight women aged 56+, compared to four in Chivi. Women in Vhembe reported that rural areas are a place of retirement and they manage to live alone because the government provides them with pensioner grants that help to sustain them while living in their homes. In contrast, the older people in Chivi do not have any source of income (i.e. grants) therefore; they rely on other family members to care for them.

3.8.3.2 Marital status

The preceding sections gave a detailed explanation of the marital status by age groups. This section compares the data found in both case studies.

Table 3.14: Marital status of respondents in the two case studies

Marital status	Chivi district	Vhembe district	Total
Married	18	17	35
Widowed	6	4	10
Separated	6	9	15
Total	30	30	60

Source: HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe (2017)

Data revealed that in both cases the number of married women is larger than those widowed or separated. In Chivi district, the number of women widowed is more than that of Vhembe whilst in Vhembe the number of women separated is more than that of Chivi district. The marital status of women determines the major household decision makers in the rural areas under study. The

women in both countries showed that they function in patriarchal societies where men are the major decision makers for vital issues such as household finance distribution and livelihood options (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). The participation in decision-making help in the WEF nexus security and resilience building for households as it allows women to make wise trade-off decisions for WEF security.

3.8.3.3 Education

The study revealed that the majority of the respondents had a basic education on primary and some on the secondary level in both case studies (Table 3.15).

Table 3.15: Distribution of respondents by education levels

Level	Chivi district	Vhembe district	Total number
Primary	12	13	25
Secondary	13	15	28
Tertiary	-	-	-
None	5	2	7
Total	30	30	60

Source: HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe (2017)

In both study areas, no women had any tertiary education and only seven had no formal education at all. Education is important in the management and security of the WEF resources. Basic education may lead to changes in the way women perceive the WEF nexus and how they cope with the challenges that they face. The education level of a person changes the manner in which they interact with and view the WEF security challenges and the manner in which they cope (Martineau, 1997:380).

3.8.3.4 Household head and composition

The results revealed that in both case studies there were more female-headed households (Table 3.16).

Table 3.16: Gender of household heads in Chivi and Vhembe case studies

Gender of HH	Chivi district	Vhembe district	Total
Male	13	12	25
Female	17	18	35
Total	30	30	60

Source: HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe (2017)

The respondents in both Chivi and Vhembe district reported various factors that made women household heads in these patriarchal societies. These included the death of a partner, divorce, migration of husband to urban areas in search of employment, which left most women in charge of households. However, even though there might be similarities in the increase of women being household heads the major difference is in the access to resources for female-headed households in a rural community. The women in Vhembe reported that they had equal opportunities with males in access to land and women can have their own land allocated to them, which differs from the Zimbabwean case where women only have individual access to land through marriage (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). Even the women who had separated from their husbands or have never been married may not individually own land; male heads in the household give access rights to use the land (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). This does not present equal opportunities and access to resources for the female-headed households and weakens their resilience capacity.

3.9 Data collection

The trademark of qualitative case study research is its flexibility in allowing the researcher to use multiple data collection tools, which increases data credibility (Creswell, 2009). This study used multiple tools for data collection. These include interviews, focus group discussions and personal observations.

3.9.1 Focus group discussions

Focus group discussions (FGD) were used to collect data in this study. An FGD is a discussion that is used to secure data on perceptions of participants on a specific phenomenon. FGDs should be held in an enabling environment conducive to open discussion and non-threatening engagement (Ritchie *et al.*, 2013:178). Focus group discussions generate varied views and responses from participants in a shorter space of time than in-depth interviews (Bricki & Green, 2007:11; De Vos, 2002:32). Human deliberations in this format allow participants to share, argue, confirm, compare and agree on certain perceptions (Leedy & Omrod, 2014:78). Focus group discussions (FGDs) are a convenient and appropriate way of data collection from several participants (May, 2001:125). Each participant in the group in this study was given time to express themselves, share their experiences and confirm issues as suggested by May (2001:125).

An FGD generic guide (see annexure E) compiled by the researcher provided a framework for the FGDs in both case studies. Questions were drafted following the broad themes of water, energy and food security, looking at availability; accessibility and utilisation under investigation in the study (see annexure E). The FGDs were used to collect data on the perceptions of people of the WEF nexus security and their coping strategies in the face of threats and opportunities. The

FGD tool was flexible and allowed for probing questions to get more information and fully understand the phenomenon under study (Ritchie *et al.*, 2013:174). The tool focussed on WEF security issues such as availability, accessibility, and utilisation. Attention was given to coping and adaptation strategies used by households to deal with various challenges. Respondents' information on each other's views and answers from the FGDs enabled the researcher to have a group setting feedback process. The FGDs provided a better understanding of the WEF nexus and the coping strategies employed. The researcher was able to secure more deeply significant information from these groups, largely because of the fact that respondents were open and more accessible in forums.

Three FGDs were held with women in Chivi district. Each group had ten members, and in-depth interviews were conducted with ten women on a 1:1 basis. Two FGDs were held with men. Each group consisted of five people. Female groups had respondents from wards 11, 13 and 30. FGDs with males were held in wards 11 and 13. The FGDs in both wards were done at the ward centre. It is the local central hub and accessible for all local residents, as well as the researcher.

The study conducted two FGDs with a total number of 30 women in the Vhembe district area. The FGDs were held at two distinct areas of Tshiombo and Gombani, with participants coming from various villages in these tribal areas. The major group consisted of women from different villages in which the first group had 13 women and the second group had 17 women. Two FGDs were conducted with men consisting of participants residing in different villages in Tshiombo and Gombani areas.

In the case of the South African research work programme, FGDs were conducted with officials in some basic service delivery departments in Vhembe district. The study made use of FGDs with the officials in water service delivery, agricultural and rural development departments. FGDs were used instead of individual in-depth interviews because the system has been decentralised and there are different managers for service delivery systems. The group with the water department had seven participants that are experts in different fields; the group included some tribal leaders. The group in the agricultural department had five participants who had experience and expertise in the agricultural and rural development affairs. Local officials in the water sector are under sub-divided sectors of governance responsible for water supply. In order to get all the relevant information from the relevant office, it was imperative that an FGD was conducted with all the water supply sectoral managers. The officials offered to do it as a group so that the responsible person would address all questions relevant to the authority of a particular office.

3.9.2 In-depth semi-structured interviews

In-depth interviews in this study were semi-structured and a framework of themes (interview guide in annexure E) was made to explore the WEF nexus security and coping strategies of women in Chivi and Vhembe districts. The interviews were informal and open-ended questions were used to allow new ideas to be brought up during the interview. In-depth interviews were used in this study. Boyce and Neale (2006:9), and Ritchie *et al.* (2013:155) assert that in-depth interviews are a qualitative research technique that enables researchers to interact with a small number of respondents and allows them to explore individual perspectives on a particular phenomenon. More importantly, these interviews contributed to gaining an understanding of in-depth perceptions and perspectives of individuals (Bricki & Green, 2007:14).

In-depth interviews require considerable time. The researcher would typically converse, over an extended period, with participants in order to try to understand their experiences. Specific methodological guidelines were followed, as outlined by Ritchie *et al.* (2013:138), and Taylor *et al.* (2015:59). Purposive sampling was used to choose participants with relevant knowledge of WEF nexus resource use and management within households. Interviews with officials aimed to secure their perspectives on potential interventions and coping mechanisms that can be used to reduce the impact of challenges being faced by rural women. Information data was collected in the form of digital audio recordings and notes taken by the researcher. The intervention served to clarify information provided during the FGDs

In Chivi district, ten women were purposefully chosen for in-depth interviews and all participated. These were used to validate data. Interviews with ten chosen officials from various departments and related institutions were held. There were no language barriers. The researcher spoke the same language as the respondents to achieve effective communication.

In Vhembe district, ten women were chosen for in-depth interviews. Individual in-depth interviews were held with officials from the tribal authorities and officials from Nature and Conservation Department, as well as the Department of Energy. There were no language barriers with officials; however, the researcher used translators when interviewing women.

3.9.3 Observations

According to May (2001:146), observations in qualitative research allows for follow-ups on factual claims made during discussions. The researcher used observational strategies to validate some claims and facts, such as looking out for the sources of resources and the functionality and serviceability of amenities, such as boreholes and taps. The researcher used field notes and photographs to validate the data collected during interviews and FGDs. Observation is ideal for

putting the researcher in the midst of the action and allows collection of data that the researcher wants in any form, like narratives, visuals, or numbers (May, 2001:153). As an observer, the researcher stayed in the confines of communities in the rural parts of Vhembe and participated in some of the daily activities during the period of research fieldwork. There were numerous opportunities for informal as well as formal in-depth interviewing. The main point of staying and observing was to be able to make follow-ups on claims raised during interviews and group discussions (May, 2001:154). The researcher sought the sources of WEF resources, verified claims of availability of resources, distances, breakdowns, and processes in service delivery. The researcher drafted a guiding tool for the observation that focussed on availability, accessibility, and utilisation of WEF nexus resources. Activities of people were observed to take note of livelihood activities as well as to see how they cope with insecurities.

Observational information was used in this study mainly for the verification of data collected from individual interviews and the FGDs. The researcher noted WEF nexus sources described by the women in their own words, and observed WEF nexus security-related activities in the areas chosen by taking notes whilst the respondents went about their chores. These included fetching water, collecting firewood, and doing gardening. In some cases, the researcher took pictures with the consent of the respondents.

3.10 Data analysis

Qualitative data analysis is an ongoing cycle found in the daily practice of research (Creswell, 2009:185). It is the central step in qualitative research and frames the results of the study (Flick, 2013:3). Data collected for qualitative research can be organised in thematic groups for analysis (Ritchie *et al.*, 2013:200). Data presentation was in line with the WEF nexus resilience framework. The researcher recognised broad themes as water, food and energy security for this study. The presentation was done in isolation for each of the WEF nexus resources for a better understanding and clarity. Attention was paid to availability, accessibility, utilization, and coping strategies. The researcher took into consideration the challenges people experienced that potentially pose a security threat to each component of the WEF nexus – water, energy, and food. The three central areas of focus enabled the researcher to present data in a narrative discourse, tables, illustrations, and maps.

A comparative analysis between the two case studies of this research was done to obtain similarities and differences (see Chapter 6). The exposition of the similarities and differences was done using the text-by-text format by giving detailed descriptions of the similarities and the differences to help in the understanding of WEF nexus security, challenges, and coping

strategies. Diagrams were used to capture the key elements of the cases and give a description of the similarities and the differences revealed.

3.11 Pilot studies

The researcher undertook pilot studies in Chivi district (in 2015) and Vhembe district (in 2016) for familiarisation with both research areas. The first pilot study was done in November 2015 in Masvingo Province and in May 2016 in Limpopo Province. Pilot studies were done to find all the vital information for successful data collection and to ensure that the areas chosen had the vital characteristics (rural setup, rural women) required for the purposes of the investigation. Specific localities were chosen according to their accessibility in relation to the rest of the district. The researcher paid visits to different areas and made contact with village chiefs to identify communities that could be used for the study. Potential participants had to be permanent residents in the rural areas. An area in South Africa was chosen in line with the Zimbabwean case. The pilot study was used to seek permission from community leaders, government officials and secure gatekeepers for the research. A number of research instruments were tested using random respondents to see if the instruments were ideal for data collection.

3.12 Trustworthiness in qualitative research methodology

Qualitative research is a naturalistic method of inquiry used to understand phenomena within their real settings (Algozzine & Hancock, 2006). It is highly descriptive and based on narratives, rather than statistics and quantification. In qualitative research, the researcher plays the role of the research instrument, becomes a part of the study, and therefore can be subject to bias. Therefore, the researcher should be able to promote credibility and trustworthiness. Trustworthiness is a process of justifying the authenticity, worth and importance of a particular study. According to Lincoln and Guba (1985:290), there are four ways in which to promote trustworthiness of qualitative research credibility, dependability, confirmability and transferability. These criteria were also addressed in this study to ensure trustworthiness

3.12.1 Credibility

Credibility focusses on the truth of the data or views of respondents about a certain phenomenon. It looks at the representation of these truths and views by the researcher (De Vos *et al.*, 2005:345). Credibility is therefore about verifying information or data gathered during the research. The researcher is therefore the key player in ascertaining credibility. The assumption was that, there is external truth and reality in individual experiences. Even though the study explored opinions and perceptions, the population for the study share have common traits they share in experiences, which comprise of truths. The WEF security challenges, availability and accessibility of resources,

and coping strategies reported are a reality of what these people face in their daily lives and is thus reflected in the data. In this research, a follow up on the given views and experiences was done to verify given information (De Vos *et al.*, 2005:345). The researcher visited the areas and locations that may have been mentioned. The use of different data collection tools also allowed the researcher to corroborate information gathered. The review of available literature and documents helped to promote the credibility of data. In addition, the researcher kept audit trails of data collection methods, time, study areas and the data collected.

3.12.2 Dependability

Dependability is the constancy that is maintained by the study and its data over similar conditions. Dependability is achieved when the results would be found if a similar study would be carried out within the same context. According to Lincoln and Guba (1985), dependability should also be ensured by taking note of the changing nature of the phenomena studied, which may make the attainment of dependability problematic. To ensure dependability the researcher used multiple methods for data collection. The research process was also discussed in detail in the study, and the researcher took note of the changes that were encountered during the process. The researcher also gave details in discussions of the whole research process and what transpired during fieldwork.

3.12.3 Confirmability

Confirmability refers to objectivity in qualitative research work, which depends on the reduction of the researcher's biases (De Vos *et al.*, 2005:346). The research report must be a true reflection of the participants' views and experiences and the preferences and characteristics of the researcher must not influence it (Mertens, 2010:259). Therefore, confirmability involves the use of various methods to overcome bias and increase data validity. In this study, the researcher gave a summary and held discussions at the end of each interview or focus group discussions to allow respondents to reflect on the given responses and ascertain that the answers recorded were symptomatic of their perceptions, views and experiences. Interviews with men and officials in this study were used to reflect on the responses given by women.

3.12.4 Transferability

Transferability is achieved when the results of the study can be applied to other areas (Mertens, 2010:296). The research should have a meaning to other people and readers who are not part of the study but can associate the results with their experiences or those of other areas (Mertens, 2010). To achieve this the researcher gave detailed information of the case study areas, and the characteristics of the main participants of the study. The information was given to inform the

reader of all the characteristics they can identify with. The researcher also provided detailed descriptions of contextual variables within the research scenery.

3.13 Ethical considerations

At all times the researcher observed the ethical guidelines outlined in the research project proposal, which had been approved by the relevant NWU research ethics committee. The researcher sought permission to conduct the study in the area from both the local political leadership and district administration officials. Respondents worked with the researcher willingly and were given assurance of confidentiality and anonymity. In Vhembe, permission to conduct research was granted by the Vhembe district municipality and the traditional leadership. In Chivi district, the researcher secured permission from Chivi rural district council, councillors, and traditional leaders to conduct research.

3.14 Conclusion

The chapter gave an exposition of the social, economic and ecological characteristics of the two case study areas as well as the methodology employed. The study made use of qualitative research design using the case studies to explore the WEF nexus security and coping strategies of rural women in Zimbabwe and South Africa. The chapter gave a description of the case study areas and the characteristics of respondents in each area before giving a synthesis of the similarities and the differences. Both study areas are situated in semi-arid regions, with poor water resources/prone to drought, low average annual rainfall making them vulnerable to WEF nexus insecurity. The chapter discussed the data collection tools used and the procedures for data collection. The research commenced by undertaking pilot studies in both areas before embarking on the main data collection survey. The first phase of the study was done in Zimbabwe, Chivi district and thereafter in South Africa, Vhembe district. The study had 100 participants in total, 60 women, 20 men and 20 officials comprising both men and women. Five focus group discussions were held with women in both case studies, two focus groups were held with officials in Vhembe district and four focus group discussions were held with men. The study conducted in-depth interviews on a one-on-one basis with women as well as officials in both case study areas. The study used direct observation to collect data; the researcher took notes and pictures to verify some of the information given during interviews and focus group discussions. Data collected was collated using themes looking at the availability, accessibility (stability of supply) and utilisation of WEF nexus resources. Interviews were transcribed verbatim and tables and images were used to present data collected. Data analysis was done by giving an exposition of the WEF nexus security situation in each case study. Ethics were adhered to and proper channels of getting

permission from different offices of authority were followed. The next chapter explored the current WEF nexus security situation in Chivi district, Masvingo Province, Zimbabwe.

CHAPTER FOUR

THE WEF NEXUS SECURITY STATUS OF RURAL HOUSEHOLDS IN CHIVI DISTRICT, MASVINGO PROVINCE, ZIMBABWE

4.1 Introduction

This chapter covers the findings of empirical research fieldwork in Chivi District, of Masvingo Province in Zimbabwe. In this chapter, the reader is provided with the empirical findings on the current water, energy and food security situation in Chivi District, Zimbabwe. In addition, there is an overview of WEF nexus security in the larger Masvingo Province, based on the available literature. The data collected is presented thematically and in individual categories for the nexus components of water, energy and food to clarify complex matters for the reader. The findings are listed thematically by looking at water security under the following categories: water availability, accessibility, utilisation; factors affecting water security challenges; and how rural women cope with water insecurity. The same criteria are used to present findings on energy and food security.

The focus of the study was to explore the perceptions of the people (officials, men and especially women) living in the rural areas on the WEF nexus' current security situation. The coping strategies that are used to adapt to challenges and the constantly changing environments were explored. In the final sections, the chapter deals with the factors that shape the outcomes of WEF nexus, before making a summative assessment that feeds into a comparative analysis of rural women in Chapter 6.

4.2 WEF nexus security background

This section explored the current situation of the current state of WEF nexus security in Chivi District. The background is given as a backdrop of the empirical findings of this research and was derived from relevant literature and discussions with officials on WEF nexus elements of each sector. The study gives an exposition of the current security state of each WEF nexus element in Chivi District from various sources before reporting and analysing the research findings.

4.2.1 Water security in Chivi District

Studies by Perrone *et al.* (2011) and Pickering *et al.* (2010) assert that a community without better water access is negatively affected in terms of health. Zimbabwe adopted the Millennium Development Goals (MDGs) proposed by the United Nations in 2000 which stress the importance of water security (UN General Assembly, 2000:1). In Zimbabwe, some efforts have been made to

improve access to water and sanitation by the government, non-governmental organisations (NGOs), and other community-based organisations (CBOs) (Makoni *et al.*, 2004:1292). These include increasing public-private partnerships, investment by large organisations, the creation of more community-based institutions that would enhance access to water and promoting water-based livelihoods. Katsi *et al.* (2007), Makoni *et al.* (2004), and Van Koppen *et al.* (2006) argue in favour of water security in rural areas by explaining that water is needed for multiple uses and for livelihoods in rural areas, which are highly dependent on the availability of water.

Water access entails improvement in the supply, sanitation and hygiene of societies (Tussupova *et al.*, 2016:1). In Zimbabwe, 67% of the rural population have access to water (ZIMSTAT, 2012:115). However, some poor rural people may have access to adequate water supply but remain insecure because they lack the proper means of exploiting them (Grey & Sadoff, 2007; Vorosmarty *et al.*, 2010). Access to water is influenced by the facilities available for extraction, treating, distribution, supplying and delivering water to consumers (Cook & Bakker, 2012). In Chivi District, several NGOs have contributed to improving the rural people's access to better water supply and sanitation. They have funded programmes that have introduced several low-cost technologies to increase water supply and have an impact on area development (UN, 2006; (UN-Water, 2006:244). Census data in Zimbabwe showed an analysis of household water accessibility in the district – the report stipulated that 7% of households had water sources on their premises, and that 18% fetched water sources off their premise. Furthermore, 18% fetched water from a distance of less than 500m while 70% had to secure supplies of water more than 500m from their places of residence (ZIMSTAT, 2012:117) (Table 4.1).

Table 4.1: Percentage distribution of households by main source of water for drinking and cooking and by distance (km) to the water source

Water Source	On Premises	Less than 500 m	500 m to 1 km	More than 1 km	Missing	Number of Households
Piped water inside house	100	0	0	0	0	653
Piped water outside house	82.8	12	3.9	1	0.4	1577
Tape Communal	11.2	33.9	40.5	13.2	1.1	439
Well borehole, protected	2	17.8	43.2	35.9	1.1	19 671
Well unprotected	1.7	25.3	39.7	32	1.4	4440
River, stream, dam	0.2	18	40.1	39.8	1.9	7276
Other sources	1.9	14.8	22.2	57.4	3.7	54
Missing	0.5	2.3	4.3	2.8	90.1	1802
Total	7	17.6	37.6	32.1	0	35 912

Source: ZIMSTAT (2012:117)

The analysis by ZIMSTAT (2012:117) shows that a large number of households in the district have access to safe drinking water sources, but residents had to travel distances of more than 1 km to fetch water. This would pose a challenge for households, as it requires more energy and time spent fetching water. Some households did not even have access to protected water sources, which made them vulnerable to diseases.

Water is important to support livelihoods options (Van Koppen *et al.*, 2006:2). Since the late 20th century, there has been a growing corpus of knowledge on climate change in all parts of the world. Climate change has globally been responsible for highly varied drought conditions, heatwaves, floods and cyclones. Increasingly intermittent climatic events have had a marked impact on livelihoods and the general wellbeing of people (Bogardi *et al.*, 2012:39; Drimie & Ruysenaar, 2010:318; Nthenge, 2016:47; Oli *et al.*, 2007:1150; Pereira *et al.*, 2009:35; Tussupova *et al.*, 2016:7).

Chivi District's main livelihood option is communal farming. Farming has been affected by the challenges brought about by erratic conditions associated with climate change (Mudzonga, 2012:4). The result is reduced crop yields; possible increases in pests and disease infections that affect production and development and make rural households less resilient (Alauddin & Sarker, 2014:205; Bwerinofa & Chiweshe, 2016:202; Gwimbi, 2009:76). Livestock production is an important source of income and includes small livestock and poultry (Campbell *et al.*, 2000; Scoones, 1995). Livestock serves as a source of income for health and education services, and

enables people to buy food (Chaminuka *et al.*, 2014; Kristjanson *et al.*, 2014; Muchadeyi *et al.*, 2004). Most of the district's agricultural activities rely heavily on water harvesting, especially from small dams situated across the district. There is evidence of a regular assessment of dams to check the conditions of the local reservoir dams, which would typically determine the success of agricultural purposes (all things are held constant) (HJPA/CD/FN Interviews Officials, 2017). The district dam inventory has recorded 107 small dams in different wards. One official reported:

Twenty-six dams in good condition are distributed in 13 wards. Fifty-eight dams are in a fair condition and the rest are in a bad shape, silted or breached (HJPA/CD/Official AGRITEX 20170222, 2017).

Most dams are sources of water for domestic use, which include use by households and domestic animals (HJPA/CD/Official AGRITEX 20170222, 2017).

4.2.1.1 Water supply in Chivi District

Water is a human right in Zimbabwe and various forms of policies and legislation have been introduced to ensure water access for all and to protect that right (Derman & Hellum, 2007:665; Hall *et al.*, 2014:850; Nemarundwe & Kozanayi, 2003:117). There are specific sections in various policy documents adopted by the Zimbabwean government administration, which recognise this right for women. The UN General Assembly (1979:5) on the Convention on the Elimination of all Forms of Discrimination against Women (CEDAW) asserts that all state parties shall ensure that women enjoy the right to adequate living conditions and efficient water supply. The SDGs emphasise the importance of water security and almost all of the goals are inextricably linked to water supply and sanitation. MDGs 7 and 10 emphasise the importance of water security by pushing for the reduction of the number of people without safe drinking water and achieving universal access to safe water (Konkagul, 2009:6). Water security can be achieved through increasing availability of water, promoting access to good quality and reliable water resources for all uses. These security elements have different definitions and descriptions attached to them. This study assumes these elements to be:

- a) *Availability*: Each person must have sufficient and continuous water supply for domestic and personal uses, for example washing, cooking and hygiene (Animesh *et al.*, 2016:2).
- b) *Quality*: Each person should have access to safe water, which is free from substances that may cause health problems. The water should have an acceptable colour, odour and taste (Animesh *et al.*, 2016:2; Rahut *et al.*, 2015:2).
- c) *Accessibility*: Water sources have to be within safe physical reach; should be sufficient for human consumption; and should provide acceptable amounts of water. Water should be

affordable for all and no forms of discrimination should be practised (Animesh *et al.*, 2016:2; UNU, 2013:2; WaterAid, 2012:5).

Women are the principal domestic water managers (Graham *et al.*, 2016:2). There are various challenges that women face in their households regarding availability and access to water and water resources. The responsibility of coping with water stresses and shortages is the domain of women (Chitja *et al.*, 2016:1; Graham *et al.*, 2016). They are forced by circumstances to formulate coping strategies, such as changing water consumption patterns that will cushion and lessen the burdens caused by water insecurity (Basu *et al.*, 2015:48; Nthenge, 2016:43). The inclusion of women in decision-making processes in the water sector is therefore very important (Hall *et al.*, 2014:850; Sigenu, 2006:50). Provisions to alleviate the burden of women in water collection was called for, with governments being urged to come up with strategies to alleviate this through the use of low-cost technologies, income supplements and appropriate water pricing policies (Cleaver & Elson, 1995:1; Hall *et al.*, 2014:851; Sigenu, 2006).

In Zimbabwe, efforts to ensure water supply have been witnessed by the formulation of the National Master Plan for Water Supply and Sanitation (NMPWSS) in the 1980s (Mtisi & Nicol, 2003:3). This plan guided a framework for implementation in rural areas to provide them with access to safe water. The Integrated Rural Water Supply and Sanitation Programme (IRWSSP) coordinated by the National Action Committee (NAC) planned to ensure the provision of adequate, safe and reliable water supply services (Makoni *et al.*, 2004:1292). It aimed to ensure rural areas had adequate water for all its populations. It catered for providing adequate, reliable, efficient and low-cost water supply infrastructure for all rural areas. From the year the IRWSSP started, considerable success was recorded up to 1999 before the onset of the economic challenges of the year 2000 (Makoni *et al.*, 2004:1292). According to a new policy document of 2004, the Zimbabwe domestic water supply and sanitation, in tandem with the MDGs 2000, aimed to improve water supply in the rural areas of Zimbabwe (Government of Zimbabwe, 2012:4). In Chivi District, the rural Water, Sanitation and Hygiene Programme (WASH), funded and spearheaded by UNICEF and CARE International, aims to improve the rural water situation. The WASH programme aids in building boreholes for communities, toilets and generally educate people on water sanitation and water handling practises (HJPA/CD/Official 1 NGO 20170214, 2017).

A shortage of water supply facilities and portable clean water have a marked impact on rural households and their livelihoods. The problem increases the burden on women who travel long distances to fetch water. Moreover, these conditions threaten the hygiene and health of people (Cleaver & Elson, 1995:2). Water is essential for domestic uses and for the improvement of rural livelihoods (Hall *et al.*, 2014; Hope, 2006). Water is an essential component for the reduction of

poverty, and is a basic need for multiple uses and livelihoods in rural areas, where most human activities are highly water dependent (Van Koppen *et al.*, 2006). In Chivi District, most households in the rural areas practise farming as a prime livelihood option. As a result of recurrent drought conditions over several years, most households rely on backyard gardens and small livestock rearing activities. Water remains a crucial resource in these activities (Mudzonga, 2012; Scoones & *et al.*, 1996). These livelihoods ensure food security and energy security and create rural household pathways for resilience.

Currently the main policy on water in Zimbabwe is the Water Act (Chapter 20:24) of 1998 which was intended to ensure a most equitable supply of water and the participation of stakeholders in the management of water resources (Dube & Swatuk, 2002:868). This act provides for water permits and considers water as an economic good for which the user has to pay institutions like the Zimbabwe National Water Agency (ZINWA) (Dube & Swatuk, 2002:868; Latham, 2002:908; Manzungu, 2002:928). ZINWA is responsible for water planning and bulk supply for domestic uses; it manages water resources at catchment areas (Dube & Swatuk, 2002:870). However, the agency provides the smooth supply and management of domestic water to areas and growth points in some areas in the district (HJPA/CD/Official ZINWA 20170214, 2017). Most rural areas have been excluded because various challenges prevented service delivery. These include a lack of infrastructure and funding to increase service delivery (HJPA/CD/Official ZINWA 20170214, 2017). There is thus evidence that some rural areas in Chivi District do not benefit from the ZINWA initiative and would be vulnerable to water insecurity in terms of availability, accessibility and even quality.

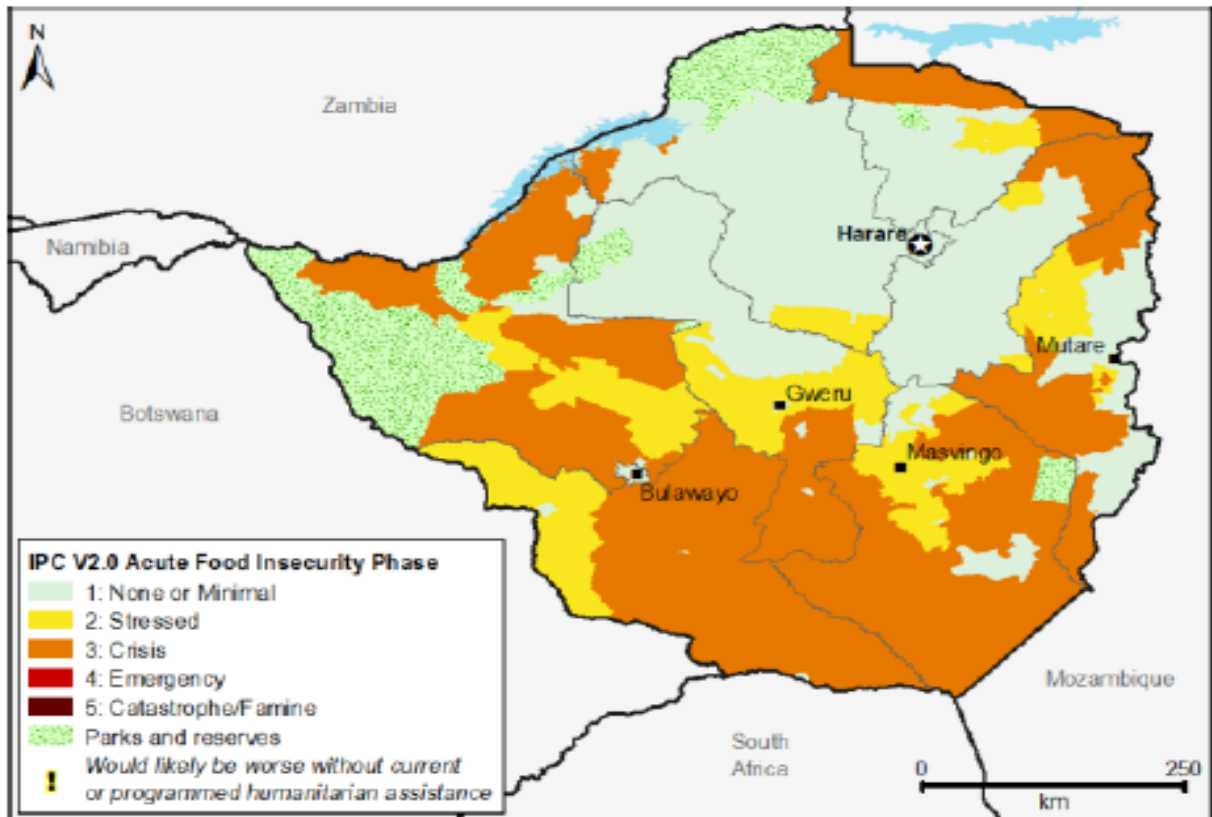
4.2.2 Food security

Stability of supply is an important aspect of food security. It refers to the people's ability to obtain food over time (Pingali *et al.*, 2005:1468). Food insecurity is best explained over time, it can be transitory, chronic or seasonal (FAO, 2008a:1). Depending on the challenges faced, they can cause transitory food insecurity where food may be unavailable for short periods. Challenges caused by natural disasters may lead to low production of food and crop failures, which negatively affects food availability. Therefore, food security relies on stability in access, availability and supply (FAO, 1996; Gandure *et al.*, 2010). People can be food secure if they have adequate food supplies (Gandure *et al.*, 2010). Adequate access to food today does not make people food secure, if they will not simultaneously have adequate future food supplies (Del Ninno *et al.*, 2007:414; Devereux, 2006:7).

In Zimbabwe, rural households face various challenges, which lead to food insecurity and vulnerability (Gandure *et al.*, 2010; Mudimu, 2002; Rukuni *et al.*, 2006; Simba *et al.*, 2012). The

major challenge emanates from erratic climate conditions that are mostly responsible for poor rainfall in the rural areas (Campbell *et al.*, 2000; Kinsey *et al.*, 1998; Scoones & *et al.*, 1996). The economic conditions in Zimbabwe are poor and worsening. Low incomes, an unstable political environment and the impact of diseases have increased the vulnerability of people in rural areas. Chivi District is situated in a drought prone zone of the country. Consequently, agricultural produce from this area contributes very little to the country's GDP (Mudzonga, 2012:4). Despite this, the majority of the population in Chivi are farmers and most households depend on agriculture for food and income (Gandure *et al.*, 2010:514; Mudzonga, 2012:5). Livestock rearing has been affected by poor grazing lands resulting in a lower number of livestock and related assets. The increasing population in the district puts more pressure on the land, which previously was used, primarily for grazing. Each household is allocated a piece of land for settlement, agriculture, and more pressure on the land results in settlement of people on marginalised land, and ultimately landlessness. Livestock is regarded as an asset base that a household can fall back on in critical times. The reduction and disruption of livestock rearing makes rural households less resilient.

Despite all the challenges Chivi residents rely mainly on agriculture, and livelihood options are limited (Bird & Shepherd, 2003). The major livelihood options in the district rely on the availability and accessibility of water and energy. Water extraction uses electronic, petroleum, solar and physical energy. Households' dietary diversity in the district is minimal (Gandure *et al.*, 2010:514); Mavengahama *et al.*, 2013). According to ZimVAC (2017), Chivi District is highly food insecure. The district's households were described as being in crisis in 2015. Major factors responsible for food insecurity include poor livelihoods options, high food prices and low sales of vegetables. Most households in the district rely on food assistance and other programmes spearheaded by NGOs and the government (Gandure *et al.*, 2010; MHCW, 2008) (Map 4.1).



Map 4.1: The vulnerable food security zones in Zimbabwe, including Chivi District

Source: FEWSNET (2016:1)

According to a study by FEWSNET (2016), the NGO Care International is running various programmes in Chivi District to alleviate the challenges of food insecurity and poverty (FEWSNET, 2016:8). The consortium runs supplementary feeding activities targeting pregnant women, breastfeeding mothers, and children. Household activities include food-for-work programmes, where people are recruited in community work and paid with food hampers, and food-for-assets programmes, where people do community work and are paid with money, livestock and machinery. Approximately 710 households take part in these programmes (ENSURE, 2014:7; FEWSNET, 2016:8). Other organisations have been implementing programmes to feed elderly people, orphans, vulnerable children and the handicapped (HJPA/CD/Official 1 NGO 20170214, 2017; Ruel *et al.*, 2010). The government has provided food for primary schools to reduce food insecurity, in Chivi district the respondents in wards 11 and 13 reported that the government had feeding programs running in all primary schools in the district. This came as an intervention to reduce the rates of hunger and malnutrition among children (HJPA/CD/FGDs Field Notes Chivi, 2017). Some organisations have resorted to funding projects aimed at mitigating poverty and enabling food security. The International Labour Organisation (ILO), Care International, Zvishavane Water Project, World Vision and others have come up with project to boost the livelihoods of people in the district. This shows that food aid and other humanitarian aid projects

indirectly are coping strategies for mitigating and adapting food insecurity in the study areas. The absence of food aid for households may lead to detrimental food shortages.

The modified WEF nexus resilience framework in this study is useful for exploring nexus security and the coping and adaptation strategies of rural women. The relationship between water, energy and food in the households in Chivi District is important to understand the security state and the decisions women make. Water is the main driver of production in the district for the achievement of both energy and food security (Mudzonga, 2012:7). The district relies on biomass energy sources for domestic use, which relies on the availability of water for environmental production.

Water is important for irrigation schemes in the district. Consecutive poor rainfall seasons have increased the reliance on irrigation farming and gardening (Mudzonga, 2012:9; Ruel *et al.*, 2010:172s). Local irrigation schemes and gardens have become the main sources of food and income for Chivi rural households. Chivi District is specified as agro-based despite the challenges of agricultural water insecurity. Ward 22 recorded the highest number of farming households at 1626, while ward 6 the scored the lowest, with only 254 farming households (HJPA/CD/FN Interviews Officials, 2017). This shows to what extent water is important in the district. Table 4.2 shows the importance of agriculture as a source of food and income to households and the number of farming households in Chivi District.

Table 4.2 indicates how rural households rely on farming as a livelihood option. The type of land ownership in the rural areas shows that its communal ownership which reduces the value of land in the rural areas as asset. The people can only make use of the land but do not have individual ownership rights. Individual land ownership rights, such as having title deeds, enable people to obtain loans to initiate income generating projects. Land can be used as collateral when applying for loans and credit (Chaminuka *et al.*, 2014; Ejigu, 2008; FAO *et al.*, 2010). Lack of financial capital limits the people from initiating productive income generating projects and build their asset base, which they can rely on in crises. This keeps rural areas in poverty cycles and reduces rural households' capacity to initiate good coping strategies for challenges faced. The pillars of resilience include understanding impacts, and formulating strategies to cope and adapt. Lack of land ownership, which is one of the major productive resources, may reduce the sense of responsibility of people in how they interact with the ecosystems, which may cause future WEF nexus challenges for them. The way in which systems respond to challenges can make the socio-ecological systems recover or collapse.

Table 4.2: District Farming households by wards

Ward	Type of Land Ownership Agricultural Sector	Number of Households
1	Communal area (CA)	1053
2	Communal area	1404
3	Communal area	1115
4	Communal area	960
5	Communal area	1118
6	Communal area	229
6	Small scale communal area	15
7	Communal area	910
8	Communal area	1129
9	Communal area	868
10	Communal area	1130
11	Communal area	851
12	Communal area	915
13	Communal area	971
14	Communal area	1450
15	Communal area	1465
16	Communal area	1492
17	Communal area	1059
18	Communal area	982
19	Communal area	1560
20	Communal area	1255
21	Communal area	1050
22	Communal area	1626
23	Communal area	1464
24	Communal area	518
25	Communal area	1779
26	Communal area	1500
27	Old resettlement	631
28	Communal area	1440
29	Old resettlement	680
30	Communal area	218
31	Communal area	432
32	Communal area	1110

Source: HJPA/CD/FN Interviews Officials (2017)

NGOs operating in Chivi support WEF nexus security initiatives through projects that improve water supply for food and energy production; and projects to secure the supply of energy for water

pumping and food production. NGOs operating in this area provided various services such as drilling of community boreholes for community gardens. These initiatives promote WEF security and resilience of human and environmental systems (FEWSNET, 2016:8). Different technologies are used for boreholes. Some are solar powered, while others are hand pumps. In a project funded by the ILO, biogas use includes cooking and lighting (HJPA/CD/Official WA 20022017, 2017). NGOs have endorsed projects such as heifer, goat and poultry production, which require water and food through crop feed. Though livestock production is not prominent due to poor grazing lands and lack of water, some households however still rely on livestock as assets they can fall back on during a crisis.

4.2.3 Energy security

According to ZIMSTAT (2012:15), the larger percentage of the population in Chivi District resides in the rural areas. The district has a population of 166 049 with 97.4% of the population residing in the rural areas whilst 2.6% are resident in the urban (growth point) areas. In Zimbabwe, about 70% of the population resides in the rural areas. They use firewood as the main source of energy in the home (ZIMSTAT, 2012:121). However, the availability of firewood as an energy resource is under threat due to diminishing forests and the subsequent damage to the local ecosystem. Lack of access to alternative sources of energy is still a challenge for people in the rural areas of Zimbabwe (Marufu *et al.*, 1997; Mehretu & Mutambirwa, 1992). As is the case in many countries, Zimbabwe, endeavours to promote access to affordable and sustainable energy services (Africa-EUEIP, 2008; Cherp & Jewell, 2014; Ejigu, 2008; Farrell *et al.*, 2004). In Zimbabwe, about 79% of urban households have been electrified, 19% of rural households have been electrified, whilst only 32 % of the population in the country have access to modern energy (Bazilian *et al.*, 2012; Suberu *et al.*, 2013).

Internationally, an estimated 2.4 billion people fully rely on traditional biomass fuels for domestic use (International Energy Agency, 2014:5). A demand for fuel wood has been increasing in rural areas, which takes away time and physical energy from other activities. This problem reaffirms the need for alternative sources of energy that are more reliable and affordable for these households (Adkins *et al.*, 2012; Barnes & Floor, 2003; Biran *et al.*, 2004; Desalu *et al.*, 2012). In order to manage the existing situation, rural households rely on multiple sources of energy, such as wood, animal dung, crop residue, electricity, solar energy, liquefied petroleum gas (LPG), and kerosene. The use of these and other sources have reduced the pressure on the forests, but it does not guarantee energy security (Cherp & Jewell, 2014). According to ZIMSTAT (2012:121), 90.7% of the rural households use wood, 0.1% use paraffin, 5.9% use electricity and 3.5% use other fuels as sources of energy in Chivi District. The diminishing forests and increasingly vulnerable ecosystem of the district, as well as energy security is a growing cause for concern.

4.3 Rural livelihoods in Chivi District

A survey of livelihood options pursued by women in the rural parts of Chivi and gives an insight into what assets and options rural women have to cope with challenges. The study found that in the selected study areas, rural households rely on seasonal subsistence farming. All women reportedly rely on seasonal farming as primary livelihood option. Table 4.3 shows the prevalent livelihood option as cited by rural women in the case study area.

Table 4.3: Rural household livelihoods options households

Livelihood option	Type	Number of households	Percentage rate
Farming:	Seasonal	30	100
	Irrigation	09	30
Gardening	Community	23	76.7
	Home	04	13.3
Livestock rearing	Cattle	03	10
	Goats	07	23.3
	Free range chickens	24	80
Commercial poultry project	Broiler chickens	01	3.3

Source: HJPA/CD/FGDs Field Notes Chivi (2017)

The findings show that the most relied upon livelihoods are seasonal farming practised by 100% of the households, 76.7% use community gardens; only 30% practised irrigation farming whilst 13.3% had home gardens. Livestock rearing is prevalent in the rural areas especially the rearing of free-range chickens (*huku dzechikaranga*) which 80% of households practised. Cattle rearing was reported by 10% of household; 23.3% households kept goats and 3.3% engaged in a commercial poultry project funded by an NGO. Free-range poultry rearing is important because of fewer difficulties in keeping them and the cultural values attached to them, of which one woman said:

It is our culture that women should rear chickens (traditional), it is a woman’s pride and we as women rely on poultry in times of crisis. They are easy to keep because they do not require any special feed or drugs. They scrounge for small insects and small grains and are disease resistant. They are sold or exchanged for money or other goods (HJPA/CD/FGD2 Women 02022017, 2017).

This is not to say that men did not keep chicken. It is a common practice among some rural households to keep chickens. Rural households in Chivi also reported low rates of livestock farming. The major challenges are lack of good grazing lands and water scarcity. The district is

drought prone and finding food for cattle is a nightmare for most households, making it very difficult for livestock rearing. One woman said:

Keeping cattle is good if you have money to buy cattle feed during off-season. Grazing lands are better during the rainy season. Off-season, cattle have to be driven long distances to water points such as dams for water. The dam is almost 5km away. This creates problems for most of us because we do not have enough resources and time (HJPA/CD/FGD3 Women 07022017, 2017).

Institutionally funded projects are a source of income and WEF nexus resources. The government and NGOs have various projects that assist people in vulnerable situations in rural areas in a bid to promote resource security and reduce poverty. The study revealed there are various sources that bring income for rural households. The households reported that they rely on remittances (70%), piece jobs (26.7%), fruit and vegetable selling (23.3%), village saving schemes (20%), institutionally funded projects (56.7%), informal trading (13.3%), and selling firewood (6.7%) (HJPA/CD/FGDs Field Notes Chivi, 2017). The per capita GDP of households in Zimbabwe was recorded as USD\$1080 in 2017 (World Bank, 2018). The results reveal that even though there are other avenues for income generation few households reported their engagement on each livelihood option as shown in Table 4.4. There are various challenges that hinder livelihood diversification. The major one is the lack of capital. Table 4.4 shows the other livelihood options that are available to rural women in Chivi and the distribution of households that reported engaging in each livelihood option.

Table 4.4: Distribution of households per each off-farm livelihood option

Livelihood option		Number of households	Percentage rate
Remittances		21	70
Piece jobs		08	26.7
Fruit and vegetable selling		07	23.3
Village saving schemes (<i>Mukando</i>)		06	20
Informal trading		04	13.3
Selling firewood		02	6.7
Institutional funded projects	Food aid	09	30
	Food for work	04	13.3
	Income generating	04	13.3

Source: HJPA/CD/FGDs Field Notes Chivi (2017)

The study found that households diversify their livelihoods. All households sampled relied on more than one livelihood option. Some households have as many as four options of income generating

projects and resource supply. They had a different livelihood option for off-farming season, which provided income and food for the household. One woman said:

Farming is prioritised during the rainy season; farm work takes up a lot of our time leaving no time to do other activities. After harvest, we concentrate on different livelihood activities. These vary from one household to the other. Livelihood options include informal trading, income generating projects, village saving schemes, piece jobs and community gardening (HJPA/CD/FGD1 Women 16012017, 2017).

4.4 Findings of the study: perspectives on WEF nexus security, challenges, and coping strategies

This section deals with the findings of the empirical research done in Chivi District. The exposition of the results was done in different categories. The study gave an exposition of the current state of each WEF nexus resource individually, and the results were discussed following the major themes that looked at availability, access, utilisation, challenges and the coping strategies for the WEF nexus.

4.4.1 Water security

In this study water security is an equal access to safe and adequate water to meet basic household needs for livelihoods and productive uses and maintain an active, healthy and safe lifestyle. Water should be readily available at an acceptable distance and of acceptable quality. Focus on water security at rural household level should include water for agriculture, livelihoods, household consumption and sanitation.

4.4.1.1 Availability of water in Chivi District

Chivi District rural area relies on more than one source of water. Women rely on natural sources of water. Water is procured through rainfall, at surface storage or stream sources and ground water. The sources are affected by various factors, such as seasonal variations, climate change and costs of installing water infrastructure and its maintenance (HJPA/CD/FGD1 Women 16012017, 2017; HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/CD/FN Interviews Officials, 2017). Table 4.5 shows the water sources available in the selected study areas.

Table 4.5: The water sources available in the selected study areas

Ward	Available sources of water
11	1. Boreholes (individual, community)
	2. River bed shallow well (<i>Mufuku</i>)
	3. River
	4. Shallow wells (<i>Matsime</i>)
	5. Dam
	6. Rainfall
13	1. River, shallow wells (<i>Mufuku</i>)
	2. Community boreholes
	3. Shallow wells (<i>Matsime</i>)
	4. Rainfall
30	1. Community taps
	2. Boreholes
	3. Dam
	4. Rainfall

Source: HJPA/CD/FGDs Field Notes Chivi (2017)

The main source of water in the rural areas according to women, are the boreholes, river streams and shallow wells (*Mufuku*) in riverbeds. These were reported as the most reliable for domestic consumption. One woman clearly articulated the state of affairs by explaining:

Most of the households rely on boreholes and shallow wells that we dig in the riverbed (HJPA/CD/FGD2 Women 02022017, 2017).

There are few households with private boreholes, which provide water to some families in close proximity. In ward 11, a woman said:

It is better for those with wealthy relatives or those in better positions who can drill boreholes on their homesteads. They can find a source of water close by (HJPA/CD/W2 04022017 Interview, 2017).

Few households are in this category. In cases where electricity is needed for the use of the personal borehole, people are charged US\$1 a month to help pay for the electricity if they want to make use of the borehole (HJPA/CD/W4 04022017 Interview, 2017). In this category, households do not buy water, but instead purchase energy to procure water. It means those who cannot pay for energy, resort to alternative sources of water. Thus, there is a “no energy no water” scenario where the ability to contribute towards the purchase of energy ensures access to a reliable water source.

Various factors, such as drought, seasonality and anthropogenic climate change, affect the sources. Rivers in Chivi are seasonal and even during the rainy season only flow just after the rainfall. In a few villages visited in ward 11 and 13, there were rivers in community settlements, which women use as sources of domestic water. Villages closer to the river use them as sources during both the rainy and dry season. However, in all wards women travel for more than a kilometre to fetch water from rivers.

Image 4.1 shows a riverbed shallow well dug by rural women to fetch water for household use.



Image 4.1: Riverbed shallow well (Mufuku) water source in Chivi District

Photograph: HJPA/RSWP 16012017 (2017)

During the off-season (*Chirimo*), women dig shallow wells (*Mufuku*), as shown in Image 4.1, so that they can fetch water for domestic use. Rainfall harvested by bowls, which are used to collect rainwater falling from the roof, is used for domestic consumption. Water is collected from open swampy areas in the riverbeds. This water is used for domestic uses such as drinking, washing and cooking. These are open sources that they share even with the animals making the water unclean. However, due to water scarcity they are forced to use this water for household consumption (Image 4.2).



Image 4.2: Water collected in the riverbed after rainfall: The riverbed as a source of water for domestic use

Photograph: HJPA/RWSP 15022017 (2017)

Few households rely on hand-dug wells that are situated within the yards of their homesteads. Women say the wells are not reliable as they dry up during the peak of the dry season in all areas. One woman explained:

It is better during the rainy season and immediately after, because it is quite easy to find water closer to home. Some households dig wells that collect water during the rainy season (HJPA/W6 12022017 Interview, 2017).

In addition, during the time when the water table is higher due to rains, the wells are a good source of water.

Communal taps are potential water sources in ward 30 where there is a ZINWA managed tap, which is along the main pipeline supply for the growth point. The communal taps are non-functional due to the deterioration of infrastructure, and poor water management that increases water bills for the people until the water is disconnected. The mandate of ZINWA community taps

was that a certain number of households would use the same tap and share the bill. One woman said:

Because of the hard times that we have been going through (economically) we failed to raise enough funds to pay for the water bill. We tried to manage water use by rationing, but still it was difficult resulting in disconnections. The use of secure locks for the taps failed due to vandalism. Water management and controls to help reduce the water bills failed and, in the end, led to disconnections (HJPA/CD/FGD3 Women 07022017, 2017).

Some rural households rely on boreholes for water. In the district, women showed that the boreholes were major sources of water. NGOs and the government have made efforts to improve water and sanitation facilities in this area, despite challenges thereafter. In ward 11, a recorded number of 23 boreholes are scattered across the whole ward. In ward 13, there are 12 boreholes in the whole ward. In ward 30, 17 boreholes drilled for community domestic use, are the main sources of water (HJPA/CD/Official Mechanisation 1 20170222, 2017; HJPA/Official RDC 25022017, 2017). However, women and key informants said that some boreholes were no longer in use because of vandalism, lack of spare parts, drying up in summer time, lack of skills to fix the broken pumps, and the high costs of material use for the boreholes. Image 4.3 shows the typical design of most boreholes found in Chivi District.



Image 4.3: Borehole water source in Chivi District: servicing both the local school and the community

Photograph: HJPA/CBP22022017 (2017)

In some areas, dams are a source of water. People choose this source for domestic use because it is close to their compounds and makes it easy to fetch water. These small dams constructed across the district were mainly for livelihood purposes, and to enable rural households to conduct water-based activities, such as gardening, irrigation and to use for livestock. Some dams, constructed by the government during the colonial era, are funded by NGOs to improve agriculture-based livelihoods. These have become sources of water for household purposes. According to one respondent in a men's focus group:

In our area, we have a small dam that is mainly for livestock and community gardens. We are now using that dam water for household needs as well because we have no other options. The water is not clean, but women find ways of making it look better than it is, but the taste does not improve (HJPA/FGD1 Men 15022017, 2017).

Image 4.4 shows the Marimbe community dam in ward 11 where people in nearby villages source water.



Image 4.4: Dam water source for household domestic and livelihoods use in Chivi District

Photograph: HJPA/CDP 12022017 (2017)

The study suggests that each locality of community residence has a variety of water sources. However, women varied in their selection of preferred sources of water and its appropriate use. Some households have better and safer options of water sources close to their houses and need not travel far for water. Some houses had to resort to certain unsafe and unreliable sources such as shallow riverbed wells and dams because the alternative sources were too far. They may not have the time or the energy to travel too far for water.

4.4.1.1.1 Household choices of water sources

The survey shows that though sources of water are varied, households had preferred sources. These choices for water sources are affected by seasons when certain sources of water would not be available during certain times of the year. The women cited that different water sources catered for their water needs at different times of the season. One focus group discussion showed that during the rainy season water harvesting was prevalent in most households for cooking and drinking (HJPA/CD/FGD2 Women 02022017, 2017). For the rest, in matters of hygiene use, like washing and bathing, they use water collected in deep contours dug on the edges of their small home fields, water collected on wetlands, and hand dug wells. One female respondent explained:

During the rainy season, we do not have major water challenges. The dry open hand dug wells collect water during this time. During the rainy season most of us do not have to travel far for water (HJPA/CD/W2 04022017 Interview, 2017).

The proximity of water sources to a household, determines preferences. Most women reported choosing water sources based on the distance from home, sometimes even if it is not clean and safe. Women reported that they chose water sources according to the safety of the water for cooking and drinking. In an FGD, women responded that the reason why they chose a source was how clean and well-kept the source is, but still would choose to use a source with poor quality of water if it was close to their homes (HJPA/CD/FGD3 Women 07022017, 2017). One woman said:

I would rather use a communal tap for household purposes because it is very safe, ZINWA water is treated with chemicals to destroy germs but I cannot afford to pay for the water. The borehole is second best but considering the distance even with a wheelbarrow, we end up using closer to home sources despite water quality (HJPA/W6 12022017 Interview, 2017).

The respondents were asked to indicate their preferences for sources of water during the rainy season and the dry season. Women claimed that they chose the source that is closer to home to enable them to do all their chores in time and it lessened the burden of fetching water

(HJPA/FGD1 Women 16012017, 2017). During the rainy season, about 75% of households obtained water within 200m from their homes and only 14% of these households got water within the same distance during the dry season. In the rainy season few households (3.3%) travelled more than 1km to fetch water, whilst 87% of the households travelled more than a kilometre for water in the dry season. The responses are presented in the Table 4.6.

Table 4.6: Household water preferences per season

Water sources	Rainy season		Dry season	
	No of households	%	No of households	%
Community boreholes	02	6.7	08	26.7
Individual boreholes	02	6.7	02	6.7
Community taps	00	00	02	6.7
Shallow hand-dug wells	10	33.3	04	13.3
River bed shallow wells	00	00	04	13.3
Dams/Rivers	00	00	06	20
Rainfall harvesting	10	33.3	00	00
Other	08	26.7	06	20
Total	30	100	30	100

Source: HJPA/CD/FGDs Field Notes Chivi (2017)

The data shows that during the rainy seasons the most preferred sources of water are the shallow hand-dug wells on their compounds and rainfall harvesting. This is because during the rainy season these wells collect a lot of water used for domestic purposes. These wells save a lot of time because they are situated within the perimeters of compounds of most households. These wells are protected with covers to keep dirt out but most of them are open, which may not provide the best quality of water. Image 4.5 shows an unprotected hand-dug shallow well within the compound.

In the dry season, most women prefer community boreholes, mostly because other sources would have dried up or would not be producing enough water for all. One respondent in a women’s focus group discussion said:

The major reason why we go to the boreholes in summer is because we run out of options for water sources, the rivers are far and local rivers would be dry
(HJPA/CD/FGD2 Women 02022017, 2017).

The women mentioned that there were other sources of water, which were not included in the list, because some are illegal connections, or are not regular sources such as commercial purchasable water for household uses. The data shows that during the dry season the sources of water used by women are a lot more than during the rainy season. The choices for sources of

water in dry seasons are affected by various factors, such as available labour to collect water, the distance of the source from home, quality of water at the source and the need for the water, e.g. for cooking and washing.



Image 4.5: Unprotected compound shallow well used for domestic consumption

Photograph: HJPA/CD/Observation Field Notes Chivi (2017)

Water availability has generally been termed as the continual water supply at the source. In terms of water availability, the study thus found that in the district there is water insecurity, as the sources available to these women did not offer a consistent water supply. It makes rural households less resilient. In the months of October to March, they rely heavily on rainfall and from April to November their sources vary. Each household chooses a particular source of water, irrespective of its quality. The supplies of permanent sources, such as community taps and boreholes, were reportedly not continuous, because of breakdowns and disconnections. This puts rural households at risk of water scarcity and water insecurity. The results show that not all sources available could provide safe and sufficient water for all households needs. This makes rural

households vulnerable and susceptible to food and energy insecurity because water is the main resource for promoting food and energy security in Chivi and generally Zimbabwe’s rural areas.

The availability of water is questionable. Women interviewed reported that in most cases, people have to queue for water especially during the dry season. One man said that:

It is difficult because in most cases the water sources dry up. People have to wait for long periods for water to well up or seep (Kudzinira). Sometimes we do not get the desired water quantities (HJPA/FGD2 Men 17022017, 2017).

This shows that water is not available around-the-clock in these areas. The results showed that sources like shallow hand-dug wells, riverbed shallow wells, and community boreholes are affected during the dry season when the ground water table is low. These sources dry up or become shallow. Then they cannot sustain and meet the needs of households. This increases the time that people have to wait at the source points affecting the availability of water for households in a long period. More than 80% of households reported using more than one source of water for all domestic needs. The lack of reliable water sources leads to water scarcity, increases rural household vulnerability and lowers resilience capacity.

4.4.1.2 Water collection and division of labour in rural households

The study found that more than three quarters of the population sampled for this study left their homes to collect water. This is not uncommon as another study by Pickering *et al.* (2010:3268), also found that over 70% of the population in sub-Saharan Africa collect water from outside sources, and in most cases far from their homes. This study exposed the principal collectors of water within rural households and in the study area. This aspect was explored to see the linkage water has with other aspects like food and energy within the WEF nexus context. The time taken, and amount of energy used for water collection has a bearing on energy and food security as well. Primary respondents selected for this study reported that in Chivi District the principal collectors of the household water are adult women, only a few households had the help of children and men (Table 4.7).

Table 4.7: Household principal water collectors

Ward	Female		Children		Men	
	No of households	%	No of households	%	No of households	%
11	08	26.7	02	6.7	00	00
13	09	30	01	3.5	00	00
30	09	30	00	00	01	3.3

Source: HJPA/CD/FGDs Field Notes Chivi (2017)

The study found that in Chivi District, Zimbabwe, most of rural households have no water on their premises and walk a considerable distance to fetch water. Table 4.7 shows the household distribution of water collectors. About 86.7% of water collectors in the rural area are women, and 6.7% are children for those with water sources closer to their homes. Few households reported men helping with water collection. In a similar study, it is reported 82% of rural households in Zimbabwe have no access to reliable water sources, and 83% adult females and 5% children have to walk for more than 1km for water and spend more than 30 minutes on the task (Graham *et al.*, 2016:8).

Most households with children over 15 years were in a better position. They reported that young boys and girls would fetch water before nightfall for use the next day (HJPA/CD/FGD1 Women 16012017, 2017). However, most women argued that this did not lessen their burden of water collection because the children usually fetched water, which would assist them in preparation for school. Once they depart for school, it would be the mandate of adult women to fetch water for other household needs such as cleaning, cooking, bathing and washing.

Men were found to be helpful in water collection, but only in few households (less than 3%). This was mainly attributed to societal constructs where fetching water is regarded as a woman's job. Men only resort to fetching water if it is for their livestock, of which in most cases they prefer driving their animals to water sources rather than fetching the water (HJPA/CD/FGD1 Women 16012017, 2017; HJPA/CD/FGD3 Women 07022017, 2017; HJPA/FGD1 Men 15022017, 2017). Women being the principal collectors of water within the rural households imply that they are the principal managers of water for household uses.

4.4.1.3 Perceptions of women on the availability of water

The study explored the water perceptions on water availability in the district. Women were asked if they would rate the availability of water in their area. Categories used included describing their water supply situations, as well as matters of scarcity, adequacy and abundance. Responses varied according to seasons. In the rainy season, 40% of respondents regarded the water as adequate for their household needs and domestic use. Almost 26% of households still considered water as scarce for their household needs, whilst 34% regarded the water as sufficient to meet desired needs. This shows that during the rainy season water is not considered as a problem.

Water insecurity primarily occurs during the dry season. This does not have anything to do with the number of sources available to them, but rather the accessibility of these sources. Approximately 80% of participants reported that water would be scarce during the dry season.

One woman said:

During the dry season most of the sources ... dry up completely or we have to wait long hours for the water to well up again. For our village both the dams and rivers are more than 5 km away from our homes. Even for those close to Tokwe River it is not safe to fetch water from the river because of the dangers of crocodiles that have killed many of our children and relatives (HJPA/CD/FGD2 Women 02022017, 2017).

This poses a great danger to the lives of women and children. The reasons cited reduce the resilience capacity of rural households. Those who depend on digging shallow wells on the seasonal riverbeds in the dry season described the availability of water as scarce. In a focus group discussion, one respondent claimed that:

The wells we dig are very shallow and we dig them on a daily basis. We cannot take the water that we find welled up because it may be dirty. You dig and wait for the water to well up until you have a bucket of water. This water we use it out of desperation because river water is not clean and safe at all. A lot of things are done in the river, some wash, some bath and even animals use them too (HJPA/CD/FGD2 Women 02022017, 2017).

It is evident these households are water insecure. Boreholes and compound hand-dug wells are reported to dry up as well if there are too many people fetching the water. This leads to water rationing in the morning to allow all households to do their chores and fetch more water later in the day or use alternative sources in worst-case scenarios.

Respondents reported that besides using water for their household/domestic needs, water is the most important input of their livelihood options and its scarcity posed a threat on food security and income generation. It leads to failure to access basic services like education and health for their children and families. Women reported on the difficulty to maintain livelihood options during the dry season, because they have to walk long distances to the gardens and small-scale irrigation schemes close to dams or rivers (HJPA/CD/FGD3 Women 07022017, 2017). However, these sources have been failing to provide enough water for their intended purposes as they dry up in some areas or become too shallow, causing these activities to become difficult. They have to travel long distances of not less than 5 km to livelihood water points. There is evidence of water scarcity, not only for household domestic needs, but for household livelihood options as well. It makes rural people more vulnerable.

Approximately 13.3% households reported that water was adequate for their household needs, whilst 6.7% of the women reported that water was abundant and sufficient for all their domestic needs. In an interview one official in the district commented that:

The district has been affected by long lasting droughts, which lasted for more than six years, making the district more vulnerable to water insecurity. Though various organisations have tried to do a lot of initiatives in terms of water supply and sanitation the district is not yet water secure due to effects of climate change. Since 2000, meaningful rains have been received only in the 2016-2017 rainy season (HJPA/CD/Official RSC 20170222, 2017).

This explains why only a few households considered water as adequate and sufficient for their household needs. The majority of households have water shortages. This has influenced their choice of water sources for household needs leading to reliance on multiple sources where possible and multiple uses of water in other areas. The results of the study show clear interdependencies among WEF nexus resources within households. A lack of water affects production, development and the wellbeing of rural households. The results show the continuous cycles as explained by panarchy where the shortages in one resource potentially influences the security and stability of other WEF nexus resources.

4.4.1.4 Access to water

There are various factors that affect access to water and sanitation services. In this study, access to water was regarded in terms of safety, infrastructural development and distance from households and this influence the choice of water sources for households. Household management of WEF nexus resources is the women's responsibility in Zimbabwe. Women carry the burden of fetching water, cooking, cleaning, washing and participating in livelihood activities. In this community, women preferred to use sources that are closer to homes to reduce the time spent on fetching water and to save the amount of physical energy needed for other household chores. According to Rahut *et al.* (2015:1), most women in rural areas spend almost six hours daily fetching water or waiting for water at different sources. In a men's FGD in the district, they said that as men it was not their responsibility to fetch water. However, they were concerned with the amount of time women spent fetching water, as they have to walk long distances (HJPA/FGD2 Men 17022017, 2017).

The response given above shows that there is a need for government and responsible organisations to ensure that safe water sources are provided for rural communities and which may be in the form of increasing the number of protected boreholes and wells to reduce distances from household and time taken (Table 4.8).

Table 4.8: Household distance to water source per safety type of source

Distance to source	Protected source		Unprotected source	
	No of households	%	No of households	%
Less than 100 m	02	6.7	00	00
100m-500 m	04	13.3	04	13.3
600 m-1 km	14	46.7	10	33.3
1 km+	10	33.3	16	53.3
Total	30	100	30	100

Source: HJPA/CD/FGDs Field Notes Chivi (2017)

From Table 4.8 it is clear that the majority of the households (46.7%) travel 100m-1km to fetch water from a safe water source, whilst 33.3% of households reported walking more than 1km to a water point. Furthermore, 20% of households reported to be within a 500m radius of safe water points. These safe water points are the community's sources and individual boreholes, community taps and protected hand-dug wells within the confines of community areas. Ward 13 had the most households that relied on unprotected and unsafe sources from which they could access water within a 1km radius from their homes. In ward 30, a number of women cited the availability of protected sources of water as community taps and boreholes. It was an advantage for this ward as it has a growth point and a rural area. The proximity of other sources was recorded, where 53.3% of women reported walking for more than 1km to sources such as rivers and dams. Approximately 33.3% of these women walked distances of between 600m-1km for the same sources, and only 13.3% of the households were within a radius of 500m (HJPA/CD/FGD1 Women 16012017, 2017).

In the study areas, most households access water from local school boreholes. However, only households closest to schools have access to the boreholes. In the dry season, the water from these boreholes is reserved for the school needs. This leaves the benefiting households without safe water for their household needs. In ward 11, respondents said most of the boreholes that were functional were at local schools. In communities, some boreholes were no longer functional and needed to be repaired forcing people to use unprotected sources of water for drinking and cooking, which could lead to outbreaks of diseases, e.g. the cholera outbreak 2008. One woman claimed:

School boreholes are open, and we can fetch water from them, however, that would mean travelling for more than 2km to fetch water, even if you go there, you would not be able to collect a sufficient amount of water for household needs (HJPA/CD/W8 12022017 Interview, 2017).

The relative wealth status of households play an important role in access to water. In this district, choice of water sources is influenced by the income of a household. Wealthier households have the capacity to have their own boreholes and protected wells drilled for easy access to safe water. Even if a neighbour drills a borehole, there are certain costs incurred that will lead to water vending to those that need water. One woman said:

There are few households with either tapped water connections, personal protected boreholes or protected wells. These do not easily guarantee water access to the other neighbours and there are always contributions one is required to make towards maintenance and extraction of water. If you do not have the money, there is no access to the tapped water. Same as the ZINWA community taps where monthly rates are paid. One ends up opting to pay a limited amount for drinking water or resorting to unsafe sources of water (HJPA/CD/W9 12022017 Interview, 2017).

The lack of infrastructure is another cause for lapses in water security in the rural areas. In Chivi District, various NGOs make efforts to improve water access to rural areas. NGOs such as Care International, Zvishavane Water Project, World Vision and Chomuzangari Women's Cooperative have made notable efforts in building water infrastructure for rural households (HJPA/CD/Official Mechanisation 1 20170222, 2017; HJPA/CD/Official RSC 20170222, 2017; HJPA/Official RDC 25022017, 2017). It is clear evidence of the influence of available infrastructure on household access to water.

4.4.1.5 Rural household water uses

The study explored rural household uses of water as perceived by rural women. The women were asked to rank their household uses of water according to importance. The FGDs established that women rank water uses differently. It became evident during the study that women played a significant role in water use within the household and the community at large. The available literature argues that women are the major users and managers of household water and hygiene (Makoni *et al.*, 2004:1293). Women in the FGDs were requested to make a list of water uses within their households and order it according to importance.

The findings revealed that all households (100%) ranked water for drinking and cooking as their major priorities. It shows that women value water for domestic use as more important. Water for agricultural purposes was reportedly important for all households represented. Agriculture is the main source of food and income for most households in the district and the availability of water for farming is highly important (Mudzonga, 2012:3). Water for irrigation, livestock and gardening was reported as important within the households' structures. More than 70% of women reported

that water for irrigation, livestock and gardening was very important. These were designated income generating projects and sources of food. Water for household cleaning and personal hygiene ranked lowest as women reported that these issues were easy to handle once there was enough water for all the above activities and even when water was scarce. Rural women reported having coping strategies when facing water scarcity for personal hygiene and household cleaning.

The results show that women value first the survival of their families. One respondent in the group said:

Water is needed most importantly for cooking and drinking; this ensures that we will survive to do all the other activities. One needs to eat first before they start worrying about enough water for the goats and the garden and all other activities. We need to have good sources of water close to home so that we can be assured of reliable good quality water supply for these basic needs (HJPA/CD/FGD3 Women 07022017, 2017).

The prioritisation of water use is highly influenced by reliability of water sources in the communities, as well as having excess water for other activities. A study by Katsi *et al.* (2007:1162) came to the same conclusion in a study assessing factors affecting water sources at household level in rural Zimbabwe. Thus, even though water needed for livelihood activities was reported as important to women, they pointed out that they could only consider water for livelihoods after they had enough for their household needs. It also influences the choice of sources for different uses. During one FGD, a male respondent said:

We have to be on alert on the rains we receive during the rainy season. This determines how we use our water so that it would last us until the next rain season when we receive rain again (HJPA/FGD1 Men 15022017, 2017).

Household water use is a factor that influences choice of sources in rural households. Women reported that sources of drinking water were community boreholes, community taps, protected wells, and some of them still relied on unprotected sources for drinking water (HJPA/CD/FGD3 Women 07022017, 2017). They had preferences for household water for cooking and cleaning. This finding corresponds with the study of Nemarundwe (2003:105), who found that water-use priorities relied heavily on access, reliability and availability of water in the communities.

A number of women in Chivi largely relied on natural sources for water, e.g. rivers, dams and riverbed shallow wells (HJPA/CD/FGD1 Women 16012017, 2017). Illegal connections are done in a bid to access water for household consumption. These illegal connections provide water for drinking in some households and this would be raw unheated water collected from a river or dam in the area (Table 4.9).

Table 4.9: Household water source preference in relation to use

Household use	Water sources											
	Community boreholes		Community taps		Shallow hand-dug wells		Riverbed shallow wells		Dams/ rivers		other	
	No	%	No	%	No	%	No	%	No	%	No	%
Drinking	10	33.3	02	6.7	06	20	03	10	03	10	06	20
Cooking	07	23.3	03	10	06	20	08	26.7	03	10	03	10
Cleaning	-	-	-	-	10	33.3	10	33.3	04	13.3	06	20
Washing	10	13.3	-	-	-	-	06	20	10	33.3	04	13.3
Bathing	10	33.3	-	-	-	-	10	33.3	08	26.7	04	6.7
Livestock	-	-	-	-	-	-	-	-	25	83.3	05	16.7
Livelihoods	09	30	-	-	-	-	07	23.3	14	46.7	-	-

Source: HJPA/CD/FGDs Field Notes Chivi (2017)

Table 4.9 shows the probable preferences of water sources per household water use. These findings indicate that the majority of women opt for protected sources of drinking water; almost 60% of households rely on boreholes, community taps and compound or community wells for drinking water, which are protected therefore providing safe water safe water. However, the remaining 40% still rely on unsafe water sources for drinking water that may compromise their health and make them vulnerable to waterborne diseases. Other household chores were done with water from natural sources such as riverbed shallow wells (*mufuku*), dams and rivers. Approximately 65% of households relied on those natural sources for bathing, washing and cleaning water in their homes. Livestock production and livelihoods rely on these natural sources of water and during the dry season, they are highly affected. Water scarcity transcends to poor production leading to food insecurity and reduced access to energy sources.

4.4.1.6 Challenges for household water security in Chivi District

The study explored the perceptions of people in the rural areas, as well as, the officials working in the WEF nexus sectors, on challenges affecting water security in the district. During FGDs and interviews held separately in the district, various factors were reported as the main contenders against household water security. These included distance from water sources, water infrastructure technology and systems design, related water costs, water use restrictions, lack of physical capital to collect water and poor water quality. In addition, climate change leading to droughts, poor rainfall, cyclones, heat waves, poor irrigation infrastructure to transport enough water from the rivers or dams to gardens, and dam siltation were reported (HJPA/CD/FGDs Field

Notes Chivi, 2017). The factors reported were determined by the use for water in the community and the two main uses were water security for domestic uses and for productive activities (livelihoods).

Climate change was reported as the major challenge towards water security in the district as they have been experiencing recurring droughts, which have been affecting the area since 2000. The changing climate mainly resulted in fewer rainy days each year with very little rainfall, which hardly enabled them to carry on with dryland seasonal farming (HJPA/CD/Official WA 20022017, 2017). The local people's knowledge on climate change emanates from looking at the historical trends of rainfall, harvests and related experiences. The study established that over the years, the rainfalls became erratic, temperatures increased, seasons of the year became difficult to determine (occurrences of droughts increased when rain was actually expected), and over the years their environment became unstable (HJPA/CD/FGDs Field Notes Chivi, 2017). The amount of rainfall received each year during the drought period in Zimbabwe was not enough to provide for off-season livelihood such as gardening and livestock production. The respondents reported that the changing climatic conditions have affected the availability of water in the district; the most common challenges were the droughts and the floods caused by cyclones. These have interchangeably affected their lives through the destruction of crops, property and drowning them in a poverty cycle (HJPA/CD/FGDs Field Notes Chivi, 2017). One woman said that:

Our area has gone through a series of droughts and floods that have destroyed crops, houses and livestock. This made our households vulnerable to poverty and put our wellbeing at risk. Due to these climatic changes, our area has become unsuitable for farming and most of our water sources have been filled with sand. Therefore, we have insufficient water for household consumption and for livelihoods (HJPA/CD/W4 04022017 Interview, 2017).

Climate change has led to some extreme weather conditions in the district, which have had detrimental effects on water security. Climate change puts rural households at risk of WEF nexus insecurity, unless coping strategies that promote both social and ecological resilience are formulated.

Respondents reported occurrences of erratic high temperatures and cyclones, which all had negative effects on water security in terms of either access or quality of the water. In an interview one of the councillors reported:

The major challenge towards water security in our area emanates from erratic climatic changes and we often experience extreme weather conditions. In most cases, water security is affected by persistent drought waves, which can last for more than three years at a time and has made this area donor dependent. Most households rely on subsistence agriculture, which relies heavily on annual seasonal rains (HJPA/Official RDC 25022017, 2017).

This statement shows that the erratic climatic changes have a bearing on water security for productive uses. The same has an effect on household water security as shown when one woman in an in-depth interview claimed that:

During the year of severe drought, some local hand-dug wells get dry. Cyclones are equally bad; they drown crops and make it difficult to conduct our daily chores. Cyclones cause river flooding which makes it dangerous to fetch water from rivers. The flowing water leads to the contamination of most natural and unprotected sources from which we fetch water for domestic use (HJPA/CD/W2 04022017 Interview, 2017).

This report shows that climate change affects household water security for both domestic and productive uses. The result corresponds with the results of the study by Kanda *et al.* (2017:472) who postulated that climate change had an impact on household water security as it could lead to water scarcity.

This study found that the long distance to water sources and lack of physical labour to fetch enough water for households threaten household water security (HJPA/CD/W8 12022017 Interview, 2017). This report is in tandem with the study results by Nemarundwe (2003), who found that women in other wards in the same district were having similar challenges. This was burdensome in cases where people have to travel long distances for water and still have to spend more time waiting for water in long queues especially in the dry season. It limited the number of litres these women could fetch for their households and resulted in water shortages (HJPA/FGD2 Men 17022017, 2017). Some women complained about the technology and system designs of the boreholes in the area. The boreholes are hand pumped and reported to be too heavy, which required two or more women to draw water (HJPA/CD/FGD1 Women 16012017, 2017). They reported that the wells that they used required them to use long ropes with a tin tied at the end, which they throw in and pull to draw water. These water source systems required a lot of energy

and are quite tedious, so much, so that some women would not be too productive in some household duties.

Women commented on water use restrictions put in place by the communities to ensure a continued supply of water, especially during the dry season. One respondent clarified when she said:

During the time when the water levels lowers, the community leadership creates rationing laws to enhance continued supply of clean water especially from boreholes. In most cases, people would be allowed only a certain amount of water per day and will not be allowed to use the sources for intensive water demanding activities like washing clothes, watering livestock and gardening (HJPA/CD/W4 04022017 Interview, 2017).

Breakdowns at water sources such as boreholes cause temporary and sometimes prolonged water scarcity. Respondents reported that the costs of repairing the damages or maintaining a water source might be too much for the communities, leaving the rural people without access to safe water. This is supported by a study by Machiwana (2010:37) who found that the repair work on malfunctioning water sources and replacement of old parts were a problem in rural communities in Chivi District, which posed a challenge to rural water access by households. In such cases, people just opt for alternative sources of water for household uses, even if the source was of poor quality and the drinking water was unsafe.

4.4.1.7 Coping strategies for water security in Chivi District

Coping strategies are implemented for protecting and conserving resources in the short and long term (Sigenu, 2006:85). Rural women as role players in the household water management learnt how to cope with water insecurity challenges. The government and NGOs have rendered assistance by building infrastructure for water supply such as boreholes and dams to improve rural water supply (HJPA/CD/Official RSC 20170222, 2017). This did not alleviate water insecurity challenges and forced rural households to develop their own coping strategies (HJPA/CD/FGDs Field Notes Chivi, 2017). The exposition of the results shows major challenges causing water insecurity in Chivi District. The research found that water shortage and scarcity are ongoing problems in the area studied. Various factors continuously undermine water access, availability and uses in the rural households. The study explored the various needs for water in the rural areas according to water for domestic uses or for production and income generation. Rural communities need to be water secure as they produce their own food, and shortages in water supply for various needs has an impact on the wellbeing of people.

The coping mechanisms in this study were categorised into two: coping with water shortages for household domestic needs such as drinking, cooking and hygiene; and coping with water scarcity for household livelihood needs such as farming, gardening, livestock and other water-related activities. This categorisation aims to clarify coping strategies in relation to household water needs. The coping strategies to reduce the causes and the effects of challenges are formulated, based on local perceptions and understanding of the situation. These strategies are resilient pathways to reduce the impacts of certain challenges arising that may threaten the existence and survival of a system (Basu *et al.*, 2015; Maxwell & Caldwell, 2008).

4.4.1.7.1 Water for domestic needs

FGDs and interviews showed that there were a number of strategies practised within the community to meet everyday household needs for water. The coping strategies reported include the efficient use of water; reducing the amount of water used for washing and other hygiene purposes; reducing the number of dishes to be cooked; giving up some water-use activities; using water storage facilities; and finding alternative sources in times of crisis. Community coping strategies included water restrictions, water rationing, and community-funded water supply initiatives. The community reported that most of the people migrated their livestock, shifted from keeping cattle to goats, and adopted non-water-based livelihood options. The manner in which systems cope with challenges show a direct WEF nexus relationship.

Conservation of water

The study found that women employ productive uses of water and had ways of minimising wastage of water. About, 80% of women reported that they use water recycling to ensure that they do not waste water. This coping strategy ensures that women will not do many trips to fetch water, which will save on time for other activities. This strategy may save the women from long walks and long waits during water collection, but some of the strategies they use could actually cause adverse health problems, such as using the same water to wash dishes the whole day. During an observation session the researcher noted that after washing the plates which are left outside to dry either on a plates rack (*Padara/ Pachitanangare*), or on a heap of collected firewood (*pabakwa*), the dishes with washing water are either left on the ground or they are put on top with the plates. Most households placed the dishes on top to avoid the losing the water to stray goats or to have dogs drinking from them. This shows how this water-use practice may cause health and hygiene problems. It reduces the resilience capacity of households if their health is threatened.

Practises of efficient uses of water were clarified, when one woman responded:

I am the main water collector in my household because I do not have children that are of age to help fetch water, my husband will be busy with other menial activities and besides that, it is a women's work to fetch water. My household uses 60ℓ of water per day for all household needs including bathing. In one of the community meetings with CARE International and our councillor, advice on ways not to waste water, such as having a kitchen garden was shared with us. In my household, we use the same water to wash and rinse dishes the whole day. The used water is reused to water the kitchen garden, which could just be few tomato plants and a few plants of green leafy vegetable. Used water from bathing is stored and used to wash clothes and mop the floor, as it would be soapy. When we wash our hands during the meal, we use the water to water the kitchen garden (HJPA/CD/W5 04022017 Interview, 2017).

Women pile up clothes and wash them at the water source. The women reported that they did not collect water for washing but they trekked to different water points available to do their washing. This means that clothes are worn for lengthy periods and washed occasionally, to avoid frequent trips. They mentioned that some did not change their clothes unless they were dirty. However, this was because the women try to save soap. One man in an FGD commented:

Women have days that they agree on with their friends to go down to water points and wash their clothes, this serves as socialisation time. They will wash clothes and lay them on branches of trees to dry out before they go back home. This takes a lot of time and disrupts most routines for other activities but there is nothing else to do about it. It is the only way out (HJPA/FGD2 Men 17022017, 2017).

Water harvesting and storage

As a coping and adaptation mechanism to avoid water shortages, rural households store their water at home (HJPA/CD/FGD3 Women 07022017, 2017). Water harvesting is done using dishes and buckets that are placed on walls to collect water from the roof. This water is stored and used for domestic needs such as cooking and cleaning and is reportedly not used for drinking as they claimed it may not be clean to drink since water is collected from the roofs (HJPA/CD/FGDs Field Notes Chivi, 2017). Image 4.6 shows how the women harvest water from the roof.



Image 4.6: Water containers lined up to harvest rainwater for domestic use

Photograph: HJPA/CD/Observation Field Notes Chivi (2017)

Water is collected from available sources and stored at home for use. This strategy helps them to reduce the time spent on fetching water, as well as reducing the number of trips to the water source. Water stored could be used for a short period extending to a week or two. Women reported that water is generally stored in 20-25ℓ buckets or containers (HJPA/CD/FGD1 Women 16012017, 2017; HJPA/CD/FGD2 Women 02022017, 2017; HJPA/CD/FGD3 Women 07022017,

2017). The water is placed inside the house or outside, depending on its domestic use. In a discussion with women, the researcher probed to find out if they covered their water to protect it against dust, dirt and insects. Approximately 20% reported they do not have lids for the water containers. The other 40% did not see the need to cover it since they relied on open sources of water; 30% covered their water and 10% sometimes covered the water. In an interview with one of the councillors, he said:

There is a WASH programme in the district spearheaded by CARE, which has various programmes such as Water and Sanitation awareness. They educate women about hygienic water handling practises. The programme went as far as giving two 20ℓ buckets to each household in wards under its operation to provide households with clean water storage facilities. During the rainy season, water harvesting is very common in many households, but they will not have appropriate water storage and collecting equipment. Some end up cleaning the dishes and buckets they use for washing and bathing to collect water, which they will use for cooking. This has detrimental health effects and the poor storage facilities may lead to contamination of stored water (HJPA/Official RDC 25022017, 2017).

This shows that though storing water can be a good coping strategy it causes hygiene problems if done poorly.

Water rationing

Water rationing is another way of coping with water shortages in the rural households. Water for bathing at home is rationed, and small amounts of water will be given to each person and they have to manage it. Asked to give an approximate, one woman said:

For children they can use 2-5ℓ of water for bathing and elders use 9-10ℓ of water for bathing, for those that need to use more water they have to trek down to the river and bath there or they can fetch their own water (HJPA/CD/W2 04022017 Interview, 2017).

The research showed that water rationing was done for all other household needs such as washing dishes, mopping the floor, or washing vegetables. If children are helping with the chores, they had to consult with their female heads on the amount of water they can use. The use of rationing as a coping strategy is common placed, a study by Onditi (2010:50) found that rural women use water rationing as a coping strategy to water insecurity. Water rationing reduces the burden of water collection by reducing the amount of water to be fetched.

Reducing water-based activities

Reduction of water-demanding activities was reported. Women reported that they reduced water demand activities by either skipping or reducing the water used (HJPA/CD/FGD1 Women 16012017, 2017; HJPA/CD/FGD2 Women 02022017, 2017). Activities such as bathing and cooking are affected the most. In most cases, household members skipped bathing and only bathed after a day, two, or three, especially children and men. Women suggested they reduced the number of meals they cooked per day to avoid washing dishes. They coped with water shortages by cooking foods that demanded less water and did not need use of plates, such as sweet potatoes. This obviously has an impact on food varieties and nutrition, due to the reduction of varieties of food. Similar to a study by Basu *et al.* (2015:59), rural women employ this coping strategy during the dry season when water is scarce, and compromises are made on water use for domestic needs. However, this cannot be done for a long time and is less resilient as it can cause health problems.

Community initiatives and use of alternative sources

To cope with household water scarcity, women reported that they use alternative water sources. During the dry season, water security is compromised as the water table falls this leads to the drying up of ground water sources such as wells and rivers. Water levels in boreholes and riverbed wells drop and cannot supply water for household uses (HJPA/CD/FGD2 Women 02022017, 2017; HJPA/Official RDC 25022017, 2017). During these periods, communities have to come up with alternative sources of water. These include begging for water from boreholes owners, and diverting water from rivers and making illegal connections. Respondents reported digging a well beside the dams where water would collect through seepage from the dam, which is protected from animals by fencing and used even for drinking (HJPA/CD/FGD2 Women 02022017, 2017). An interview with the water official in the district revealed that there were cases of water diversions from the river courses especially in the Tokwe River. People dug trenches in which water flows to supply a well not too far from the river. Even though the water was used to supply water for domestic purposes, it was termed as illegal (HJPA/CD/Official RSC 20170222, 2017). In one village, people fetched water from a broken pipeline, meant to transport water from the river to the ZINWA water supply plant. The local water sector official said they suspected foul play (HJPA/CD/Official ZINWA 20170214, 2017). For local people these breakages are a given. They are far from all other natural sources such as rivers (which are about 7 km away), and a dam (about 5 km away) (HJPA/CD/FGD2 Women 02022017, 2017).

One woman said that:

In our area we are too far from any natural source of water, we are only getting water because of the pipe, which is leaking. The community then dug a hole in which water can be collected and people can use. It is tough during the times when they repair the leakage; so far, it has always managed to breakdown and leak again in another part (HJPA/CD/W2 04022017 Interview, 2017).

When asked to comment on such an occurrence, one water official said:

The breakdown in our water supply infrastructure is common as the pipes are now very old since they have not been replaced for more than 25 years now. We try as much as we can, but the pipes cannot contain the water pressure. Therefore, it leaks again. However, some villagers are taking advantage by vandalising the structures so that they can continue to have water supply. It is difficult to take corrective measures because it is difficult to find the culprits (HJPA/CD/Official ZINWA 20170214, 2017).

Image 4.7 shows how women in the village are getting water from a leakage in the water supply pipe passing through the village. The pipes are deep in the ground and villagers can see that the pipes are leaking by the increased wetness of the ground above it. They will dig to reveal the leaking pipe and the pond they dig will collect water (HJPA/CD/Observation Field Notes Chivi, 2017). Villagers confirmed that they would ensure they dig with care so as not to cause any further damage to the water pipes. Image 4.7 shows that a trench has been dug to avoid damage to the pipes.



Image 4.7: Women fetching water from a water supply pipe leakage in a village in ward 11.

Photograph: HJPA/CSWAP 08022017a (2017)

Image 4.8 below shows how wells are dug beside or close to a dam. These wells are used to source water for household uses. This was cited as a coping strategy in times of water crisis. The wells are dug for hygiene purposes as the dam uses are varied. Some people swim and bath in dams, animals drink from the dams, some people fish from dams. The women said that the water in the dam was not clean; animals sometimes swim in the water leaving it muddy and dirty. The people devised side wells as strategies to ensure that they will have clean water for household use.



Image 4.8: Dam side water wells dug by Ward 11, Marimbe villagers for domestic uses such as drinking and cooking

Photograph: HJPA/CD/CSWAP 08022017b (2017)

The findings show that coping mechanisms reported are short-term strategies that help them to reduce the amount of water they use in their households. These strategies help them to survive during crises. The coping strategies they use rely heavily on the capability of their communities to come together and find a solution, this is supported by similar studies which also came to the same conclusions (Basu *et al.*, 2015; FAO, 2007; Nthenge, 2016; Pereira *et al.*, 2009). However, finding solutions as a community and their success depends on the infrastructure and assets that

they have which can help in providing a way out for these communities (Alauddin & Sarker, 2014; Hall *et al.*, 2014; Hanjra *et al.*, 2009; Van Koppen *et al.*, 2009). In this study, the mentioned coping strategies are not sustainable. They may even have detrimental effects on the wellbeing of people. Adger *et al.* (2008) purports that the successful implementation of viable coping strategies for long-term survival (adaptation) requires the necessary assets, which make it possible to devise plans.

According to Basu *et al.* (2015:60) in a similar study, the coping strategies that are used by rural women are spontaneous actions that are not sustainable and become too difficult to maintain. Coping strategies used cause infinite cycles of poverty and resource insecurity even for food and energy. The need for WEF nexus resilience in exploring resources security and actions is apparent. The need to create resilient communities that are capable of dealing with situations in a sustainable way is important. Coping strategies, such as vandalism, diversion of rivers, and digging wells have changing impacts on the existence of water sources. Increasing farming and gardening close to the dams and rivers could lead to siltation. Evidence showed that more than 20% of the dams in the district were silted up and out of use. The women lack the necessary capital to make meaningful changes to their situation and to invest in viable coping and adaptation mechanisms that are sustainable. It makes them less resilient and reduces their capacity to adapt when facing WEF nexus security challenges.

4.4.1.7.2 Water for livelihood needs

The importance of water security has become more significant and the attention given to the subject has improved the understanding of the concept by both policy makers and academic scholars (Basu *et al.*, 2015). Various factors influence water security for livelihood purposes. Therefore, there is a need for coming up with strategies that ensure availability of safe water in sufficient quantities for various livelihood needs. Water security can be achieved by improving impartial distribution, sustainable resource use and resilience to challenges (Grey & Sadoff, 2007). The achievement of water security relies on the understanding of human systems and their responses, bearing in mind that processes at local level influence global actions. This study explored perceived coping strategies by rural women to be resilient and adapt to water insecurity. The district relies on agriculture as the main source of livelihood (Mudzonga, 2012). The results showed that the district is highly dependent on the amount of rainfall received each year for production. However, for 10 years, prior to the 2016-2017 rainy season, the district experienced minimum rainfall. It could not even fill up dams for irrigation purposes (HJPA/CD/Official WA 20022017, 2017). This scenario has left most households impoverished and food insecure. The study sought to find how the communities respond to water scarcity for livelihoods and how viable are the coping mechanisms.

Conservation farming to reduce water use

The strategies used, show that the people had coping strategies and ways of adapting to mitigate livelihood water-related challenges. The main coping strategy for dealing with challenges in the agricultural sector is conservation farming (*dhiga udye-dig and eat*). In an FGD held with men in the district, they explained that households were practising conservation farming, though it was not producing the desired results (HJPA/FGD2 Men 17022017, 2017). Conservation farming, *dhiga udye* as it is termed locally, entails intensive land-use strategies that preserve the soils and boosts agriculture. The farmers are expected to dig holes in which they will put their seed and manure. These holes are deep and reduce potential runoff. This form of farming is good for the environment as it preserves the soil culture and boosts agriculture and does not waste water and manure (HJPA/CD/Official AGRITEX 20170222, 2017). This initiative is adaptive to the situation and can be used for long-term livelihood security to promote efficient use of resources and to foster sustainability. However, due to poor access to financial and productive resources such as land, conservation farming is not adequately being implemented. The women expressed their concerns about this method. One respondent said:

This method of farming introduced to us is very painful; it requires a lot of energy to dig the holes. They say (agricultural extension officers) that, we need to dig holes one metre deep and there may be more than hundred holes. Because of poor health conditions and hunger, we do not have enough energy for that labour (HJPA/CD/W1 04022017 Interview, 2017).

In an interview, an agricultural extension officer explained:

*The process of conservation farming is not easy when it is done manually. We do not have the latest technology to make the job a lot easier. Some of the people are genuinely not capable of doing the processes of digging holes due to health or hunger but others have a negative attitude because of the labour involved. The communities have now termed it *dhiga ufe* (dig and die) from the term *dhiga udye* (dig and eat) which clearly shows the negativity of communities (HJPA/CD/Official AGRITEX 20170222, 2017).*

Adoption of non-water-based livelihoods

The study found that the rural women diversified their livelihood options with those that do not require intensive use of water, such as buying and selling products, cross-border trading, piece jobs (*maricho*) and activities, such as village savings projects (*mukando*). Most women who were into beer brewing, have resorted to the making of beer brewed from marula fruit (*mukumbi/Sclerocarya birrea*) which requires less water, but is equally as popular as beer from

sorghum or finger millet. In an FGD with men, it was alluded that women help a lot in the home as breadwinners to supplement the income brought in by the husband and sometimes children and the making of *mukumbi* is quite popular. One woman said:

There are times when things get tough and brewing mukumbi helps bring in some money for a few things. It is not as viable as farming and gardening, but it helps (HJPA/CD/W5 04022017 Interview, 2017).

Another woman in an FGD said:

There are a lot of activities that we do to reduce the effects of drought on our lives, we rely heavily on farming, but it has become quite unreliable which has forced us to look for piece jobs (HJPA/CD/FGD3 Women 07022017, 2017).

Piecework is found especially at teachers' cottages, and could include washing; cleaning and sometimes they need someone to look after the children whilst they are at work. The teachers are able to give some women part-time work because they have a monthly income. This may only be a day job or an extended arrangement.

Village saving schemes help to alleviate some of the effects. It is reportedly common for women to come together and organise saving schemes by doing *Chikande* (where they take turns to give one woman either money or goods). This shows that water scarcity has affected the sustainability of rural livelihoods in this area. According to the FAO (2007:23), communities in the rural areas produce their own food and it is highly important to ensure they have access to water for agriculture to secure their food production locally. Reliable water supplies to the rural communities enable poverty reduction and development. Due to the shortage of water for agriculture, rural people have diversified their livelihood to include activities that require less or no water at all.

Irrigation farming

Irrigation is another way of coping with drought-induced water shortages to adapt to changes. Irrigations farming uses water from dams and boreholes built for this purpose. The communities in rural Chivi District received support in form of dams and boreholes for micro-irrigation schemes from the government and NGOs. Women reported that the main source of water for irrigation are the boreholes and the community dams. In some villages closer to the river, communities have come together to try and use the river for irrigation. Though it is a very good innovation, the process is too long due to existing water policies and the lack of finance on the part of the community to purchase and build proper irrigation facilities.

One man said:

It is possible for us to use the river to irrigate, that can sustain us and promote food production and income generation. However, the irrigation approval process is quite long and tedious. There is need to get the people from the Ministry of Lands, Agriculture and Mechanisation and engage with the office of the Tokwe-Mukosi sub-catchment area which makes the process too long (HJPA/FGD1 Men 15022017, 2017).

An official in the water sector management said:

The process of creating an irrigation scheme is a bit long. It includes the pegging of the land, surveys to assess potential environmental effects of such a development. The major problem we have for all departments is the issue of funding and transportation to make regular follow ups. The people sometimes would fund the officers with transportation in order to accelerate the process. This creates a burden on the people and sometimes the initiative fails (HJPA/CD/Official RSC 20170222, 2017).

This report shows us how livelihood options and resilience options rely heavily on the assets available to people to formulate successful and sustainable coping and adaptation mechanisms.

Drought-resistant crops

The farming households have shifted to growing drought-resistant crops that do not require a lot of water. Agricultural extension officers interviewed reported that farming households in the district have been encouraged to grow small grains that were more drought resilient and ensured better yields. Crops such as finger millet (*Rukweza/Eleusine africana*), sorghum (*mapfunde/ Sorghum bicolor*), are encouraged to improve on food security, as well as the general wellbeing of people. The most common crop is maize, which is a staple for the people in Zimbabwe. Most households are not keen on growing the small grain crops. One woman said:

It is difficult for us to grow the small grain crops, as a source of food and income. To begin with, the children of today are so used to the maize that they do not want meal from the small grain crops, which is very dark. Even to sell the grains is very difficult; there is no ready market for small grain produce. It is only very few people who need the grains for health purposes or to brew beer for rituals and traditional functions that buy them. These functions are few and spaced in our area because people no longer have resources enough to perform them (HJPA/CD/W4 04022017 Interview, 2017).

The study thus found that the communities and households under study were water insecure in terms of access. The study shows that there is a problem of safe water for domestic use. This is a major stressor for the people in the district, as water is the centrepiece of their day-to-day living and activities. The water resources available in the district have been directly affected by climate change, as well as other manmade challenges like unreliable water supply systems due to breakdowns and expenses of maintenance. Climate change projections for the future promises to negatively affect the water availability unless there are much more resilient ways to meet and adapt to the challenge. Poor access to water resources has an impact on the overall WEF nexus security. Water is important for production in both food and energy sectors in Chivi District. The poor access to water increases the vulnerability for rural women as well as households. The coping strategies that have been discussed are mainly used to conserve the available resources. Women also try to save the water they have available.

The people in the rural areas are caught up in a cycle of WEF nexus insecurity, the viability of most rural livelihoods is dependent on water. Looking at the challenges discussed, and the coping strategies used, it shows that rural households are caught up in cycles of insecurity in the WEF nexus. They pass through the stages of the panarchy cycle rapidly creating constant changes and weakening the resilience capacity of both the human and ecological system. People continue to exploit the available resources to provide for their needs. Various actions taken by people do not conserve or preserve the available resources. This overexploitation of resources lead to potential collapse of systems. The community strategies they implement also meet with varied challenges that hinder the achievement of WEF nexus security. The negative impacts in the water sector have serious implications on food security and energy security of these households. Therefore, there is a distinct need for resilient and adaptive water management strategies for all systems in the cycle. The processes that happen in local communities and households lead to changes that have an implication for the future of the ecosystem as a whole. It is quintessentially important to find resilient ways of managing, adapting and coping with the negative drivers of change.

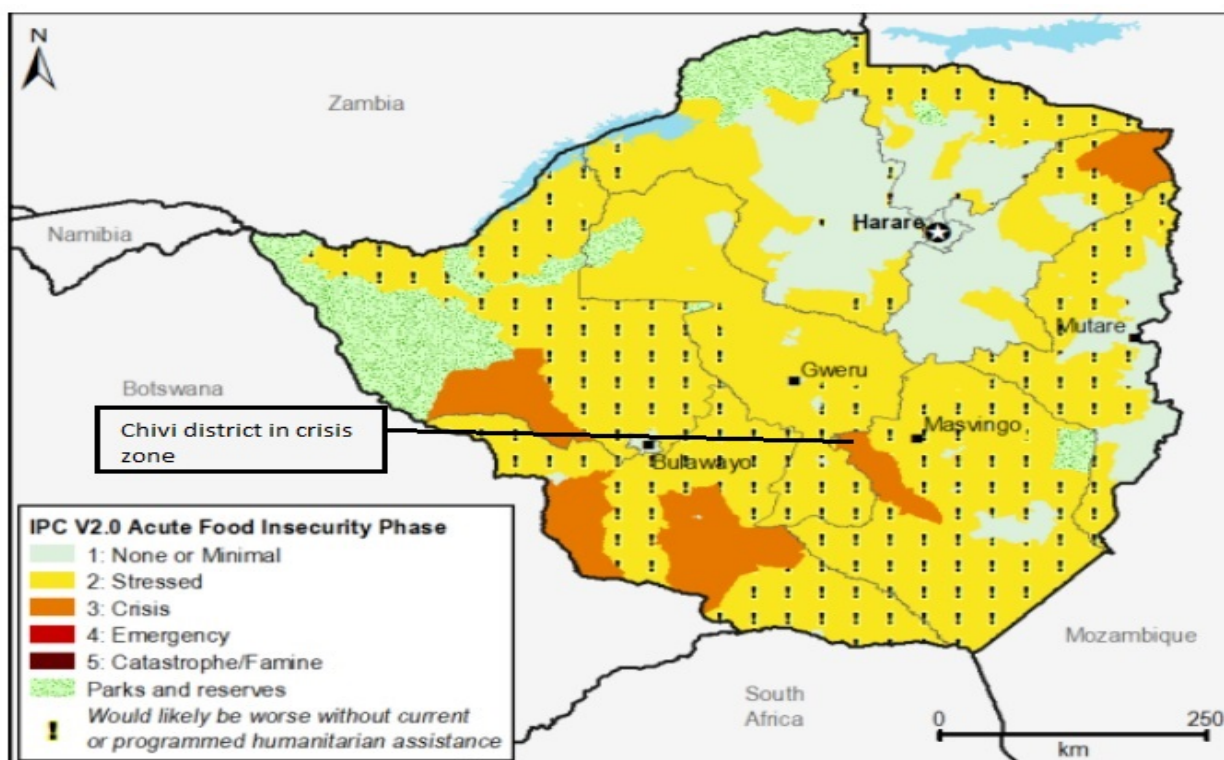
4.4.2 Food security

Food security is an important part of development given that food is a basic need for survival, growth and the development of human beings. Overall, Chivi District has been identified as a district that experiences a high frequency of food insecurity (FEWSNET, 2016:7). The major driving factors of insecurity identified include: natural disaster conditions of drought that constitute states of shock in vulnerable rural subsistence farming communities; unpredictable seasonality as a result of increasing evidence of conditions of climate change; general instability of human

livelihoods; land degradation; finite access to decreasing natural resources; and increasing population growth.

Respondents reported that food sources for households and their importance could best be explained in seasonal terms (HJPA/CD/FGD1 Women 16012017, 2017). The findings showed that rural households relied on different sources according to the season of the year. Asked to explain what this meant one woman said that the major food insecurity challenges occur during the farming season from September to around March (*nhamo yechikafu yakanyanya nguva yekurima*) (HJPA/CD/W8 12022017 Interview, 2017). This is because food reserves will all be exhausted and major food donors focus mainly on donating seeds, fertilisers and equipment for households to grow their own food. The seasonality of food insecurity is because during the farming season, most households focus on farming activities, which leave them with very little time for other income-generating activities. During the off-farming season, most women reported that they focused on other activities. During this time, they use the food reserves from the harvest for household consumption. Due to deforestation, traditional wild foods, insects, fruits and vegetable species are no longer available and those that are do not offer much to promote food security. A similar study in Zimbabwe by Maroyi (2011:522) found that reliance on wild food is affected by deforestation and climatic changes that affect rainfall. This explains why climatic changes events such as droughts, do not promote growth and resilience for ecosystems.

However, it was reported that there are instances of severe cases of drought in the area where farming produces a very small yield (HJPA/CD/Official AGRITEX 20170222, 2017). In these instances, they had to rely on donations, food aid, government subsidies on maize, gifts from neighbours, remittances and other sources (HJPA/CD/FGDs Field Notes Chivi, 2017). According to FEWSNET (2016:7), Chivi District is categorised as a perennial food insecure zone, in the 2015-2016 harvest season Chivi District contributed 6% of the total cereal harvest in the country making people rely more on food purchases. However, the livelihoods options in Chivi District are limited and more so for rural women, who fill their income with subsistence farming, selling their produce or doing additional temporary work such as washing clothes. According to FEWSNET (2016:7), Chivi District lies in a highly food insecure zone and the district is prone to varied natural shocks that have an impact on food security. Most households rely on purchased food despite the fact that the district is reliant on subsistence farming (FEWSNET, 2016:2) (Map 4.2).



Map 4.2: Projected acute food security outcomes, January - March 2016

Source: FEWSNET (2016:3)

4.4.2.1 Availability of food

The study explored the household sources by asking the groups to name their perceived sources of food. The responses provided by both women and men’s groups suggested that the availability of food in the rural households is reliant on available capital that allows them to pursue various livelihoods (HJPA/CD/FGDs Field Notes Chivi, 2017). These capitals are human – such as skills, education and the ability to work; social – such as communities, families; physical –such as livestock and equipment; natural – such as land, water resources; and financial –such as loans (Batterbury, 2008:7). The livelihoods mentioned include, subsistence farming, irrigation and community gardens, food purchasing, food aid and donations. Most households relied more on dryland gardens, which were the main source of domestic income and food supply (HJPA/CD/FGDs Field Notes Chivi, 2017).

Seasonal farming

The research findings suggest that rural communities rely more on seasonal farming for food security. Agriculture has remained the main livelihood option for food and employment over the years. Agriculture has always been the main source of food and income for rural communities in Chivi District. Seasonal and subsistence farming is practised. Each household has a piece of land

to grow crops every season (HJPA/CD/FN Interviews Officials, 2017). The food from seasonal farming is for subsistence consumption. If grain farming operations produce surpluses, they are sold (HJPA/CD/FGDs Field Notes Chivi, 2017). However, due to erratic climate conditions, rural households have found it difficult to practice seasonal farming successfully (Mudzonga, 2012:4). This has contributed to high levels of food insecurity in the district. FGDs conducted in the district revealed that though the district has suffered both droughts and floods, people still perceive seasonal farming as their main source of livelihood and food (HJPA/CD/FGDs Field Notes Chivi, 2017). Representatives of households stated farming as their main source of food – regardless of the challenges communities faced. Water access and availability thus play an important role in ascertaining food security for households in Chivi District. This shows that the relationship of the WEF nexus cannot be denied and coping strategies for security cannot be formulated in sectoral isolation to reduce the impacts on other resources.

Irrigation and dryland gardening

Irrigation and dryland gardening provide food for households. Respondents in areas with irrigation facilities claimed that these sources represent schemes that contribute to both food and income. Irrigation schemes are either community driven or institutionally funded (HJPA/CD/Official AGRITEX 20170222, 2017). This study found community-driven irrigation schemes in ward 11, where communities identify land and seek permission to create small plots for farming using water from the river Tokwe (HJPA/CD/Observation Field Notes Chivi, 2017). These community irrigation schemes lack proper funding, are therefore small scale, and lack proper infrastructure to boost production (HJPA/CD/Official RSC 20170222, 2017). The irrigation schemes that were formulated on community initiative in the district lacked proper infrastructure and this makes watering difficult (HJPA/CD/Official AGRITEX 20170222, 2017). In the FGDs women mentioned that the opportunity to have a plot where they can plant, however small, was an opportunity for ensuring provision of food (HJPA/CD/FGD1 Women 16012017, 2017). They have to water their crops using buckets, but it was reportedly better than not to plant anything. One woman stated:

We have had the privilege to formulate our own small-scale irrigation schemes for food production as a community with the help of the Agritex extension officers. Most NGOs have furnished us with infrastructure that helped us make community gardens that provide us with vegetables for daily household food needs (HJPA/CD/FGD2 Women 02022017, 2017).

The irrigation schemes in these areas rely on small community dams that harvest water during the rainy season for use during the off-season. These small dams were built by the government to improve rural household access to water for domestic and livelihood purposes (HJPA/CD/Official RSC 20170222, 2017). The non-governmental projects for income generation

included the use of boreholes for small-scale community gardens and farms (HJPA/CD/Official WA 20022017, 2017). The most prominent organisations are CARE International, the International Labour Organisation (ILO) and World Vision. They build the infrastructure and provide the necessary machinery and equipment needed for implementation such as boreholes; biogas plants and solar energy for pumping water; the farming inputs such as seed and fertilisers; and engage with the specialists in various governmental departments on behalf of rural people (HJPA/CD/Official 1 NGO 20170214, 2017).

Community gardens are mainly for growing green leafy vegetables and tomatoes, which can be sold in the nearby growth points, or by means of door-to-door selling. The sale of vegetables raises income to buy other food supplies as well as to pay for other basic services (HJPA/CD/FGDs Field Notes Chivi, 2017). These gardens produce good produce in areas where they are successful, however in this district they sometimes only produce enough for household consumption and no excess to sell (HJPA/Official RDC 25022017, 2017). This entails that households may not raise income to purchase other foods needed for a nutritious and healthy diet. The major challenge is water shortage due to drought-induced poor rainfall; low water tables; and the poor management of existing water sources (dams) leading to siltation and eventually drying up (HJPA/Official RDC 25022017, 2017).

Food purchasing

Food purchasing was mentioned as an important source of food in the rural areas where research fieldwork was conducted. In one FGD, some women reported that they would purchase food for their households. Food purchasing was explained as a situation in which the household relies entirely on purchasing all food for consumption. This means the household should have a stable income to avoid food insecurity. One woman said:

Because of the poor condition of our farms, we are forced to buy food from the local market. This is a very challenging situation for me because 20kg of maize costs range from \$5-\$10, depending on the time of the year and I do not have reliable sources of income (HJPA/CD/FGD1 Women 16012017, 2017).

Rural households' reliance on purchased food increases household expenditure on food per annum. The study found that they spent an estimated amount of US\$300-600 per annum in a normal household with four to five people. According to ZIMSTAT (2013:67), rural households spend more on food with an average of US\$550 per annum (40.7%) of cash income and USD\$1,106 (46.3%) of non-cash income (ZIMSTAT, 2013:71). Non-cash income refers to the collection of forest or natural products for household consumption (Shepherd, 2012). These

products include forest fruits, vegetables, animals, medicines and the other forest products that are used in the home to promote production and processing of food.

Food aid programmes

Food aid, donations and subsidies top the list as the main food source in the district. Various NGOs have a variety of projects running in the district to promote food security. Programmes include the food programmes for the poor where NGOs donate food for distribution to vulnerable households. CARE International and social welfare programmes give food insecure households food hampers. Various UN organisations, CARE International and the social welfare department, sponsor orphans and vulnerable children, pregnant and lactating mothers, infants and school feeding programmes.

There are food-for-work programmes aimed at developing, maintaining or refurbishing local resources, such as roads and dams in exchange for food hampers (HJPA/CD/Official 2 NGO 20170215, 2017). Communities are encouraged to do work in exchange for food hampers or cash. These projects contract people to repair public service infrastructure such as dams and roads. These kinds of projects aim to improve self-reliance and lower the risk of dependency of free aid.

Furthermore, NGOs in the district have asset-building programmes such as the heifer project and the goat project where a household is given a heifer or two goats to keep and required to pass on the offspring to other households. Other organisations such as the Zvishavane Water Project, Chomuzangari, ILO, CARITAS, and World Vision have funded projects, such as the community gardens, poultry projects, peanut butter making projects, village savings projects and other initiatives mainly aimed at the reduction of poverty and food insecurity. Through these projects, women are empowered to produce food and goods for sale and for household consumption. However, these projects do not benefit all households due to specifics in target populations.

The findings of the study thus show that food availability relies heavily on household production in this study area. From the discussion above it becomes clear that there are a number of avenues in place to promote the availability of food to the people. However, food availability does not lead to food secure systems. Food security can be affected by access, utilisation and the ecosystems' ability to sustain and replenish the resources imperative to food security. Food system is highly reliant on availability of water for both production and household consumption, clean drinking water and adequate rainfall each season.

4.4.2.2 Factors affecting access to food

Food access is reached when all people have adequate resources to get sufficient food quantity, quality and the varieties needed to maintain healthy nutritious diets (FAO, 1996:18). In order to be food secure, households need to have the power through stable incomes to purchase food available. Food security and food access is directly linked to livelihood opportunities available to rural people. In most rural household food insecurity is poverty induced and the viability of livelihoods goes a long way in ensuring food security. Various challenges limit access to food for rural people, such as the lack of economic resources, poor income, transportation, long distance from retail shops, and high pricing of foodstuffs. Food access is determined by distance and availability of retail shops, access to transportation, and livelihoods (that provide direct food sources or income).

Distance to markets

The study looked at the distance of these rural communities to growth points. The study found that the majority of the women participating in this study lived within 10 km of the nearest shopping centre. However, women in ward 13 reported that though they have Takavarasha shopping centre in close proximity to their villages they still needed to travel to the main Chivi growth point to have access to a variety of products and to have cheaper products (HJPA/CD/FGD3 Women 07022017, 2017). The retail outlets in this area have to transport their goods a long distance from wholesalers. It increases the pricing of certain goods and even makes some of the things needed unavailable as they concentrate on the basics that will sell fast. Some of the women resided within a 15-25km radius from the main growth points and they had to pay transport fare of USD\$2 and sometimes even more, for a single trip, which makes it difficult for them to access goods and limits their choices (HJPA/CD/Observation Field Notes Chivi, 2017). This shows that rural access to food is limited and can lead to food insecurity.

The issue of poor or a lack of reliable transportation makes it very difficult to get to growth points. One woman said:

We have to wake up very early in the morning to get transport to the closest towns and growth points. The minibuses are only available to go to towns in the morning and return late afternoon. Therefore, the plan to go and buy things from the growth point is done well in time (HJPA/CD/W10 12022017 Interview, 2017).

This means one always has to plan and buy things in bulk to minimise movement. Women typically will require a lot of time to go to the shops and return to their homes. Time limits the

access to food for rural people and exacerbates food insecurity. Food should be readily available and within an acceptable distance and quality for food security.

Costs of transportation

The issue of transportation featured as a problem for women in gardening schemes growing fresh vegetables. They complained that they did not have transportation to sell their produce elsewhere. Consequently, they would sell locally at very low prices. It was an unfavourable situation for them to be in as most of these women cited that they would sell their produce to buy the foodstuffs needed for their households. One woman said:

I am producing green leafy vegetables and I have to sell the vegetables to raise income for my household needs. I do not have reliable transport and cannot afford to hire one even as a group we cannot hire because it is expensive. I have to put my vegetables in a sack and walk a long distance to the growth point to sell. This limits the amount I have to sell and times am forced to lower the prices even further so they can be bought fearing to carry the load back home (HJPA/CD/W5 04022017 Interview, 2017).

This shows how transportation has a profound influence on securing access to supplies for food security in rural communities. It shows that rural women in the communities under study do not have full access to food supply services, which lead to food insecurity.

Household income

The study found that rural households' income plays a role in promoting access to food. Household income promotes the capacity to respond to challenges and empowers households to accumulate wealth and purchase goods. The household food security relies on economic access to food. According to ZIMSTAT (2013:59), an average household income for rural households is USD\$1,384 and approximately 40% of this amount is spent on food purchasing only. The real GDP of Zimbabwe as indicated in a 2017 study by the World Bank was at USD\$1,080 per capita (World Bank, 2018). To be food secure, rural women cited aspects that proved that economic access is a key factor. Livelihood options available for these rural women are not viable and reliable to provide adequate income for household needs. Women do not have access to savings and credit facilities.

In an interview, one woman said:

It is very difficult to sustain income for our households as we are facing many challenges, the most relied upon source of income is through farming activities and temporary work. These do not offer sustainable inflow of income. Diversifying is difficult as we do not have the initial capital to start businesses and credit institutions only give credits to those who are formally employed (HJPA/CD/W9 12022017 Interview, 2017).

The flow of income in households have an impact on expenditure and in most households, they would primarily buy food for sustenance. Household income has a bearing on poverty because the available income of households promotes the household's ability to obtain adequate food. This study found that women lack adequate income to buy enough food for their households,

Poor access to productive resources

Food security relies on equal access to productive resources. The study found that in Chivi District, though a variety of initiatives have been put in place by the government and other NGOs, major productive resources are still inaccessible for women and this leads to poverty and food insecurity. Basic production resources include land, labour, and capital. Land is an umbrella term which describes all natural resources and provides households with access to fisheries, farms, woodlands, and more that have an effect on food security (Campbell *et al.*, 2000; Chitja *et al.*, 2016). Natural resources such as food crops and fruits, animals and insects and woodlands are renewable and go a long way in ensuring food security for rural households (Legwaila *et al.*, 2011; Nemarundwe, 2003; Paumgarten & Shackleton, 2011). Land itself is a fixed resource that relies on good management and use to sustain the lives of species found on it. It is the access to land that allows people to produce food for consumption and for sales.

Land is important for agriculture and improving access for women may foster food security for rural households (Baiphethi & Jacobs, 2009; Gumede, 2013). Women reported that the land is under communal ownership. A piece of land is allocated to each household for settlement and for farming purposes. Land in Chivi District mainly supports seasonal farming and ownership of pieces of land comes through inheritance and family reallocation (HJPA/CD/Official AGRITEX 20170222, 2017). Land is usually allocated to male children after they marry, but the divorced or unmarried women are entitled to live off their parents. There is still the belief that a woman can own land through marriage. This has made it difficult for single, divorced or unmarried mothers who still have to work on their parents' land and not have the right to make decisions on how to use the resources afterwards. In some instances when parents die the land is inherited by other males in the family and the women become vulnerable, as the continuation of their use of land will be at

the mercy of the male family members (HJPA/CD/FGD2 Women 02022017, 2017; HJPA/CD/FGD3 Women 07022017, 2017; HJPA/FGD1 Men 15022017, 2017; HJPA/FGD2 Men 17022017, 2017). The access to land is important to provide rural women with pathways to livelihoods, food production and income generation for household food security. The rural land tenure system in this study area is based on patriarchal notions, where women do not have direct access to land and this has had an impact on food security for some households.

From the findings of the study, women are limited in terms of access to resources and not having a say in how resources are to be used within the households. There was consensus on the fact that women do not have general decision-making powers in communities, or even in the household for that matter, on most important matters. However, at country level the status of women has improved in decision-making (Gaidzanwa, 2004:45). The opposite is true at traditional, local and household levels where men are still dominant. Nationally, women can run for political governmental posts such as Member of Parliament, or local councillor (Gaidzanwa, 2004:45). They would then have a certain influence on decision-making and management of resources. Locally, traditional norms are still in place where chiefs, headmen and other local leadership positions are still reserved for men. In rural households in this study, men are chief decision makers. In most cases, the decisions men make will be contrary to achieving food security for the households. One woman gave an example:

The government and NGOs usually donate farming inputs such as fertilisers, ploughs and seeds to help the people during the farming season. The men have absolute powers of decision-making on what to do with such donations. Some men may decide to exchange the received inputs for money, whilst others exchange with food stuffs, e.g. sugar, cooking oil and sometimes beer at the local stores. That season the household will not plant any crops and the money is usually used for selfish purposes which worsen the food insecurity situation for a household (HJPA/CD/FGD2 Women 02022017, 2017).

In an interview, one councillor remarked how sometimes they would wish to work with women on development initiatives, since they have their families at heart. He explained how sometimes they received farming equipment to empower households and improve agriculture only to have some of the men selling these at a giveaway price (HJPA/Official RDC 25022017, 2017). This shows that as women they have limiting conditions to access food and lack an enabling environment to achieve food security.

4.4.2.3 The stability of food supply

According to the results of this study, most rural people indicated that they experience food insecurity in terms of stability. Households gave an exposition of their food insecurity situation looking at the time the situation lasts. Approximately 63.3% of households reported having short-term (transitory) food insecurity. Most of these women indicated that food shortages were experienced during the farming season when families failed to have access to enough food. During this time, most of them rely on food purchases and their concentration on farming leaves them very little time to pursue other forms of livelihoods. Food prices spike during this season (2016-2017), where a bucket of maize was bought for USD\$8 and mills charge USD\$1 for a bucket. Most of them stay far from market centres and needed USD\$2 or more for transport (HJPA/CD/FGD3 Women 07022017, 2017). They complained that this was too expensive for most of them who do not have reliable sources of income and when they do, it is very little. They reported that they might have food shortages for a short period if there are sudden disasters such as drought and cyclones that destroy their crops. Unavailability of commodities on the market, loss of jobs of children and family in towns who send remittances can cause transitory food insecurity (HJPA/CD/FGD1 Women 16012017, 2017).

In addition, 36.7% of the households in the study said that they have experienced long periods of food shortages. They fail to put enough food on the table for their children; – this implies that although they do eat, they do not enough to meet their daily food needs. Women reported that they do not have enough resources that lift them out of poverty, so they can provide enough for their families. They reported that they survive on food donations and aid from the NGOs and the government. They do not have adequate means of earning an income and may not be receiving any remittances. In these households affected by food shortages, some persons may be too old to work and are thus taking care of the grandchildren whose parents have died. Some people are not healthy enough to work. Deteriorating health conditions due to diseases disabled some, making them unable to perform in labour intensive jobs. Its direct consequence was food insufficiency in the household.

Stability of food supply influences the utilisation of food in households. Food utilisation encompasses the quality and quantity of food consumed by households at a given time. Food utilisation includes the preparation of food, nutritional content of foods, dietary diversity and food distribution. The availability and access of food and the stability of food required, have an influence on household food consumption patterns (Guo, 2011; Sibhatu & Qaim, 2017). Food intake and the nutritional value determines the wellbeing of household members and their energy to perform other duties in the home such as farming, fetching firewood and water for household uses. The results of this study pointed out that in most cases, these families eat the food available

to them at a certain time, regardless of nutritional content. Most women said that they do not know much about nutritional composition of food but lived by the norms for food. When asked to elaborate the meaning of this one woman said:

Breakfast is tea and a side dish. Most households skip lunch, and dinner is usually sadza and relish (any available relish), which may be vegetables locally grown or traditional, small animals and insects or meat. We do not pay attention to nutrients we do not have any knowledge of their specifics, but we just try to do the normal consistence of what our meals should be like (HJPA/CD/W7 12022017 Interview, 2017).

This shows that these women are in a situation where their handling of food lead to the poor nutritional status of household members. Food security is achieved when individuals care for their food and pursue good feeding practices and preparation.

4.4.2.4 Food security challenges

Food security in Chivi is affected by climatic changes causing droughts and poor rainfall patterns. Rural households suffer from lack of access to productive resources, such as credit and loan facilities. Credit providers such as banks and loan companies prefer to offer credit to people who are formally employed or with registered assets, such as houses. This proves to be a challenge for rural populations and further makes them vulnerable to poverty and food insecurity in particular.

The availability of good infrastructural facilities such as irrigation, water infrastructure, and road networks are important for the creation of interventions that reduce poverty and promote food security. These would enhance production and facilitate networking to markets. The need for appropriate technologies is essential to promote adoption of viable coping strategies for food security. Besides implementing conservation farming for water preservation, it is a good strategy to promote food security. However, the technique has not yielded better results due to a lack of proper technology and implementation facilities. Access to these facilities create pathways for resilience during disasters for local people.

An official in the food production sector reported that:

Conservation farming has been cited as one of the best farming methods that enhance production. However, farmers do not have access to appropriate technologies that make farming easier. This has reduced the impact of conservation farming a lot (HJPA/CD/Official AGRITEX 20170222, 2017).

The study found that even the intervention from the government and NGOs could not cater for all households in the district. The study found that all the households have food insecurity at some point, short term or long term, but they all reported that they experienced food insufficiency. Due to continued challenges experienced, food insecurity will continue in this area unless there are proper, resilient ways to cope with the challenges. The interventions mentioned above mostly seek to secure food for the current day and might compromise the food security situation for the next day, e.g. selling firewood. There is a need to come up with good resilient strategies based on local knowledge and education on how to use resources wisely especially the natural resources such as the fisheries, timber and non-timber forest products. The resources must be used in a manner that secure them for future generations and utilisation.

4.4.2.5 Coping strategies for food security

There were a number of coping strategies that were identified during the FGDs and individual interviews with participants. Coping strategies for food in Chivi District found in this study include reduction of food intake by skipping meals; rationing; reserving food for children; changing diets and consumption patterns; taking inferior foods and borrowing money and food from others. They identified coping strategies that provided access such as getting food aid, working for food in food-for-work schemes of NGOs, piece jobs (*maricho*) and paid in food stuffs, crop diversification during farming season and selling of household assets. Furthermore, they identified diversification of livelihoods to include migration for wage employment, selling of firewood, selling of other non-timber forest products (NTFPs). Previous studies conducted on food insecurity coping strategies of rural households have yielded similar findings (Harris & Mohammed, 2003; Maroyi, 2011; Mavengahama *et al.*, 2013; Ofoegbu *et al.*, 2016; Paumgarten & Shackleton, 2011; Termote *et al.*, 2010). There are coping strategies related to improving access to food. The research found that in most cases women undertake more than one coping strategy. The findings on the household coping strategies are presented in Table 4.10, which also shows the number of households undertaking a specific strategy at one point in the time of need.

Table 4.10: Percentage distribution of households according to the coping strategies implemented for food security

Coping strategies	No of households		Percentage%	
	Yes	No	Yes	No
Changing consumption patterns	30	-	100	-
Use of non-timber forest products (NTFPs)	30	-	100	-
Reserving food for children	5	25	16.7	83.3
Borrowing money or food from others	10	20	33.3	66.7
Food / Humanitarian aid	26	4	86.7	13.3
Off-farm livelihoods	17	13	56.7	43.3
Crop diversification	27	3	90	10
Selling of household assets	7	23	23.3	76.7
Migration of family members	30	-	100	

Source: HJPA/CD/FGDs Field Notes Chivi (2017)

Women in FGDs were asked which coping strategies they implemented to cushion household food insecurity. A variety of coping mechanisms were brought forward and households indicated which ones they used for food security in their households. Table 4.10 shows the coping strategies that rural women resort to when facing food security challenges. The research found that there were common strategies that were practised by households to which all women attested to have used before or during the time of the field visit. The most common strategies used by all households were reportedly chosen because they are no cost or low-cost coping strategies. These strategies mainly promote behaviour and consumption changes. The use of NTFPs require the physical capability to collect the wild forest products for household consumption. All the households (100%) sampled agreed to have used or was using common mechanisms such as skipping meals and food rationing by reducing portions and varieties in a meal which entails changing household consumption patterns and behaviours of the available resources. Food and humanitarian aid had a higher percentage because it is also a costless coping mechanism for households.

Change of consumption patterns to cope with food insecurity

Due to long-term or short-term food shortages, the rural households affected have resorted to food rationing. Food rationing was done through the reduction of the amount of food for one person or by reducing the varieties of food in one plate. Officials in the food security sector agencies mentioned that these coping mechanisms were used the most in rural areas. Food rationing starts during food preparation where the sizes of pots used will be reduced. Women

argued that this is helpful because it helps them to save food and to ensure that it lasts until such a time they can get another supply. One woman said:

My children are all at the school attending ages and leave for school each morning. Then we make sure they eat solid meals especially yesterday's leftovers. Lunch time is usually skipped, and they have a light meal of maybe tea and mutakura (mixture of grains boiled together e.g. maize and round nuts) or sweet potatoes (mbambaira) if in season. At night, we have another solid meal of Sadza and relish (HJPA/CD/FGD1 Women 16012017, 2017).

Use of non-timber forest products (NTFPS) to cope with food insecurity

The research found that 100% of the respondents' households in the rural areas rely on NTFPs to supplement their dietary needs (HJPA/CD/FGD1 Women 16012017, 2017; HJPA/CD/FGD2 Women 02022017, 2017; HJPA/CD/FGD3 Women 07022017, 2017). These are products and services, other than timber, produced in the forests as a natural environment. These include edible insects, fruits and nuts, vegetables, fish and game and an array of other products. Rural women agreed that the NTFPs are the most relied upon source of food during the times of serious food insecurity as well as general household food supply. Some of the NTFPs are seasonal especially certain fruits, insects and vegetables (HJPA/CD/FGD2 Women 02022017, 2017). In addition, during every season, households make use of available fruits, vegetables and insects that are available in the forests to sustain themselves and cope with food insecurity.

The women in this study reported that various NTFPs are available in different seasons: some in the rainy season, dry season, or both. They explained how most of the NTFPs, especially vegetables and insects, are available during the rainy season and preserved for use in the dry season. There are a number of vegetables, fruits and insects that were mentioned as useful to households. Image 4.9 shows a woman collecting termites (*shwarara*) after the rain had stopped and how they preserve them by drying them for future use (Image 4.9, bottom right).



Image 4.9: Picture showing a woman collecting flying termites and how they are preserved for future use

Photograph: HJPA/CD/FCSP 29012017 (2017)

The NTFPs mentioned are insects and small animals, which include mopane worms (*Madora/Gonimbrasia belina*), termites (*Majuru ne Shwarara/Alates*), locusts (*Mhashu*), crickets (*Zvikugwe*), mice (*Mbeva*) and others. Vegetables include the spider flower (*Nyovhi/Rudhe/Cleome gynandra*), wild gherkin leaves (*Muchacha/Cucumis anguria*), black jack leaves (*Mutsine/ Bidens pilosa*), pigweed leaves (*Mbuya/Amaranthus hybridus*), and wild jute leaves (*Derere/Corchorus tridens*). Fruits included, spiny cucumber (*Magaka/Cucumis metuliferus naudinl*), brown ivory (*Nyii/ Berchemia discolor*), wild fig (*Mawonde/Ficus sur*), mobola plum (*Shuma/Parinari curatellifolia*), baobab fruit (*Mauyu/Adansonia digitata*). This corresponds with research by Faber *et al* (2010), Harris and Mohammed (2003), (Hunter *et al.*, 2007), Maroyi (2011), Maroyi (2013), Mavengahama *et al* (2013), as well as, Termote *et al* (2010), who found that rural households rely on the use of wild species to supplement their dietary needs.

Temporary migration of family members to cope with food insecurity

The study found that migration trends of family members are common in households. All households reported that some of their family members have migrated. Most migrated temporarily to search for jobs that can help them raise money to take care of families at home. One woman reported that all households in her area had, at some point, family members that moved either to the urban areas of neighbouring countries in search of jobs to help those at home (HJPA/CD/W7 12022017 Interview, 2017). From the discussions with men, it was gathered that able-bodied young men and women mostly choose to go to either South Africa or Botswana in search of low skill jobs (HJPA/FGD2 Men 17022017, 2017). This has helped to reduce the impact of food insecurity. Most send food and money back home. A negative consequence of these departures is evident. Migration reduces the agricultural production of most families. The loss of human capital influences the work done in the household.

Family support systems also play a role as a coping strategy for food security challenges. In some families, it emerged that the wealthier relatives and family members volunteer to take some children from the burdened households and take care of them. These wealthier relatives become responsible for feeding, educating, sheltering, clothing and providing access to health facilities for the temporarily adopted children. It emerged from this study that it is a common practice in these communities that the ones in better economic positions will take care of some of the family members to lessen the burden on the poorer households. In some cases, relatives help in finding temporary employment for youths as caretakers and housekeepers in towns and cities. This helps to provide households with an income and cater for their needs. To explain this one woman said:

Relatives with better living standards may take some of the children to stay with them. This also lessens the burden of securing food (HJPA/CD/W1 04022017 Interview, 2017).

Some communities have families that have permanently migrated to other areas with better soils for agriculture. An official said:

Our people were hard hit by the 2007-2008 economic crisis that was made worse by the poor state of our soils and limited rainfall. Most people did not produce anything in the field and moved to stay in other places permanently. Some have moved to Gutu, Mwenezi, Masvingo rural resettlement areas and Chiredzi. This was their only way of ensuring they will survive food shortages (HJPA/Official RDC 25022017, 2017).

Similar studies on coping with food insecurity studies have found both permanent and temporary migration is resorted to during worst cases in the rural areas (Ghimire, 2014; Gillespie & Gillespie,

2006; Indu *et al.*, 1998; Maxwell & Caldwell, 2008; Quaye, 2008). This shows that migration is a common strategy to cope with food insecurity for some households.

Implementing crop diversification to cope with food insecurity

Crop diversification is also a well-implemented strategy. The majority of households (86.7%) use crop diversification as a coping mechanism while 13.3% of households reported they farm maize, which is the most popular. Studies by Brush *et al.*, (2000); Muchadeyi *et al.*, (2004) and Rukuni *et al.*, (2006) have found that small grain farming is used by some rural household to produce enough food for consumption and surplus for selling on local markets or barter exchange with some goods or services. The people are encouraged to farm drought resistant crops, which are the small grains such as *Rukweza*, *Mhunga* and *Mapfunde* to supplement their maize yields. The reason for diversification of crops and benefits of adopting small grain farming was explained by an agricultural official who said that, “*due to the amount of rainfall received in the district the maize crop production is not producing good yields to sustain families even at subsistence level*” (HJPA/CD/Official AGRITEX 20170222, 2017) The major challenge is that though the meal from these small grains ranks second in Zimbabwe after maize they are still highly unpopular and considered low class despite their health benefits. One woman in an interview said:

Chinonetsa pakurima zviyo vana vechidiki sadza racho havaridi zvachose, zvongozokusundazve mubereki kutenga upfu hwamabagwe (the problem of farming small grains is that the meal from these grains is very unpopular among the younger generation which will force the parents to buy maize meal) (HJPA/CD/W8 12022017 Interview, 2017).

In spite of this assertion, these crops are drought resistant and can survive higher temperatures in the district than maize.

Borrowing and begging for food and money

This study found that 33.3% of households borrow food or money from relatives and neighbours. It includes begging for food handouts from neighbours and relative. Two-thirds (66.7%) of the households do not use this coping mechanism for food insecurity although they reported that it is common to ask a neighbour for a quick food relief such as salt and sugar, tea leaves and cooking oil, which sometimes run out before they get a chance to go and buy at the local shops.

Food and humanitarian aid programmes to cope with food insecurity

Rural households rely on food aid from government and various organisations. About 86.7% of households in the study receive food or other humanitarian aid. The most popular food aid

projects are funded by CARE International where poor households are chosen and given food handouts. The package usually includes meal for soft porridge, beans, cooking oil, maize, rice, lentils, barley rice and other commodities (HJPA/CD/Official 1 NGO 20170214, 2017; HJPA/CD/Official 2 NGO 20170215, 2017; HJPA/CD/Official SW 20022017, 2017; HJPA/FGD2 Men 17022017, 2017). The social welfare of Zimbabwe has feeding programmes for children, the physically handicapped and other vulnerable groups where they give them food handouts and sometimes grants to buy basics (HJPA/CD/Official SW 20022017, 2017). There are other projects funded by other organisations such as gardens, small livestock projects and irrigation schemes that have created pathways for rural households to cope with food insecurity (HJPA/CD/Official WA 20022017, 2017).

However, not all vulnerable households benefit from this. In this study, 13.3% of households reported that they have not benefited from food aid projects and had to find their own means of ensuring they had enough food. Interviews with officials brought to light that it is difficult to have enough funding to provide for all households in the area (HJPA/CD/Official 1 NGO 20170214, 2017; HJPA/CD/Official SW 20022017, 2017). Though we see the need because of too many challenges faced to secure enough food at household level, the aid received for the district is not enough to cater for all households, but there are certain characteristics (such as disabilities) considered for one to be chosen as a beneficiary. The findings on aid correspond with studies done by Del Ninno *et al* (2007), Gandure and Drimie (2011), Haile (2005), and Maxwell *et al* (2003), where food aid was reported to be one of the strategies relied on to mitigate food insecurity on both short term and long term basis. Humanitarian funding was reported to be very helpful in alleviating poverty, food insecurity and improving the well-being of poor people in some cases and good humanitarian strategies should not create dependency and hinder development (FEWSNET, 2017; Gandure *et al.*, 2010). In an interview, an official said:

We have to select the most vulnerable in the communities such as orphans and vulnerable children, the handicapped, the elderly and people living with HIV and AIDS. In this way, we reduce the impact of food insecurity. The able-bodied people offer labour in community development projects, such as road maintenance, in exchange for money or food packages. This is done mainly to curb the dependency syndrome and push people to be innovative and work for their needs (HJPA/CD/Official 2 NGO 20170215, 2017).

This shows that though the district has a higher rate of food insecurity the responses offered by NGOs and the government push for development. They aim not to create dependency syndrome but to ensure that citizens are reminded that they need to work for their needs (HJPA/CD/Official 1 NGO 20170214, 2017). Local food and development projects in the area help people to find

employment and livelihood pathways out of poverty (HJPA/CD/Official WA 20022017, 2017). Some projects focus on women only and aim to empower rural women by providing them with means for raising income for their households needs. These include projects such as, community gardens; livestock pass-on projects, poultry projects, irrigations and ensure food security (HJPA/CD/Official 2 NGO 20170215, 2017; HJPA/CD/Official AGRITEX 20170222, 2017; HJPA/CD/Official SW 20022017, 2017; HJPA/CD/Official WA 20022017, 2017; HJPA/Official RDC 25022017, 2017). It aims to empower single mothers, divorcees, widows and the married who are vulnerable and in poor situations (HJPA/CD/Official WA 20022017, 2017). They mainly chose mothers or household heads, in cases of female child headed households, who have families to take care of and need resources. This shows that the areas are less resilient to food insecurity. See Image 4.10 below:



Image 4.10: Illustrations of an NGO-funded community garden and poultry project for women in Chivi District

Photograph: HJPA/ FPW February2017 (2017)

Due to continuous varied challenges, most households in rural areas have exhausted their assets and rely on aid programmes (HJPA/CD/W8 12022017 Interview, 2017; HJPA/W6 12022017 Interview, 2017). Years of consecutive and erratic drought had an impact on both animal production and agriculture. Household assets were sold to generate income or for household consumption, in a bid to cope with the challenges. Thus, many rural households do not own cattle, goats and chickens or have any assets that they could sell or rely on in crisis (HJPA/Official RDC

25022017, 2017). Guo (2011:108) argues that household assets play a role on enabling food security and that building on household assets can create pathways for food security and development. There have been efforts by various organisations and the government to improve household income and asset base through provision of agricultural tools and machinery at both community and household levels. The heifer and goat pass-on projects were also meant to ensure that the poorer households could have an asset-base to fall back on in times of need (HJPA/CD/Official 1 NGO 20170214, 2017).

These programmes and projects are some of the various coping strategies used by people to counter challenges and maintain wellbeing that have an effect on the social ecological system (HJPA/CD/Official 1 NGO 20170214, 2017). Coping strategies help to stabilise households during times of need but some cause major effects in the future. It is therefore important to come up with good coping strategies that foster the resilience and adaptation of both rural households and the ecosystem. Such resilient options can be derived through remembrance of past occurrences, how they were dealt with, and examine the impact of past actions on stability and sustainability of systems. Resilient systems have to be innovative and management of natural resources should be promoted.

Off-farm income generating activities for food

Women engage in various off-farm activities that raise income to buy food. The study found that 56.7% of the households engaged in activities such as selling firewood, piecework, cross border trading, *Chikande* (pooling resources together and sharing them later or giving to one person each month). Some women reported travelling across borders to acquire goods for resale. Pottery and knitting of booties and gloves were reported. The remaining 43.3% of the households were not involved in any other activities besides farming. Some livelihood options have detrimental effects on the environment; the most common include selling firewood to the local townships, schools and villagers to raise income to purchase food. Excessive cutting down of trees for firewood can cause challenges for access to food in Chivi District. The challenges are due to deforestation that reduce the capacity of the local forests to provide people with wild food (NTFPs) and increases erosion. The people now go into the forests and fell down many trees and go home to let it dry before collecting it. This has caused deforestation, that lead to increased erosion, siltation and even impact on soil quality for food production (HJPA/FGD2 Men 17022017, 2017; HJPA/Official RDC 25022017, 2017). The irresponsible cutting down of trees has an impact on the stability and sustainability of the natural resources and the ecosystem. It also reduces the resilience capacity of the environment to maintain its natural status in the ecosystem.

It is important for a household to have other income generating activities they can engage in to raise income. Efforts must be made by the state, to improve access to credits and other resources especially for rural women (HJPA/CD/Official AGRITEX 20170222, 2017). One official said:

The running peanut butter project is a testimony as women involved attest to that it has greatly improved their lives. The major problems are that most women have no access to funding and inputs (HJPA/Official RDC 25022017, 2017).

This shows that off-farm livelihood options are a coping strategy for food security for a number of households. This corresponds with the study by Matshe (2004:184), on off-farm work in rural Zimbabwe where it is argued that the increase in off farm work has the potential to improve food security and that incentives should be put in place to encourage households to engage in off farm activities. This shows how imperative it is to formulate income generating strategies for rural households.

Household assets

Households rely on assets to formulate coping strategies for food insecurity. A household with assets could raise income through selling of assets in times of crisis (Beverly *et al.*, 2003; Ribar & Hamrick, 2003). The study found that 23.3% of the households reported selling their assets to raise income for food; the remaining 76.7% of the households did not use this strategy citing that they have no assets, which they can sell (HJPA/CD/FGD1 Women 16012017, 2017; HJPA/CD/FGD2 Women 02022017, 2017; HJPA/FGD2 Men 17022017, 2017). Household assets create ways of the household's ability to cope with challenges (Ghimire, 2014:1; Mavhura *et al.*, 2013:42). Similar studies on coping strategies for food security found that household's assets play a major role in food security but found that impoverished people hardly have any assets to rely on in food crisis (Aasoglenang & Bonye, 2013; Chagomoka *et al.*, 2016; Kinsey *et al.*, 1998). Therefore, assets are an important factor in ensuring household food security. The few households who rely on household assets claimed they sold their small livestock to get income and some kept small livestock for their own consumption in crisis. However, the majority of households in the rural areas studied did not have assets to rely on. This is because of the continuity of food insecurity challenges and the need for other basic services their asset base has been exhausted without means to rebuild them (HJPA/CD/FGD2 Women 02022017, 2017; HJPA/CD/Official 2 NGO 20170215, 2017). The study thus found that the communities and households under study were food insecure in terms of access and availability. The study found challenges that affected food security includes, climatic changes leading to severe droughts. The district is affected by climatic changes that have a destructive impact on agriculture. Droughts has reduced the amount of yields that households harvest per each farming season, making

households food insecure. Most households reported they had lack of assets to fall back on due to economic challenges in the country. These economic challenges worsened the poor conditions of the rural households; people were forced to sell their assets to buy food, which became scarce and very expensive. Opportunities for credit and loan facilities are available only for people who have formal jobs.

4.4.3 Energy security

Energy is an important factor in the development and reduction of poverty for people living in the rural areas (Adkins *et al.*, 2012:1087). Rural households need energy for various purposes and energy required differs from households and activities. The main and common activities for energy use in the household include, cooking, heating and lighting the area (Johnson & Bryden, 2012a; Kowsari & Zerriffi, 2011; Marufu *et al.*, 1997; Matsika *et al.*, 2013). Energy consumption is categorised under, direct and indirect energy uses. Direct energy use refers to the use of electricity, natural gases, and fossil fuels in households. Indirect energy use includes, energy used for production, transportation of goods and services (Adkins *et al.*, 2012). This study mainly focused on direct uses of energy. Energy for production was considered with special focus on livelihoods of rural women. The most reported used forms of energy in the rural areas include, kerosene, candles, biomass, fossil fuels and other. A household is regarded as energy secure if it has the adequate amount of energy for use that meets its needs (Brunner *et al.*, 2012; Karekezi & Majoro, 2002; Mansson *et al.*, 2014).

The objective of this study was to find out the rural women's perceptions about energy and the various factors that affect household energy security. The study explored the strategies that are available and used by rural women to ensure they have enough energy for their household needs. According to Desalu *et al.* (2012:2) over three billion people in the world are using solid fuels for cooking and heating in their households. Energy is one of the major contributing factors in poverty mitigation and sustainable development (Cherni *et al.*, 2007; Kaygusuz, 2011; Miah *et al.*, 2010). Energy is also a relevant commodity for the well-being and eminence of life in the rural areas across the world (Adkins *et al.*, 2012; Barnes & Floor, 2003; Howells *et al.*, 2005; Matsika *et al.*, 2013; Miah *et al.*, 2010). The study thus sought to find out the availability, accessibility, security of supply of energy sources, and major uses of energy in rural households.

4.4.3.1 Household energy supply and uses

The study found that energy services in this area were mainly required for cooking, heating, lighting, processing and production purposes. The study found that cooking and heating consumes the largest part of energy in these households. The available energy sources that were reported included fuelwood, biomass fuels, electricity, kerosene, Liquefied petroleum gas (LPG),

bio-gas and solar energy (HJPA/CD/FGD1 Women 16012017, 2017; HJPA/CD/FGD2 Women 02022017, 2017; HJPA/CD/FGD3 Women 07022017, 2017; HJPA/FGD1 Men 15022017, 2017; HJPA/FGD2 Men 17022017, 2017). The firewood was collected from nearby bushes and forests or purchased from firewood sellers locally, biomass fuel is from crop remains e.g. maize stalks or the maize core (*maguri*). Fuelwood and biomass are reportedly the major sources of households in this area (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/CD/FN Interviews Officials, 2017). These fuels are categorised as solid fuels and often associated with pollution and toxicity that is detrimental to human health. Even though these fuels are regarded as health hazard the use of these solid fuel were recorded to be very high in this district with many rural households relying on them for energy (ZIMSTAT, 2012:117).

Biomass is used in the absence of firewood or to supplement firewood, which is the main source of energy. Biomass is not always available for use. It is only available after harvest and the stalks are reserved for animals, thus they use the cobs of maize after shelling but this is used together with firewood. Kerosene was mentioned but they reported that it was not used for cooking due to its costs and is thus mainly reserved for lighting. The study found that energy for lighting is very important in all rural households. Women reported that the major sources of lights in their homes is from self-made paraffin lamps (*Chibani, Rambi*) and candles. These sources of energy are part of households' expenditure bills and purchasing the energy cannot be avoided since lighting is crucial in rural households. In some areas in Chivi, there is an initiative to have homes electrified if individuals have the capital to pay for the connection services and infrastructure. The government has a mission to electrify rural areas but due to funding shortages, the electrification process can be done individually by households, as the service is made available through the rural electrification programme. However, the majority of households in the rural areas under study do not have enough capital to electrify their homes. Solar energy is mainly used for radios and mobile phone charging. Rural women reported that they use solar energy to recharge their mobile phones or they have to pay a fee to recharge their phones in households that have electricity.

4.4.3.2 Household fuel choices and challenges

Women in Chivi District outlined all the various sources of energy that they knew existed and how they are best used in the households. The researcher sought to find out if these women had different choices of energy for the major household uses. According to Johnson and Bryden (2012a:284), all household energy uses are driven by basic domestic needs that include cooking water heating, space heating, income generation activities, transportation, communication and public services. In this study, the other activities such as transportation, communication and public services were classified under other uses of a certain type of energy as reported by the

respondents. The less recognised forms of energy in the households' daily use of energy services as reported were classified under other types of fuel. For this study, firewood was separated from other biomass fuels in the Chivi District for clarity (see Table 4.11).

Table 4.11: Number of households out of 30 using a fuel type at one point per activity

Type of fuel	Cooking/heating		Lighting		Income generation		Other	
	No	%	No	%	No	%	No	%
Wood	30		03	10	22	73.3	-	
Bio-mass	25		-		-		13	43.3
Kerosene	01	3.3	16	53.3	-		-	
Candles	-		7	23.3	-		-	
Bio-gas	-		-		13	43.3	-	
LP-gas	-		-		-		-	
Electricity	-		02	6.7	01	3.3	07	23.3
Solar	-		02	6.7	-		23	76.7
Other (e.g. Petrol, diesel, animals)	-		-		23	76.7	30	100

Source: HJPA/CD/FGDs Field Notes Chivi (2017)

The study found that 100% of the households represented relied on firewood for cooking. The other women reportedly use other fuels in the absence or shortage of firewood. About 83.3% of the households' supplement firewood with biomass fuels. Only 3.3% of households used kerosene for cooking and heating if available. For lighting purposes, kerosene use ranked high within 53.3% of households, 23.3% reported using candles, whilst 10% of the households used wood. Furthermore, 6.7% of the households use electricity and another 6.7% use solar panels for lighting.

The study found that besides cooking, heating and lighting energy is required for income generation in the livelihood options available to rural people. Reportedly, use of energy includes income generation and livelihood activities such as brick making (firewood to burn the bricks); gardening (solar and biogas energy to pump water from underground); transportation of surplus products for sale/consumption elsewhere (diesel, petrol, human and draught power); processing of food products such as peanut butter, mealie meal, vegetables (diesel, electricity, and human energy). The livelihood options available to rural people require various energy sources for successful production. Findings show that 73.3%, of households use firewood for income generation as either an input or selling the firewood. The other, 43.3% of households, use the biogas plant donated by ILO for community projects. Furthermore, 23.3% used other sources of

fuel for income generation such as diesel, petrol and animals and 3.3% households reported using electricity for income generation.

Some households reported other uses of fuel. All households (100%) reported that they needed other fuels for transportation of finished products to markets. The use of tractors to plough their land requires diesel, animal draught power is used to carry mainly crops from farms to home and the markets. Daily household chores require human energy and ability to execute them. They need other sources of energy for entertainment and communication purposes. Reportedly, 76.7% of households use solar energy for recharging their mobile phones and playing radios for entertainment at home. Furthermore, 23.3% of households reported they recharge their mobile phones at the nearby homes with electricity for a stipulated fee of 0.50 cents per full charge. Biomass is used to feed the animals during the dry season, which helps to give continued draught power for daily activities. Some women reported that they use biomass to produce biogas at a local community project for women in ward 11. Of the households represented, 43.3% reported using biomass for other purposes of energy supply.

Firewood

Firewood is the main type of energy for household use in Chivi rural district area under study; it was reportedly used for a number of purposes within the household. Firewood was reportedly used for cooking, heating, lighting and for use in income generation and livelihoods activities. The women reported that firewood was the major and most important fuel type that made survival possible (HJPA/CD/FGD1 Women 16012017, 2017; HJPA/CD/FGD2 Women 02022017, 2017; HJPA/CD/FGD3 Women 07022017, 2017). Firewood is used every day in a number of household activities. Therefore, it is imperative to have a stable and continued supply of firewood for every household. The firewood is reportedly acquired through collection from nearby forests and some households resort to purchasing firewood. All participating households reported that they collected their own firewood either from the nearby forests, the land that they own or randomly in the nearby bushes (HJPA/CD/FGDs Field Notes Chivi, 2017). The purchase of firewood was done mainly for livelihood activities such as beer brewing and brickmaking that would require bulk supplies of firewood.

They responded that though firewood was their main source of fuel it was increasingly becoming scarce and difficult to find (HJPA/CD/FGDs Field Notes Chivi, 2017). The women reported that not all trees produced good firewood; some do not burn well and produce excessive smoke thereby making it difficult to use them. They reported that due to excessive collection of firewood, the forests have diminished a lot and they have to walk long distances to fetch firewood (HJPA/CD/FGD2 Women 02022017, 2017). The women reported that before the firewood became scarce they were selective of the firewood they used indoors, however due to scarcity

they now settle for any type of wood (HJPA/CD/FGD3 Women 07022017, 2017). The laws that were made against tree cutting in rural areas reportedly exacerbate firewood scarcity. The law inhibits people from cutting trees for firewood and if seen with damp wood you would be prosecuted for cutting down trees. Only naturally dry wood is accepted for collection. This increased the unruly and unnecessary cutting down of trees. People now fell trees in bulk and leave it to dry for collection. An official reported that:

The law against tree felling was done to protect the environment and the indigenous tree species. The government realised that the way in which trees were being felled posed a danger to the environment. Therefore the unnecessary cutting down of trees has a penalty if caught. In addition, to make it successful the local traditional leadership are the custodians of this law (HJPA/CD/Official EMA 20170214, 2017).

In most areas in the district there was excessive cutting down of trees in the past that led to deforestation of most areas. Few big trees are available which leads to the risk of erosion, and poor soil fertility for food production. This shows the effects that overcutting of trees have on food production. One woman said, *“We collect firewood from very far as we are forced to use only wood from trees that die naturally”* (HJPA/CD/W3 04022017 Interview, 2017). Though the people are permitted to use firewood from naturally dead trees, they are taught ways to cut wood from trees in a conservative manner. They are encouraged to cut down only branches and not fell the whole tree from the roots. This coping strategy has failed as people still cut down the whole tree, as reported. Some cut down trees and leave them to dry. They collect the wood when it is completely dry and this despite the effects on environment is regarded as a coping strategy for firewood by the people who believe wood is free and should not be restricted (HJPA/CD/Official EMA 20170214, 2017). This poses challenges for the future of firewood availability and environmental stability. The people who use firewood for income generation are primarily firewood sellers, beer brewers, brick makers and potters. They require constant supply of firewood. These become everyday activities that require huge supplies of wood (HJPA/Official RDC 25022017, 2017). The rate of firewood supply to purchasers equals the number of trees that will be chopped and speed up the rate of deforestation and scarcity. This reduces WEF nexus security and the resilience capacities of both the natural and human systems.

The women reported that they were the main firewood collectors in their households and sometimes spend several hours walking to and from firewood collection areas, sometimes as far as 5km (HJPA/CD/FGD3 Women 07022017, 2017). This has caused households to store firewood stocks in the compounds and reserve time for firewood collection once or twice a week (HJPA/CD/Observation Field Notes Chivi, 2017). Some households collected firewood with the

help of animal power where they use an animal drawn cart to fetch firewood but mostly they rely on human power through carrying it on their head or pushing wheelbarrows (HJPA/CD/FGD2 Women 02022017, 2017). The women reported that sometimes girls would help in the fetching of firewood during weekends and school holidays. Men normally fetched firewood in cases where women are either unavailable, or when the household owns a cart (*Ngoro*). One man said:

We help with fetching of firewood for households when we have access to a donkey drawn cart or when it is needed for major uses in livelihood activities such as beer brewing, brick and pottery making. We fetch firewood for community needs such as funerals, rituals and other major needs where wood is required in bulk. For everyday household use, women and children are responsible (HJPA/FGD1 Men 15022017, 2017).

The women reported that firewood scarcity is realised much more in the winter than in summer because during the winter, households use a lot more firewood than in summer (HJPA/CD/W4 04022017 Interview, 2017). In winter they need more firewood for heating up spaces and keeping warm and they also cook more (HJPA/CD/FGD3 Women 07022017, 2017; HJPA/FGD2 Men 17022017, 2017). This leads to much more cutting down of trees and by so doing, the wood is becoming scarce in these areas. This forced households to change their consumption patterns to ensure they cope with wood scarcity challenges. Households practice efficient ways of using firewood and saving it to cope with shortages. One woman said that:

We limit the number of big logs (Matanda), we put in the fire at once, limiting them to two or three and add other bio-mass fuels such as twigs (Tsotso), crop residue and dung in some instances to aid the wood (HJPA/CD/W10 12022017 Interview, 2017).

They also resort to putting out the fire after use using water so that wood can be preserved. Similar studies Adkins *et al.* (2012); Barnes & Floor, (2003); Davis, (1998); Hosier & Dowd, (1987); as well as Howells *et al.*, (2005) on, rural household energy security found that firewood is the main source of fuel in rural homes. Firewood collection takes up most of the time in the home that can be used for other activities and that the principal firewood collectors in the home are women.

Biomass

The biomass fuels frequently used in the areas studied included, cow dung, agricultural residues such as maize cobs and twigs (*Tsotso*). The agricultural residues are used according to seasonal availability (HJPA/CD/FGD2 Women 02022017, 2017). During drought season, it was reported that households do not have access to cobs and stalks to use for fire. In most households, the only crop residue used is the maize cobs because they reserved the maize stalks to feed the

livestock during the dry season (HJPA/CD/FGD2 Women 02022017, 2017). Cow dung was not mainly used because of the few animals available to provide the dung (HJPA/CD/W9 12022017 Interview, 2017). Dung was not highly favoured because of the smell it produces when it burns. However, due to scarcity people are sometimes forced to supplement firewood with cow dung. Cow dung was reportedly consistently used for a community project that relied on biogas. The project has a bio-gas power plant that uses cow dung and other bio-mass materials such as crop residues which are fermented and produce gas for pumping water and lighting the project area (HJPA/CD/Official Mechanisation 1 20170222, 2017; HJPA/CD/Official WA 20022017, 2017; HJPA/Official RDC 25022017, 2017). The gas is used to cook when there are project meetings and in the areas studied, it was a project that was in only one area of the study and benefitted women in ward 11.

The women reported that the maize cobs were good sources of energy for lighting in the kitchen, one woman said:

I use maize cobs for lighting in the kitchen by constantly feeding it to the fire. Cobs provide better quality light in the kitchen than even kerosene and candles. The major problem is that you need a lot of cobs for a continued lighting supply and it depends on the harvest as well as time of the year. Cobs are usually available during the time when we shell the maize and pack it for storage (HJPA/W6 12022017 Interview, 2017).

The only disadvantage of maize cobs is the amount of ash and dust they produce which eventually makes the fire poor and a health hazard (HJPA/W6 12022017 Interview, 2017). Maize cobs cause a lot of smoke if fed incorrectly into the fire. They have to be very dry. The use of biomass fuel in rural households has been reported in other studies around Zimbabwe, which found that biomass fuels are used as a supplement or on their own for household purposes (Adkins *et al.*, 2012; Barnes & Floor, 2003; Davis, 1998). These factors show that there is fuel in sufficiency in the rural households studied. The use of poor-quality fuels that pose threats to human health show that rural households are less resilient.

Non-solid fuels

According to Desalu *et al.* (2012:1), there are two types of fuel categories, solid fuels and the non-solid fuels. The non-solid fuels includes kerosene (paraffin), LPG, biogas, electricity and candles. Though these energy types were mentioned in this study reliance upon them for energy sources was minimal and limited only to certain uses (HJPA/CD/FGDs Field Notes Chivi, 2017). The reason for limitations were mainly related to income and expenditure on fuel for household uses. Women reported that though they knew about gas for household uses such as cooking lighting

and heating, it was too expensive for them to use (HJPA/CD/FGD2 Women 02022017, 2017). This means that zero households use gas for household consumption. Bio-gas was used in one project funded by an NGO for gardening and other projects (HJPA/CD/Official WA 20022017, 2017). The women reported that it was highly impossible to have adequate requirements at household level for building a bio-gas plant for household use (HJPA/CD/FGD2 Women 02022017, 2017). An official in the mechanization department supported this by saying:

A bio-gas plant requires a huge sum of money to build the infrastructure and it requires that one should feed the plant at least 20kg of fermenting mass be it from crops or any waste of which many households do not have access to (HJPA/CD/Official Mechanisation 1 20170222, 2017).

The study found that 1kg of LP gas sold for \$2 at the local market. Average households would need about 10kg of gas for cooking only (HJPA/CD/Observation Field Notes Chivi, 2017). This would mean spending about \$20 dollars each month for energy, which is beyond the means of most households in the rural areas. According to ZIMSTAT (2013:72), rural households spend on average USD\$192 (14.2%) of cash income and USD\$584 (24.4%) of non-cash income on housing, energy and water.

The use of kerosene ranked high for lighting in the rural homes and in all the rural homes under survey they did not use kerosene for cooking and heating except for one household that used it due to extreme circumstances of firewood shortages (HJPA/CD/FGDs Field Notes Chivi, 2017). They said that kerosene is expensive and therefore could not afford to use it for cooking and heating (HJPA/CD/FGD1 Women 16012017, 2017; HJPA/CD/FGD2 Women 02022017, 2017; HJPA/CD/FGD3 Women 07022017, 2017). They reported that kerosene produces strong smells when used for cooking and does not provide enough heat for warming spaces. They reported that they use kerosene for lighting as they make their own lamps using used bottles of wine and other bottles with sealable caps, usually picked up from nearby shopping centres (HJPA/CD/FGD1 Women 16012017, 2017). People discovered that water and kerosene do not mix and that if you put water, kerosene in one bottle, the water goes below, and kerosene above which makes it to last longer than using kerosene alone (HJPA/CD/FGD3 Women 07022017, 2017). The price of kerosene was \$1.50 for 750ml/ℓ and most women said that they would use the same bottle for a month before they bought another bottle. This made it a better option than candles which though they are used only a few households could afford to maintain the use of candles.

The study found that some households (23.3%) used candles. They reported that a household would use one candle for approximately two or three days depending on time they retired to bed (HJPA/CD/FGD3 Women 07022017, 2017). Candles were reportedly cleaner than kerosene as they did not smoke or produce a bad smell and households using them said they had ways to

promote longevity by using them only when cooking and eating and using fire for lighting when relaxing in the evening (HJPA/CD/W2 04022017 Interview, 2017; HJPA/CD/W5 04022017 Interview, 2017; HJPA/CD/W9 12022017 Interview, 2017). They used candles only when they needed to make their beds. Households with schoolchildren used candles more as they provided for their study light. Though kerosene lamps were used the candlelight was reported to have a better light for study purposes. One candle costs 0.50 cents and a household needed about 8-12 candles (+/- \$5) per month depending on household use (HJPA/CD/FGDs Field Notes Chivi, 2017). Most of the households surveyed reported they could not afford the use of candles, as they were expensive and resorted to cheaper kerosene fuel for lighting.

Electricity supply and connections were only available to very few households in the study areas chosen. The government of Zimbabwe launched a rural electrification programme, which facilitated the electrification of rural areas. However, the rural electrification programme lacked adequate funding for implementation. The Rural Electrification Agency in Chivi District managed to help fast track the electrification of homes for people who paid a certain amount of money (HJPA/Official RDC 25022017, 2017). In one village, the local people reported that not all could benefit from the programme, as it required people to pay approximately US\$500 or more (HJPA/CD/FGD2 Women 02022017, 2017). This amount did not include the amount needed for tubing the house and buying other electrical infrastructural components. This made electricity to be available for the high-income households only. However, despite of having access to electricity the electrified households reported they only used it for lighting purposes and income generation but did not use it for cooking or heating (HJPA/CD/FGD2 Women 02022017, 2017). Only one household reported they used electricity to sew clothes and sell them, while two households used it for lighting in their households. The other uses of electricity were connected to general needs of the household such as milling, peanut butter making, cell-phone charging and sometimes pumping water for those who relied on sourcing water from individual boreholes. Seven (23.3%) households reported using electricity services for various needs (HJPA/CD/FGDs Field Notes Chivi, 2017).

Other non-solid fuels that were mentioned was related to services that were required at household level for upkeep and wellbeing. The use of petrol, and diesel were in relation to transport needs and sometimes to transport agricultural produce to markets. The respondents said that they needed transportation to their closest shopping centres where they bought their households items. Energy was required for communication purposes, i.e. mobile phones, where energy is required to recharge the phones' batteries. There is the need for physical energy from both animals and humans to collect and transport various items for the household and to execute certain duties. Animals and human are sources of energy that is needed in rural areas when fetching firewood, collecting food products from farms and collecting water. These types of energy

and energy uses cannot be ignored, though they are not as direct as in other fuels and fuel uses. Their scarcity has a negative impact on the day-to-day survival of rural households.

4.4.3.3 Coping Strategies for Energy Insecurity

Household needs are major drivers of energy use (Johnson & Bryden, 2012b). According to the survey conducted, Chivi rural households need energy for cooking, heating, space warming, income generation, and other energy demanding services (HJPA/CD/FGDs Field Notes Chivi, 2017). The previous sections on energy security show that firewood is the main type of fuel used for many energies needed in rural homes. Firewood is collected in the natural surrounding areas and forests (HJPA/CD/FGD3 Women 07022017, 2017). Though it is a natural commodity rural people spend lots of time and energy collecting firewood (HJPA/CD/FGD1 Women 16012017, 2017). Firewood collection if not appropriately conducted, can have immense negative effects on the environment. Such effects may change the state of the ecosystem and sometimes create challenges in the security of energy supply. Kerosene ranks high in the energy needed for lighting and there are other energy variables reported that are used in rural households. The choices of energy used for different needs is driven by various concerns that include, market availability of energy source, household income and expenditure, access to forests and governmental laws, climate change effects on the environment, distance, and seasonal variations.

The study found that the majority of rural households studied depend on wood, bio-mass, kerosene, candles for lighting and very few use electrical sources (HJPA/CD/FGD2 Women 02022017, 2017; HJPA/CD/FGD3 Women 07022017, 2017). The fuel-based energy sources of lighting are inefficient and produce poor quality light. Some of these sources like candles and kerosene come at a price, which increases household expenditure, and increase the strains on household income budgets (HJPA/CD/FGD1 Women 16012017, 2017; HJPA/CD/FGD2 Women 02022017, 2017; HJPA/CD/FGD3 Women 07022017, 2017). Firewood is collected in areas not less than a kilometre from home, which increases the household burdens and stresses the energy security of supply in homes. According to Adelekan and Jerome (2006); Adkins *et al.* (2010); Asif and Muneer (2007), fuel-based energy sources cause a lot of pollution and may be hazardous to the health of family members. The relevant and clean sources of energy such as solar and electricity, were reportedly too expensive to access for the households represented (HJPA/CD/FGD2 Women 02022017, 2017). Even though there has been a widespread support of transition to cleaner modes of energy sources, such as electricity and adoption of improved cooking technologies, the rural areas still lack access thereto (Jagger & Jumbe, 2016; Johnson & Bryden, 2012b; Masera *et al.*, 2000). The increased reliance on wood has an impact on the food and water security in these areas. It contributes to soil degradation, deforestation that can lead to increased erosion and evaporation. This results in a complete change of ecosystem

structures as explained with panarchy, changes occurring in one system have an impact on other systems (Benson & Garmestani, 2011:1421). Efforts by the responsible authorities to protect the environment and transform the rural household wood consumption patterns, have failed due to mainly limited finances.

All the households in the study reported they sometimes experience energy inefficiencies and insufficiency in the households. The dwindling forests and poor fire wood sources increase the plight of rural households that rely more on solid fuels. There were various actions that they take within the communities and as households to ensure a continued supply of energy. Forests are an asset for rural homes as they do not only provide sources of energy but also provide food for households (Harris & Mohammed, 2003; Maroyi, 2011; Termote *et al.*, 2010). The destruction of forests thus has a negative impact on WEF nexus security within the rural households. There are reportedly regular actions that are taken to cope with energy insecurity in the home and long-term actions that are mainly done as conservation to ensure the whole community will have a long-term continued supply of energy. The long-term actions however are yet to produce good results and motivation is still needed for most members of the communities to practise them (HJPA/CD/Official EMA 20170214, 2017; HJPA/CD/Official RSC 20170222, 2017).

The study found that the women employed a variety of coping mechanisms to ensure they can utilise the available resources and maintain their households. The strategies reported included, adoption of improved cooking stoves, multiple energy use, energy switching, fuel preservation techniques, settling for available fuels, fuel supplementary measures, changing consumption patterns and behaviours and conserving the environmental energy sources. The households reported using more than one of these strategies often to counter the challenges of energy insecurity. Similar studies reported the use of some coping strategies discussed in this study in rural households in other countries and areas (Adelekan & Jerome, 2006; Adkins *et al.*, 2012; Brunner *et al.*, 2012; Davis, 1998; Desalu *et al.*, 2012; Heltberg, 2004; Hosier & Dowd, 1987; Johnson & Bryden, 2012b; Masera *et al.*, 2000; Matsika *et al.*, 2013; Miah *et al.*, 2010). Table 4.12 shows the number and the percentage rate of households that reported undertaking a certain action at one point to cope with energy shortages in the household.

Table 4.12: Coping strategies adopted for household energy needs

Coping strategy	Number of households	Percentage%
Adopting improved cooking stoves	02	6.7%
Household dietary changes	30	100
Multiple energy use and fuel switching	30	100
Fuel preservation	30	100
Forest conservation and management	00	00

Source: HJPA/CD/FGDs Field Notes Chivi (2017)

Adoption of Improved cooking stoves

The study found that rural households observed, practised an open-fire cooking method where the fire is made up at the centre of the kitchen or on level ground outside. The open fire method of cooking uses more firewood, and this could make households more vulnerable to fuel shortages. The study found that rural women had the option to use the new improved cooking stoves called Tsotso stove (*Image 4.11*). However, they were still not popular in the study area the improved cooking stove is a better option to ensure energy security for cooking and water heating in the households. One official reported that:

Tsotso stove is a locally available technology used by rural women as a copying strategy to energy security. Women simply use dagga to mould bricks for constructing the Tsotso stove. We have already made forms for that purpose. The Tsotso stove is so economic that a small bunch of firewood is sufficient for cooking food for the whole family. Firewood is the most affordable and cheap source of energy as compared to biogas though both use locally available resources (HJPA/CD/Official WA 20022017, 2017).

Only 6.7% of the households surveyed in the study had adopted this cooking stove. The women reported that they adopted this as it reduces energy consumption when cooking and heating. However, some women had reservations about using this method. They claimed that it does not help warming the space and the house will be too cold without the fire. They said that it was too slow because it cooks one pot at a time unlike the open fire that can cook more than one pot. They however agreed that it greatly reduced the burden of firewood collection as it uses less fuel (HJPA/CD/FGD1 Women 16012017, 2017). *Image 4.11* shows the improved cooking stove (*Tsotso stove*) introduced in Chivi District aimed to reduce wood consumption:



Image 4.11: An improved cooking stove (Tsotso stove) introduced to rural households in Chivi District

Photograph: HJPA/ ICSP 22022017 (2017)

Women in ward 11 and 15 said they did not know about the stove and some said they had just heard about it in passing. There is a need to promote the use of these cooking stoves by promoting awareness among women in all areas. Responsible departments could hold awareness campaigns. There is also a need to come up with improved cooking technologies that would save energy while suiting their household needs. Other studies by Jagger and Jumbe (2016); as well as Johnson and Bryden (2012b), applauded the use of improved cooking stoves as ideal for reducing household energy consumption. However, in Chivi District, there is a need to improve on the stoves by upgrading the models to allow women to cook more than one pot at a time to save time spent on food preparation.

Household behavioural changes on energy consumption activities

The study found that rural households change their energy consumption patterns in order to cope with energy shortages. The survey done found that they had a number of actions that are taken in times of energy shortages. These include changing diet to food that do not require a lot of energy. The women said that there were a variety of foods that they know needed a lot of energy and time, which they can avoid in times of fuel shortages. Such foods include, beans, cow legs,

the cow's tripe and intestines, *Mutakura* (a mixture of maize, groundnuts with bambara nuts) and cowpeas. This coping strategy, though it may ease the problem of energy shortage, has an impact on food security and nutrition of households. One woman said:

Our foods consist of mainly grains that we harvest and most common is the cowpeas, bambara nuts and groundnuts, maize and beans. Some are grown seasonally, some in the irrigations and gardens we have. If we do not have sufficient firewood, we cannot cook some of these foods and have to resort to vegetables and Sadza in most cases. Our breakfast normally consists of the grains therefore having adequate firewood is important (HJPA/CD/W2 04022017 Interview, 2017).

Fuel preservation

Apart from avoiding some foods, they had fuel preservation methods. All of the households (100%) reported using these techniques. They resort to quenching the fire with water after use to preserve the firewood that they have. One woman said that:

Every time I finish cooking, I put out the fire using water and this we do every night before we go to sleep (HJPA/W6 12022017 Interview, 2017).

They reported that in cases where they have good firewood, which produces charcoal they put out the fire and preserve the charcoal that they will use during wintertime for keeping warm and boiling water for tea (HJPA/CD/FGD3 Women 07022017, 2017). They reported that in most cases, they do not use warm water for bathing but encourage their children and families who do not want to use cold water to put it outside in the sun (direct solar energy). The best spot would be to put it near the wall, because somehow the water next to the wall gets warmer than the water in the open space. To preserve firewood, they reported that they use the minimum firewood. Bulk cooking was cited as a way of economising on firewood use where they reported that cooking the food in bulk reduces the number of times to cook. These actions were reported to be effective and they make firewood last longer than it would without doing these things (HJPA/CD/FGD1 Women 16012017, 2017; HJPA/CD/FGD2 Women 02022017, 2017; HJPA/CD/FGD3 Women 07022017, 2017).

Multiple energy use and fuel switching

The study found that rural household used multiple energy sources that are available for different use in their households. Multiple energy use and fuel switching is a coping strategy especially for energy for lighting. The drivers of multiple energy use are mainly access to and availability of energy sources at a particular time. The women said they had varied sources of energy for lighting

in the households and choosing the type of energy depended on income available for energy expenditure (HJPA/CD/FGD1 Women 16012017, 2017). They reported that if they have money, they prefer candles that have better quality light and some would prefer to use solar powered lamps, which have better light. The most used energy source for lighting was subjected to availability on the market and in instances where the household had no access to kerosene, some used a lit firewood log (*chitsiga chemoto*) (HJPA/CD/W8 12022017 Interview, 2017). To clarify one woman said that they use a log from the fire to light their way in darkness though it is dangerous to use in other rooms apart from the kitchen (HJPA/CD/W2 04022017 Interview, 2017). Fuel switching to modern types of energy is not done due to financial constraints in most households (HJPA/CD/FGD1 Women 16012017, 2017; HJPA/CD/FGD2 Women 02022017, 2017; HJPA/CD/FGD3 Women 07022017, 2017).

Forest conservation and management

Forest conservation and management techniques were mainly devised by the government and enforced through the environmental management agency and the local leadership. Rural people are engaged and educated in ways that can help to preserve the environment and to manage the existing resources sustainably (HJPA/CD/Official EMA 20170214, 2017; HJPA/Official RDC 25022017, 2017). The conservation and management laws and actions do not only safeguard the environment in terms of energy security but for food security purposes. There are ways in which communities are taught how to get firewood without destroying the ecosystem structures. They are encouraged not to cut down very old trees and not to cut down the entire tree from the roots but rather use the smaller branches. An official with the Environmental Management Agency said:

It is difficult to enforce laws against cutting down of trees because the people in rural areas do not have other energy alternatives and penalising them on tree cutting would be a blow. Therefore, we educate them that they can substitute firewood with other biomass products such as the use of marula seed shells, which provide good fire for cooking. The good part is these can be harvested and placed in a heap to dry for when the marula is out of season. It enables people to have an alternative in times of energy shortages (HJPA/CD/Official EMA 20170214, 2017).

In an FGD with men, they said that it is very difficult to get firewood from tree branches because the available trees were small and branches cannot be used as wood (HJPA/FGD1 Men 15022017, 2017). The women said that the forest management techniques were too harsh and difficult to implement. One would prefer to fetch firewood closer to home than walk long distances.

This has led to increased cutting down of trees (HJPA/CD/FGD3 Women 07022017, 2017). An official said that:

Though some may be conserving the environment by following the advice, the general rural populace is still far from appreciating the environmental concerns and continue to indulge in unnecessary cutting down of trees, land clearance and encroachment into ecologically sensitive areas such as wetlands and water ways which have an impact on sustainable development (HJPA/CD/Official EMA 20170214, 2017).

The energy security coping strategies used by rural women have an effect on WEF nexus resources security. They are destructive to the ecosystem and creates future risks for WEF nexus security, reduces resilience and push for absolute destruction of socio-ecological systems.

4.5 Conclusion

The chapter provided an in-depth understanding of the current WEF security nexus within rural households in Chivi District, Masvingo Province, Zimbabwe. It explored WEF nexus accessibility, availability and utilisation of these resources in rural households. The chapter looked at the sectoral security of resources in the district as well as within households. The interactions of the WEF nexus in the rural home are undeniable. This chapter reported on the challenges that rural women are facing on WEF nexus security of resources for their needs, primarily in the domestic environment and the local community. From the onset, this study sought to find how the WEF nexus can be used to create avenues of action for WEF nexus challenges faced by rural households. It sought to explore how the WEF nexus can be used to explain, understand and cope with challenges in rural households.

The study found that there is an undeniable relationship between WEF nexus resources in the rural households. The study also found that there is a challenge of WEF nexus resource insecurity in the areas under study. Water insecurity impacts on both food and energy security for these households. Water is needed for household consumption in food preparation, hygiene and sanitation, which improve the well-being of people. Water is important for food production and livelihoods. Rural women and households rely on these livelihoods for income generation, which is important to foster access to energy and food resources for households. Water is important in energy as an input and as a driver. People in rural areas rely on firewood and biomass fuels for energy in their households. This energy type requires water availability for production. Energy is an input in food security, in production, collection, transportation and preparation. Food is needed for energy as they get their biomass fuels from agricultural crops.

The coping mechanisms show a relationship and impact on each other. Women have resorted to changing diets and consumption patterns in all areas of the WEF. The shortage of water leads to poor standards of living, where women have to settle for poor quality and inefficient foodstuffs and energy sources. Reduced access to modern energy makes it difficult for rural households to have adequate access to both food and water resources, as they need indirect sources of energy for production. The coping strategies showed that women often trade off one resource for the other. In cases of water shortages women resort to reducing activities that demand a lot of water, and to cope with energy shortages women resort to reduce activities that reduce the use of energy in the households, both have an impact on food and nutrition of the households. The coping strategies that were reported do not show continuity in the face of challenges that are predicted to persist unless there is adequate knowledge on how to create mitigation and adaptation measures that foster the resilience of households.

The chapter clearly shows that the areas under study are vulnerable to WEF insecurity which can reduce the well-being of people and increase poverty levels unless the local knowledge on coping with issues is utilised in coming up with resilient measures. The major drive of this study was to explore how rural households using the knowledge of women as the managers of resources in the home tackle these challenges. The coping mechanisms that were reported by women have so far managed to contain them and let them survive challenges that are faced. There is need to build on these coping mechanisms to ensure that they may benefit the women, as well as to foster development and sustainable resource use. The next chapter focuses on the current WEF security in South Africa, Limpopo Province in Vhembe District.

CHAPTER FIVE

THE WEF NXUS SECURITY STATUS OF RURAL HOUSEHOLDS IN VHEMBE DISTRICT, LOMPOPO PROVINCE, SOUTH AFRICA

5.1 Introduction

This chapter gives the empirical findings and analysis of the WEF nexus security challenges and the coping strategies from South Africa. The focus is on the water, energy, and food security situation in the Vhembe District in the country's Limpopo Province. Attention is paid to the perceptions of rural women, men, and officials in Vhembe District. The modified WEF nexus resilience framework, which combines resilience with WEF nexus theory to produce a framework applicable to households and local communities, guided this research. From the diverse data sourced for purposes of this chapter, there is evidence of the availability, accessibility, utilisation, challenges of WEF security, and the coping mechanisms used to cushion the threats that rural women face. The chapter explored WEF nexus security, focusing on each resource as a theme to provide exposition and create an understanding for the WEF nexus. There is an exposition of the methodology and procedures followed during research. Coping strategies for challenges are discussed that will provide background information to Chapter 6, which discusses the similarities and differences in the two case study areas.

5.2 WEF nexus security background

This section gives background information on WEF nexus security in Vhembe District. It serves as a backdrop of the empirical findings of this study. The background is information to the study was sourced from available literature, archived documents and discussions with officials. The security state of each WEF nexus element in Vhembe District is discussed before reporting and analysing the research findings.

5.2.1 Background of water security in Vhembe District

South Africa's water governance authorities have a mandate to promote access to sufficient water and sanitation for all its people in an equitable, affordable, effective and sustainable manner (Muller *et al.*, 2009:18). This mandate is promoted by the South African Constitution (1996), the Water Service Act (WSA) 108 of 1997, the National Water Act (NWA) 36 of 1998, the Millennium Development Goals (2000) which paved way for the adoption of the sustainable development goals (2015) (Muller *et al.*, 2009:20; Sershen *et al.*, 2016:457). South Africa is a water scarce country. It is considered as one of the 30 countries in the world with an annual rainfall well below

the global average of 990 mm (Sershen *et al.*, 2016:456). The country annually receives less than 500mm of rainfall, whilst Vhembe in the areas of investigation in this study, has an annual average of 300-400mm (Mpandeli *et al.*, 2015). Most water in the country is lost because of high evaporation rates and a lot is wasted and not accounted for – a situation, which has led to water shortages and scarcity (Muller *et al.*, 2009:25). It is important to be aware of the country's water plight and the implications for development – from the grassroots up – in the process of coming to an understanding of critical water security issues in Vhembe.

Water security is an on-going challenge for South Africa, especially in the rural areas (StatsSA, 2015:46). For the country's water authorities the provision of basic water services particularly to the poor remains a prime problem that has to be addressed. Since the end of the apartheid era in 1994, the new government made a concerted effort to ensure effective provision and management of water sources to the entire population (Sershen *et al.*, 2016:457). The WSA, outlined the minimum amount of water which can be supplied to households as 20-30ℓ per capita, per day within a radius of 200m of the residential unit-specifically in the case of households in informal and rural areas (Muller, 2011:3). The WSA stressed the required standards of water supply services, which have to be capable of reliably and efficiently supplying water to enhance development, personal hygiene and ensure the wellbeing of all people.

In the Limpopo Province, water is of utmost importance in supporting livelihoods and life, as well as supporting socio-economic development in the rural areas (Vhembe District Municipality, 2011b:18). Municipalities are responsible for water service delivery. In the rural areas of the Vhembe District, the process of service delivery has met with various challenges (Vhembe District Municipality, 2012:5). However, the municipality has made considerable headway in efforts to improve rural people's access to reliable water supply. The NWA in South Africa provides for Water Management Areas (WMAs, Chapter 7:4), run by Catchment Management Agencies (CMAs) and Water Service Authorities (WSAs) to enhance water service delivery and improve the management of water resources (Republic of South Africa, 1998:77). All of these institutions have not yet been created, but the general framework is in place for potential effective local water governance. It remains a project under construction and there is evidence of lapses in many areas. Studies have shown that most rural areas of South Africa remain vulnerable to water shortages (Backeberg & Sanewe, 2010:1; Gulati *et al.*, 2013:152; Kahinda *et al.*, 2007b:1050; Muller *et al.*, 2009:24; Sershen *et al.*, 2016:456; Sinyolo *et al.*, 2014:483). According to the Vhembe District Municipality (VDM) (2016:33), most rural areas in the Limpopo Province do not have access to reliable water sources and rely on unclean and unreliable open sources, e.g. rivers and dams. Therefore responsible authorities and individuals in South Africa should come up with water management strategies for multiple-use of water to ease the pressure on the few resources available (Van Koppen *et al.*, 2006:30).

Vhembe District's water security is low. Most rural areas are vulnerable to water shortages. The district relies on surface and groundwater sources, which are very limited (Vhembe District Municipality, 2012:3). There are water schemes in the district that are unable to supply adequate water supplies to local consumer communities. The infrastructure for water supply and services in the district are poor and limited. The major challenges to adequate water supply and services arise from limited funding, poor and old infrastructure, limited ground and surface water sources and skills shortages (Vhembe District Municipality, 2012:3). These challenges have made it difficult to utilise limited resources and manage the water supply for important needs effectively. Most households in the rural areas in Vhembe District do not have access to potable water (Vhembe District Municipality, 2012:3). The Vhembe District Municipality, an official water services authority (WSA) is responsible for water service delivery to households in the rural areas. The Vhembe District's rural areas consist of several villages under tribal authorities.

According to the Vhembe District IDP review of 2011, Limpopo Province has four WMAs, the Limpopo, Olifants, Luvuvhu-Letaba and Crocodile West Marico. The Luvuvhu-Letaba WMA catchment area spans across the Vhembe and Mopani Districts in the province (Vhembe District Municipality, 2011a:18). Water sources in Vhembe District include 12 dams, three weirs, and 38 521 boreholes for access to groundwater resources across the whole district (Vhembe District Municipality, 2011a:18). Yet, these water sources are regarded as inadequate to cater for the needs of local residents. Some dams, e.g. the Nzhelele, have no allocation for domestic use (Vhembe District Municipality, 2011b:17). The number of boreholes in the district, (38 521) may seem high, yet there are various challenges. Boreholes more than often fail to provide in the demand for water supplies.

Challenges attendant upon rural water sources include: poor water quality; drying up of groundwater; dropping local water tables; insufficient funding for installation and maintenance; pollution; as well as theft and vandalism (Vhembe District Municipality, 2016:22). Even though the number of boreholes in the district is relatively high, they are not distributed equally across all municipal areas. Makhado has 23165, Thulamela, 7871, Musina 1170 and Mutale 3057 boreholes (Vhembe District Municipality, 2011a:18). Households in the rural Vhembe District tend to be more vulnerable to risks of water insecurity. The 2011 annual report of the Vhembe District Municipality (VDM) shows that the people in the district rely on informal sources of water such as springs and rivers (Vhembe District Municipality, 2011a:18). Census data for 2011 suggests that, at the time, about 15 901 households in Vhembe relied on rivers and streams; 15 173 on dams, pools and stagnant water; 10 881 on springs; and 1335 on rainwater harvesting (StatsSA, 2015; Vhembe District Municipality, 2016).

Water security has been a challenge for some time. The guarantee of all sources being safe is poor. There are approximately 18 000 households in the Vhembe District, relying on water vendors and water tankers for water (StatsSA, 2015). Though there is a higher percentage of households with access to tap water from reliable schemes, the statistics show that water security in terms of access, accessibility, and quality for utilisation in VDM is still a challenge.

The lack of adequate water resources in rural areas in Limpopo limits the choices of households. Women reported that in most cases they have few alternative water sources. These statistics include both urban and rural areas (StatsSA, 2015:43). This makes rural households in South Africa vulnerable to water access insecurity. The White Paper on water supply and sanitation of 1994 stipulated that an acceptable amount of 25ℓ p/c/d or 6000ℓ per month for a family of eight people is the basic supply (DWS, 2017:23). Furthermore, water supply services should be within a distance not exceeding 200m from the homestead (DWS, 2017:23). Most rural areas in Limpopo Province do not have access to reliable water sources and usually rely on community taps that are not up to standard. Local rivers, springs, and wells are unprotected sources and are detrimental to health (Vhembe District Municipality, 2011b:18).

The percentage rate of households with access to piped water in Limpopo Province within their compounds is 52.3%. The remaining 33.7% of households in Limpopo Province have access to piped water outside their yards, while 14% of the households have no access to piped water (StatsSA, 2015:43). However, compared to other provinces in South Africa, Limpopo is one of the provinces with the lowest percentage of people who have piped water inside their dwelling or yard. Even though some live closer to sources, members of households traveled more than 500m to secure supplies (StatsSA, 2015:44). The province features high on the proportion of households without access to piped water with 14% of all households relying on unsafe sources such as rivers and streams (StatsSA, 2015:43). There is still a challenge when it comes to the provision of reliable water to households for domestic use. This state of affairs tends to affect the rural poor, especially women whose role is to ensure the availability of adequate water for household uses more than any other demographic group in the population.

The promotion of adequate and reliable water supply systems for rural areas is of paramount importance. Water is necessary to support life (Cucek *et al.*, 2015; UN-Water, 2014). Reliable access to water promotes sustainability of livelihoods such as agriculture and livestock farming for rural people. Most areas in the Limpopo Province are good for farming, and the availability of water for irrigation (production) and personal (domestic) use is important for the development of the province (Gumede, 2013:39). Water access reduces hunger, poverty, and vulnerability to various social challenges by fostering production and income generation (Hope, 2006:168). According to the infinite cycle of panarchy, systems rely on their capacity to respond to challenges

in a resilient manner (Berkes & Ross, 2016). In times of drought, people face the potential risk of food shortages. However, they can rely on available sources of water, which can be used for multiple purposes (Van Koppen *et al.*, 2009:74).

In Vhembe District, most water is made available to people through small community water systems (Vhembe District Municipality, 2012:18). These sources give a maximum amount of 25ℓ/c/d within 200-600m from the household (Vhembe District Municipality, 2011b:18). The infrastructural facilities available to people in the rural areas such as community taps, hand pumps and boreholes are subjected to vandalism and breakdowns. There is little maintenance and seldom any upgrading of facilities. It leads to poor performance and an unreliable water supply to the people.

A reliable and efficient water supply for water security is characterised by an augmented availability, accessibility, and quality of water in sufficient amounts for everyday use (Backeberg & Sanewe, 2010; Cook & Bakker, 2012; FAO, 2012). Reliable sources of water should typically deliver clean and safe water. They must be close to the household and should provide sufficient water quantity for all the needs of the people (Majuru *et al.*, 2012:480). There are a number of reasons why water is needed, such as for drinking and hygiene purposes, gardens, livestock and livelihood activities. Research reveals that poor rural households, in any case, might use water from developed or undeveloped infrastructure. Women who are the primary day-to-day users of water in the household highly and primarily experience the impact of water insecurity, at first hand. Any intervention for increased water supply and reduction of water scarcity highly benefits women (Namara *et al.*, 2010:524)

The Sustainable Development Goals (SDGs) adopted by all partner states of the United Nations is staunchly supported by South Africa. The country's water security is a major objective, considering that the other SDGs are achievable with improved access to water resources and supply (Griggs *et al.*, 2013:307). The need for equality was stressed for women who have less access to productive resources and support services. Namara *et al.* (2010:524) argue that an increase in the demand for limited water resources make sharing and prioritising inevitable. This process of sharing affects poor households and puts them at risk of water shortages. The policies formulated at both local and national levels should ensure an increase in the security of access for water users, ensuring that everyone has water for drinking, livelihoods and small-scale production (Calow *et al.*, 2010:250; Falkenmark, 1989:117; Namara *et al.*, 2010:524). A system should have arrangements and regulations that seek to protect the poor, to ensure that they access acceptable minimum quantities of water and other resources (Van Koppen *et al.*, 2002:22). Other international forums and organisations have emphasised the human right to safe

and reliable water access for a better world (FAO, 2012; GWP, 2000; ICIMOD, 2012; UN-Water, 2014; WaterAid, 2012; WEF, 2011b).

In order to ensure water access, even to vulnerable groups, the government of South Africa enacted a variety of pieces of law as pointed out above. Since 1994 a myriad of reforms were organised in line with the 1994 Reconstruction and Development Programme (RDP) (Muller, 2011:3; Sershen *et al.*, 2016:457). Reforms aimed at achieving basic human rights, reducing poverty, promoting economic growth and development and giving priority to water access for all were instituted (Chitja *et al.*, 2016:14). The government started the water reform process pushing for universal rights to water. These include the White Paper on National Water Policy of 1997, the Water Services Act of 1997 and the National Water Act of 1998, which advocated water access for the poor and smallholder farmers and contributed to the reformation of the water allocation process (DWAF, 2009:2; Republic of South Africa, 1997:10; Schreiner & Van Koppen, 2002:969). Following these, the National Water Resource Strategy of 2004 and the Revised National Water Resource Strategy 2 of 2013 pushed for the fulfilment of the National Water Policy and National Water Act (Muller, 2011:3).

These regulatory and governance measures show the drive towards security of access to water in South Africa. Ever since 1994 regulations pushed for the inclusion of women in having rights to water and other resources such as land (Muller *et al.*, 2009:18). However, rural South Africa is patriarchal and traditional leadership controls the productive resources such as land and water. This has left most women vulnerable and they still have restricted access to productive resources (Chitja *et al.*, 2016:15). Women in rural areas use water for a number of activities; this makes it important to ensure that water is accessible at a reasonable distance and that it is available for all household needs and of good quality. Women and girls spend most of their time fetching water for household uses (Graham. J *et al.*, 2016:1). Water collection creates a significant burden for households in the rural areas. In related studies, most rural households reported that they all left their houses to collect water from a source (Graham. J *et al.*, 2016:2; Katsi *et al.*, 2007:1158; UNU, 2013:5). Most rural areas have no water sources inside the dwellings. It compels household members to travel to fetch water (Pickering *et al.*, 2010:3267).

The VDM reports the lack of effective water service management strategies that minimise losses and maximise potential (Vhembe District Municipality, 2011a:20). By the early 2010s, the district had 774 dispersed villages comprising 287 190 households (Vhembe District Municipality, 2011a:39). The population has subsequently increased. Yet, in the whole district, water resources comprise 11 dams, some of which are no longer in use. Boreholes are in use across the district (961 operational boreholes), of which 221 have been affected by drought and are not working. A further 176 boreholes have been vandalised, which comes down to 1358 boreholes built across

the district (Vhembe District Municipality, 2011a:18). These boreholes use either electric, diesel, or hand pumps.

Local groundwater infrastructure technology is a cause for concern: hand pumps are labour-intensive and time-consuming, which makes people less fond of them. Diesel and electric pumps are better though they cost more for maintenance and repairs (Vhembe District Municipality, 2011a:18). The biggest challenge is the theft of pumps, which leads to water insecurity for other people. In Thulamela Municipality, 55 202 households access water below the Reconstruction and Development Programme (RDP) standard. The RDP, a socio-economic policy framework, was formed in 1994 to address the socio-economic challenges, as well as for poverty alleviation and sustainable development (Vhembe District Municipality, 2011a:18). The RDP standards stipulate that the local Water Services Authority (WSA) should provide the infrastructure necessary to supply potable water within 200m of households. The WSA should ensure the provision of basic water supply facility, maintenance and ensure it provides water for at least 350 days per annum (Vhembe District Municipality, 2011a:18). Interruptions in the supply of water should not exceed 48 hours and free water supply should be available for indigent households. However, reports by the officials showed that they were having challenges in ensuring they provide adequate water for the intended beneficiaries. This shows that water security is still a challenge.

5.2.2 Background of energy security

Energy is an important resource needed to sustain human life and well-being. However, it is a continued challenge for the rural poor in Africa to have access to reliable, efficient and affordable energy resources (Uhunamure *et al.*, 2017:25). The vulnerability of the rural poor to energy insecurity is prone to increase with the predicted rise in the demand for energy and global insecurity risks (Adkins *et al.*, 2010:250; Akella *et al.*, 2007:898; Bazilian *et al.*, 2012:2). The growth in the economy, changing patterns of diet and living standards and the rise in per capita income will lead to an increase in household energy consumption. Studies on household energy consumption in rural areas of South Africa reported that varied energy sources are available. The energy preferences of rural households have led to multiple fuel use for different needs within the household. Since the 1990s, households in the rural areas of South Africa have relied heavily on electricity as well as firewood for their daily household energy needs (Davis, 1998:216; Kituyi *et al.*, 2001:98; Thom, 2000:36; Uhunamure *et al.*, 2017:24). The drivers behind the selection and preferences of energy resources are determined by climate, local forest cover, the attitude of users, energy demand, household size, cost of energy resources, consumption needs and available income that can be used to meet everyday domestic energy needs (Uhunamure *et al.*, 2017:26).

In South Africa, rural households use electricity for lighting and wood for cooking and heating. There remains a distinct reliance on firewood, despite rural households' free electricity subsidies provided by government (Williams & Shackleton, 2002:2). Limpopo Province has a high percentage of its population concentrated in the rural areas and these people rely on firewood for cooking, heating and warming their houses, especially in winter. This reliance on wood reportedly causes soil erosion and deforestation that may cause more problems, such as poor soils and siltation leading to food and water insecurity (StatsSA, 2015:40).

In Limpopo Province, the Vhembe District Municipality is mandated to increase the accessibility of clean, efficient and reliable energy for all people (Vhembe District Municipality, 2012:36). The largest proportions of its population live in the rural areas. Previous studies concluded that rural household energy security is hindered by the lack of sufficient social services and infrastructure. An estimated 196 000 households of the 296 000 households in Vhembe District have access to electricity (Vhembe District Municipality, 2012:36). This leaves approximately 100000 households (less than 50%) with no access to electricity. Limpopo Province has about 40% of its population relying on traditional forms of fuel (StatsSA, 2015:38). Rural households in the district depend on fuelwood (firewood) for most of its energy needs (Uhunamure *et al.*, 2017:26). Electricity use in rural households in Vhembe is mainly for lighting purposes. The households tend to use wood because it is cheaper than other sources (Davis, 1998:207; Pachauri, 2004:1723; Uhunamure *et al.*, 2017:26).

Household energy security is adequate access and reliable supply of sufficient energy amounts for its needs (Kruyt *et al.*, 2009:2167; Miah *et al.*, 2010:798; Sebitosi, 2008:1591). There are direct needs for energy, such as cooking, heating, and lighting. There are indirect needs for energy such as production, transportation and other household services (Adkins *et al.*, 2012:250). This study, with its focus on direct energy needs, also considers the importance of indirect energy needs in rural households.

Household income influences the choice of fuel for rural people. An increase in household income allows people to opt for such energy sources as electricity and gas (Pachauri, 2004:1731). Other factors that influence the choice of fuel include: gender and the level of education of the household head, and cultural and social preferences, which lead to multiple fuel, use (Arthur *et al.*, 2012:399; Masera *et al.*, 2000:2084; StatsSA, 2015:33). A recent study by Uhunamure *et al.* (2017:24) revealed that in the rural areas of Limpopo most households' choice of fuel was determined by their income. However, it may not be the only driver. The guiding principle is that the higher the income the higher the chances of using better sources of fuel (Uhunamure *et al.*, 2017:24). This notion is supported by the findings of Duflo *et al.* (2008:9) in a model that shows energy preferences by degree of income (Figure 5.1).

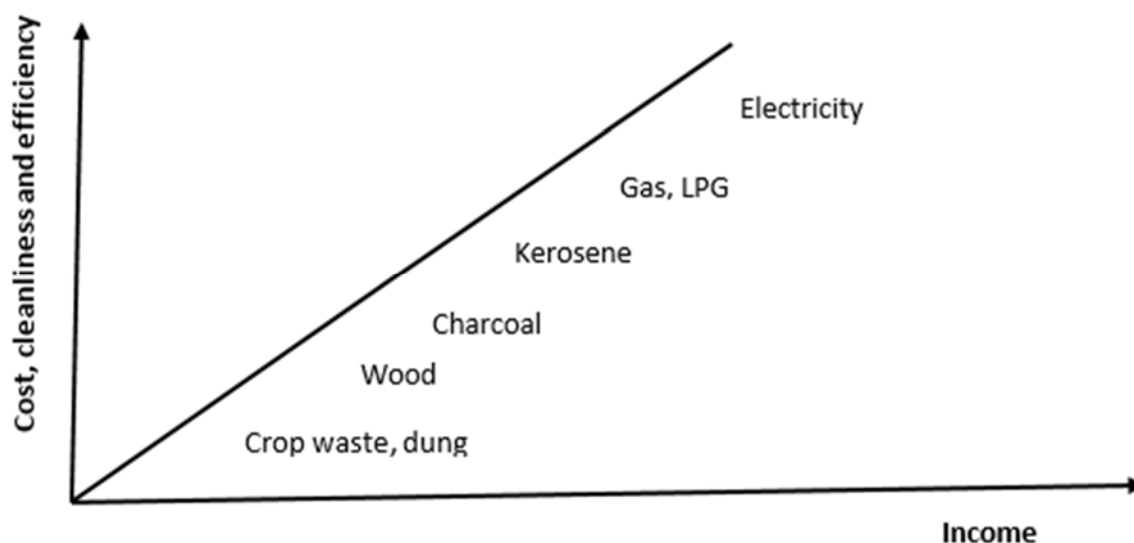


Figure 5.1: Household energy ladder model showing fuel preferences according to income

Source: Duflo *et al.* (2008:8)

The South African general survey on household energy uses, points out that electricity is the main source of energy across the country (StatsSA, 2015:35). Electricity for cooking was recorded to be relatively high in all parts of the country. Nevertheless, in Limpopo the percentage of households that used it for cooking ranked a mere 5%. It is the lowest in the country. In Limpopo 35.3% of households use firewood for cooking (StatsSA, 2017c:33). The use of paraffin, coal, gas and other fuels rank lower than 3% in Limpopo Province. This shows that households prefer two sources of energy: wood and electricity. The choice to use firewood for cooking is influenced by various factors, as most households in Limpopo Province have been electrified, including those in the rural areas (Nembambula, 2013:55). The 2017 national survey revealed that 94.1% of households in Limpopo Province had been connected to the main electricity grid supply in 2016 (StatsSA, 2017c:34). Reports mention that, though electricity is available, there are some factors that hinder rural households in Limpopo from accessing clean, safe and efficient sources of energy. The major factor is the costs related to purchasing prime energy sources such as electricity tokens and gas. The use of electricity, gas and solar energy requires special appliances and equipment, which is expensive for most rural households. There is the issue of availability. Sources, such as gas, may not always be readily available for rural people. Electricity services and supplies are sometimes set back by vandalism of infrastructures, load shedding and, in cases of breakdowns, late repairs. Consequently, rural households are often forced by prevailing circumstances to use firewood as their first choice of energy. The negative factors contribute to household energy insecurity in cases where firewood is not readily available and where funding to acquire electricity for domestic use is not readily available.

The use of electricity is mainly because of free basic electricity grants (FBE) that are given by the government to poor rural households. Firewood and electricity thus become the two main sources of energy used because they are low cost energy sources. Households do not have to pay for electricity, unless they exhaust their grant allocations for energy. They do not pay for firewood, thus the households rely on it, especially for cooking. One study found that most households in rural South Africa rely on firewood for cooking and heating, and electricity for lighting and entertainment (Nembambula, 2013:55).

5.2.3 Background of food security

Food security prevails when people in a society have enough food for an active and healthy life (FAO, 1996:2). These people should enjoy the availability of food that is nutritious and safe. Food should be of a sound quality and accessible in a socially acceptable way. Food insecurity can happen for a short period (transitory) or long period (chronic). Transitory food insecurity occur only for a short period; following an unpredicted spontaneous crisis, that affects the availability or access to food (FAO, 2008a:1; UNWFP, 2009:20). Chronic food insecurity is another dimension that explains long-term inability to meet minimum food requirements (FAO, 2008a:1; UNWFP, 2009:20). There are various challenges that can cause food insecurity. The most important aspect in food security as discussed, lies in human and natural capital, household income and location or distance from reliable sources, e.g. markets, shops and retail outlets (De Cock *et al.*, 2013:280). Also depending on challenges faced, the food insecurity situation can become transitory or chronic. A continuous and reliable supply of and access to food for households is made possible through increasing household income, natural and human capital, social services and support systems that increase household income and assets (Maxwell & Smith, 1992:28). Stability of food access opportunities and supply sources fosters food availability and enhances adequate food intake for households.

Food insecurity can occur when people have inadequate food to satisfy their daily needs. Of the estimated 814 million people who are food insecure in the world, about 204 million live in sub-Saharan Africa (FAO, 2003:1). The achievement of food security for all remains an ongoing battle for South Africa. The number of households with inadequate food access fell from 23.9% in 2010 to 22.3% in 2016, marking an improvement in food access. Furthermore, the country's households that experience hunger dropped from 23.8% to 11.8%. It is an achievement of note (StatsSA, 2017b:100). However, the majority of people remain vulnerable to both hunger and inadequate access to food in the rural areas (StatsSA, 2017b). The country aims to achieve the availability of food for all, in sufficient quantities, promote pricing policies that make food affordable and foster a 'zero hunger' environment. The rural areas of South Africa are still food insecure, though the country is rated as food secure. According to another study, conducted in Limpopo, 53% of rural

households in the province declared themselves severely food insecure (De Cock *et al.*, 2013:270). Food security studies have different dimensions and special focuses, including food expenditure, hunger, household production and poverty (Abdu-Raheem & Worth, 2011; Altman *et al.*, 2009; Backeberg & Sanewe, 2010; De Cock *et al.*, 2013).

South Africa has been rated food secure. The country's food industrial sector provides enough for its people. There is even a capacity to export food. The country's food security is high. Local food shortages can be mitigated by importing supplies available on international markets, if need be (Du Toit, 2011:15; Hendriks, 2005:2; Labadarios *et al.*, 2011:891). Although there is enough evidence that South Africa is food secure, it is not entirely true for households in rural areas (Abdu-Raheem & Worth, 2011:91; Altman *et al.*, 2009:346; De Cock *et al.*, 2013:270). Food insecurity is still a great challenge for households in the rural areas. Approximately 14.3 million people in South Africa are food insecure and the majority of this population is women, children, and the elderly (Drimie & Ruysenaar, 2010:317).

The food insecurity condition of South Africa's households is mainly caused by: increasing food prices; rising fuel and energy prices; political instability; economic imbalances; environmental degradation; poverty and poor household food production (Altman *et al.*, 2009:346; De Cock *et al.*, 2013:270; Nawrotzki *et al.*, 2014:284; Walsh & van Rooyen, 2015:118). This food insecurity mainly affects households in South Africa's rural areas. Traditionally rural areas rely on agriculture for food production as well as for income. This household food insecurity situation has been a concern for over two decades now due to high unemployment rates, poor social safety nets, and poor service delivery. Over 20% of households in South Africa have restricted access to food. A 2015 survey conducted in Limpopo Province suggests that 90.9% of the population had adequate access to food, 8% had inadequate access to food and 1.1% had severely inadequate access to food (StatsSA, 2015:59). The major sources of food for the people in the rural areas of Limpopo ranged from employment, remittances and agriculture (StatsSA, 2017c:58).

Most households in rural areas cultivate their farmlands or create backyard gardens (StatsSA, 2015:60). Agriculture is important for securing additional sources of food, augmenting existing sources of food and for income generation. In Limpopo Province, 91.1% of households resort to agriculture to supplement their existing sources of food (StatsSA, 2015:60). Food insecurity in South Africa does not emanate from shortages. Instead, there is the challenge of access to sufficient nutritious food for the average household (Du Toit, 2011:18). Despite efforts by government, through the creation of organisations that would work towards food security for all, South Africa's households have a constant challenge of food insecurity. To eradicate this challenge, the government increased its expenditure on social safety nets and programmes. These programmes provide feeding schemes, grants, access to loans, investment in agricultural

infrastructure and agricultural extension services (Du Toit, 2011:15). The government came up with legislative frameworks such as the Integrated Food Security Strategy (IFSS), Land Reform and Redistribution, Rural Development Programme, and Reconstruction and Development Programmes, which are meant to help lift the poor out of poverty and create an enabling environment for food security (Baiphethi & Jacobs, 2009:460; Hendriks, 2014:2; Kepe & Tessaro, 2014:268).

South Africa's legislative framework provides for the creation of an enabling environment for food security for all the country's citizens (Du Toit, 2011:16). The current legislative framework recognises food security as a basic human need and aspires to increase food availability, accessibility and quality for all South Africans – especially those in the rural areas (Kepe & Tessaro, 2014:269). According to De Cock *et al.* (2013), even though there is improved access to food in Limpopo Province, the province maintains the highest level of hunger and poverty. An estimated 53% of Limpopo's residents are basically poor and hungry (De Cock *et al.*, 2013:270). This state of affairs is symptomatic of structural policy dissonance, especially in the rural areas of the country.

Despite efforts to eradicate poverty and hunger, government efforts have failed to produce the desired effects. There is evidence of policy dysfunctionality; lack of coordination; lack of proper monitoring and evaluation techniques. These structural discontinuities contribute to an increasingly precarious state of food insecurity (Hendriks, 2014:2; Labadarios *et al.*, 2011:891; Pereira *et al.*, 2014:339). Most households in South Africa have to rely on their income to ensure that they have food on a daily basis. Government, it seems, needs to address plans to improve household incomes for rural people to foster resilience and empower people to adapt to changing situations.

Food security is usually affected by income, level of education, access to resources, e.g. land and water, health, knowledge of food nutrition, household size and presence of both parents (Labadarios *et al.*, 2011:895; Pereira *et al.*, 2014:356). In Vhembe District, some areas are not conducive to farming. The absence of fertile land literally forces households to rely on purchasing food. This makes it important for households to increase the collective income, to ensure access to good, safe and nutritious food. The objective is seldom realised. Due to low income levels, most people resort to purchasing cheaper food products. These supplies are usually processed and lack important nutrients. Therefore, it is detrimental to the overall health of individuals (Hendriks, 2014:4; Labadarios *et al.*, 2011:891; Pereira *et al.*, 2014:354).

In spite of all the challenges faced that hinder food security, people in the rural areas of South Africa often adopt survival tactics to reduce the effects of hunger and poverty (Barrett, 2010:826;

Maxwell *et al.*, 2003:3). These coping strategies enable them to function under adverse circumstances. Most families resort to using cheaper products, changing consumption patterns, changing diets, which have negative effects on their personal health and wellbeing (Faber *et al.*, 2009; Ghimire, 2014; Guo, 2011). Some coping mechanisms are not suitable to rely on for an extended period of time (Maxwell *et al.*, 2003:2). Most coping strategies are mainly suitable for the short-term period. These include borrowing food, reliance on wild food, fruits, vegetables and insects or animals. Changing consumption behaviours, such as the use of cheaper inferior products can be used in both short and long-term coping. The short-term coping mechanisms are used to mitigate food insecurity shocks and do not cause damage to the human social system (Maxwell & Caldwell, 2008:8). The impact of these short-term coping strategies, such as food rationing is more reversible than selling of household assets that may be difficult to recover, and migration, which may permanently destroy family structures and wellbeing (Ghimire, 2014:2; Quaye, 2008:335; Shariff & Khor, 2008:26).

Households rely on the available local resources of food, such as fruit, local traditional vegetables, and insects. Household income plays an important role in ascertaining food security. It enables household units to purchase food and accumulate assets. In food crises, households with assets sell or exchange assets for food or money. Efforts by the government, especially in the form of grants and pension funds, to eradicate poverty and food insecurity, have had little impact. Though it is a good initiative, there is little evidence to prove that the monetary support has improved the food security situation. There is a need, therefore, to build on local knowledge to find out how rural women and their households survive and cope with the challenges of food insecurity. It may contribute to locating a generic resilient strategy to improve on the general wellbeing of rural households. To understand those dynamics, we need to contemplate the perceptions of people in the rural parts of Vhembe District in the Limpopo Province. Of particular importance is a focus on women as individuals with potential resilient coping strategies.

5.3 Rural livelihoods in Vhembe District

This study looked at women's livelihood strategies in Vhembe District. Livelihood exploration was important to find out how these women secured their basic needs and their perceptions of the sustainability of such actions. Small projects, primarily brick making and informal trading, form part of the livelihood options available to rural people. In most communities, rural people practice Group Savings Schemes (GSS) (*Chiseve-seve/Stokvels*) which are notably popular for accumulating personal savings. Sustainable livelihood actions are important. They foster resilience through increasing capability to cope with, recover from challenges, and continue to provide support for local livelihoods. Rural women in this study stated which livelihood options they had available to them. Women explained all forms of activities and support that allowed them

to meet their needs and those of the household. Livelihoods in line with income generation for the household and other means allowed them to acquire their basic needs.

The women gave an outline of activities in their households that enabled them to secure their household needs for water, energy, and food. The study found that all households practiced agriculture as their main source of supplementary food. The discussion on the household compositions showed rural women chosen for this study fell under different age groups. However, the most people are children and the elderly who find moving to towns not in their favour. The women showed that agriculture by irrigation and in seasonal cycles are the most reliable sources of livelihood. Table 5.1 indicates the livelihood options available to rural women in Vhembe District and the number of households that reportedly rely on them for an income.

Table 5.1: Distribution of livelihood options according to the number of households

Livelihood option	Number of households	% Rate
Seasonal farming	24	80.0
Child grants	23	76.7
Group Saving Schemes (GSS) (<i>Chiseve-seve / Stokvels</i>)	20	66.7
Irrigation farming	13	43
Piece jobs	11	36.7
Spousal support	9	30
Firewood selling	8	26.7
Formal employment	5	17
Backyard gardening	5	17
Remittances	5	16.7
Old pension grants	4	13.3
Child maintenance	3	10
Sewing	3	10
Brick making	2	6.7
Fat cake selling	2	6.7
Fish and chips	1	3.3

Source: HJPA/VD/FNFGDs Vhembe (2017)

The results of the study show that households relied mostly on subsistence farming, group saving schemes and child grants. Approximately 80% of households rely on seasonal agriculture, whilst 76.7% of households agreed that they received child grants from the government to help the unemployed (HJPA/VD/FNFGDs Vhembe, 2017). In South Africa, child grants are given by government to support vulnerable children (Makiwane, 2010:194; Triegaardt, 2005:250). Women in this study agreed that the grant was quite helpful, though it was too little to cover all the needs

of children's upkeep. Most reported that after receiving the grant some people used the money for acquiring basic needs for the household (HJPA/VD/W5 26052017 Interview, 2017).

Most women indicated that they have saving schemes that are savings cooperatives formed by groups of people. Group saving schemes (GSS) are a variety of activities done for mutual benefit or savings in societies (Verhoef, 2001:293). They are community-based and organised to meet financial challenges and needs where formal assistance is not available (Verhoef, 2001:293). The study revealed that 66.7% of households under study said they were part of group saving schemes in which they contributed equal amounts of money per member (HJPA/VD/FNFGDs Vhembe, 2017). The types of GSS included the cash saving schemes where money contributed was given to members as credit, which the members paid back with interest. Some contributed amounts of money that they used to buy household needs such as groceries and toiletries, which they share on an agreed date. These are reportedly ways of saving money (HJPA/VD/FGD2 Women 23052017, 2017).

The study found that in areas around Tshiombo, most households were beneficiaries in various local irrigation schemes. Reportedly, 43% of households do irrigation farming (HJPA/VD/FNFGDs Vhembe, 2017). The irrigation schemes work closely with the Department of Rural Development and Agriculture. Crops such as maize, potatoes, sweet potatoes, and vegetables are grown all year round in functional irrigation schemes (HJPA/VD/FGD ARD officials 30052017, 2017). In an FGD, one woman reported:

Irrigation is the only source of livelihood for my household. It is the source of food and provides a source of income (HJPA/VD/FGD1 Women 18052017, 2017).

Not everyone can do this, as ownership of the pieces of land for irrigation is not easily secured these days. The women benefiting from these schemes got the land during at the time of resettlement phases (HJPA/VD/W2 25052017 Interview, 2017).

The above-mentioned livelihood options were the main strategies according to findings. However, the women reported that these livelihood options did not adequately provide them with enough access to the basic needs of their households, which led to diversification of options. Some households (17%) reported to be doing backyard gardening. About, 10% women reported that they relied on sewing clothes and selling them locally. In addition, 6.7% of households sold fat cakes in the communities, while 3.3% sold fish and chips as livelihood options. Only 6.7% of households were involved in brick making. However, it requires energy-intensive hard labour and another potentially scarce WEF component – water. Though the households had activities such as these to raise income or acquire basic needs, there were still households that relied on

amongst others: old people's grants (13%); child maintenance from estranged partners (10%); spousal support (30%) and remittances (16.7%) (HJPA/VD/FNFGDs Vhembe, 2017).

The energy component can secure livelihood in the WEF nexus security context. About 26.7% of households represented relied on selling firewood as a livelihood option. In areas around Gombani, the firewood is fetched from a long distance, typically requiring high-energy levels of human industry. The women involved in these activities fetch firewood for sale to households that have no time to fetch firewood for themselves (HJPA/VD/W10 04062017 Interview, 2017). Women reported that they searched for piece jobs such as washing and cleaning in nearby urban areas to earn a living. They specifically sought job opportunities in communities where payment is preferably in cash, or goods and food items (HJPA/VD/W6 03062017 Interview, 2017). They sometimes have to switch from one job to another. They work in houses and farms doing temporary work. Rural people have so far managed to survive the challenges they face in the WEF nexus. The coping strategies they use are not always viable. Women indicated that they no longer select jobs for money or food, but rather do whatever brings food on the table (HJPA/VD/FNFGDs Vhembe, 2017). This has helped them to adapt to the ever-changing circumstances in their lives. The ability to endure and strive to reduce the impact of challenges leads to the creation of resilient individuals, households and communities. The most important factor in panarchy for building resilience is the conservation and parsimonious use of the available resources and assets by the household. An awareness of resilience can increase the productive capacity of households when they face new challenges or favourable opportunities.

5.4 Findings of the study: perspectives on WEF nexus security, challenges, and coping strategies

This section will engage in an extensive discussion of findings of the empirical research done in Vhembe District. The broad themes of water security, food security and energy security were used to do a sectoral exploration of the security status for each WEF nexus resource. A discussion of indicators for resource security such as availability, accessibility, and utilisation revealed the current security status in the study areas. The study based its results on perspectives of rural people. Men, traditional leaders and officials from Vhembe District Municipality, were included to get their views: male traditional leaders as active participants in households and communities; and officials as members of resource security organisations. The study used multiple tools to gather data, and this data was combined and discussed.

5.4.1 Water security

In this study, the agreed definition of water security is equal access to adequate and safe water for all to meet the basic needs for livelihood and production, and household use and consumption

for an active, healthy, and safe life. Water secure households should have water for household consumption at an acceptable distance and the water should be of good quality. Water for productive uses such as farming and other water-based activities should be adequate and within an acceptable distance. Water for both household and productive uses should have the stability of supply all year round.

5.4.1.1 Water resources and use

During FGDs and in-depth interviews, rural women named water sources available to them for household use. Rural areas in Vhembe District are water stressed. There are 12 dams in the Vhembe District, used for irrigation purposes and water sources for the local municipalities for supplying households with water. At the time of interviews and discussions, women mentioned the sources of water available to them in their villages. Table 5.2 shows what sources are available in villages around Tshiombo and Gombani in Vhembe District.

Table 5.2: Available sources of water for household use

Study area	Available sources of water
Tshiombo	Personal boreholes Springs and fountains Community boreholes and taps Irrigation water in canals Rainfall Dams and rivers, water vendors
Gombani	Community boreholes Funded project boreholes Personal boreholes Water vendors Rainfall Water tankers

Source: HJPA/VD/FNFGDs Vhembe (2017).

According to respondents, the main source of water in communities are boreholes drilled by the municipality. These boreholes’ pumps are mostly diesel powered (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). Community taps are available in some villages around Tshiombo and women gave different main sources of water as per FGD. Women in villages around Tshiombo use mostly community boreholes and taps, canal water, rivers and mountains springs as reported. Irrigation scheme canal water is reportedly for household uses but not for drinking and washing (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). Private boreholes were mentioned and from these, people and communities could buy water in times of water crisis at R2 to R5 per 20ℓ unit. Dam water is used for irrigation purposes and not allowed to be used for domestic purposes (HJPA/VD/FN FGDs Officials, 2017). Image 5.1 shows a picture of a community tap.



Image 5.1: Picture showing a community tap.

Photograph: HJPA/VD/CTP30052017 (2017).

In Gombani, the main source of water is the community borehole, which is diesel-powered. The women reported that they experienced challenges when the borehole breaks down and they run short of fuel for pumping water resulting in people buying water from water vendors (HJPA/VD/FGD2 Women 23052017, 2017). Though community boreholes may be available, they are at times far from most households resulting in the households using other sources. During the rainy season, water harvesting is intense, with consumers using 200ℓ drums (*Mafagi*) and other large containers to store water. In this area, there are no irrigation facilities. Therefore, people rely on rain water supply for agriculture-related activities and livestock keeping. Rural women reported that water from rivers is used when the community taps and boreholes are not working. There is a distinct challenge especially in areas like Gombani because these areas are at a great distance of the district's municipal offices. The road networks – predominantly gravel – are poor. It poses a challenge in rainy seasons when the gravel roads will be closed, of accessing the energy for pumping water (HJPA/VD/FGD Water officials 29052017, 2017). At the time of FGDs, people reported that they sometimes go for three months without safe borehole water. The inadequacy of reliable road infrastructure may reduce the resilience capacity of communities if

they cannot access the growth point centres for resources supply. Image 5.2 shows a man collecting water for household use from a river source.



Image 5.2: A man collecting household water from the river.

Photograph: HJPA/VD/River source 27052017 (2017)

Different aspects such as climate change, seasonality, poor service delivery systems, poor resource management and available natural resources affect water availability. The most relied upon water sources are dependent on groundwater. Its availability is determined by the amount of rainfall. Variations in the water table have an effect on water availability and quality and the lower the water table the saltier the water. In severe drought cases, the boreholes dry up and rural households experience acute water shortages.

In Gombani, rural households practice subsistence farming. In Tshiombo, they practice small-scale irrigation agriculture. These are the main sources of food and income for rural households. Shortages of water for farming increase household poverty and water insecurity. The community boreholes in Gombani and surrounding villages are in a bad condition. Most of them are diesel-powered. The municipality sponsors the diesel. However, if the diesel is finished, it takes the municipality a long time to provide more supplies (HJPA/VD/Tribal leader 06062017, 2017). When

asked to expand on this, one official cited the long process involved in acquiring funding and new stock for maintenance, repair and fuel supplies. Governance protocols and division of roles and unresolved issues of service delivery are responsible for delays. There is a plethora of different official canals. One office deals with maintenance and the other deals with purchasing, and requests. Prospective new stock supplies undergo a rigorous process that is both inefficient and time-consuming (HJPA/VD/Official water 25052017, 2017).

The available alternative option to ensure water to local communities is to use tankers. These would supply people in areas where there are severe water shortages. The researcher observed the tanker system in Vhembe District and concluded that though it is a good initiative, it benefits mostly the wealthier people in society while marginalising the poor (HJPA/VD/FN Vhembe, 2017). Tankers move along the main road and do not do door-to-door service delivery. This means people have to buy their own containers and carry them to the roadside to be filled with water. This requires transportation that some households cannot afford. Most people have to pay for transportation and they are charged R50 per 200ℓ container (HJPA/VD/FN Vhembe, 2017). This limits water access and availability for those who are poor. Officials were asked how much water they give to each household. They responded:

We give water as per required by each household as long as the tanker still has water (HJPA/VD/FGD Water officials 29052017, 2017).

This state of affairs poses problems. Sometimes people farther from the tankers' entry point may not secure water. The tankers could rapidly be emptied of supplies. Considering that it takes some time to send tankers to places, some households are left at the mercy of water vendors. Therefore, water tankers may be a good water security initiative, but they fail to eradicate the problem of a high rate of water insecurity. This calls for innovation and the development of available resources in order to make households water secure and be resilient. Image 5.3 shows containers (*Mafagi*) lined up on the roadside, waiting to be filled up with supplies from water tankers.



Image 5.3: Water containers (Mafagi) used by households to collect water from tankers.

Photograph: HJPA/VD/Water containers 02062017 (2017)

In villages surrounding Tshiombo, women reported that they used wells/springs for household water uses. One said:

We use water from wells and springs situated up in the hills. We use the water for all household needs including drinking and washing (HJPA/VD/W2 25052017 Interview, 2017).

An FGD with men in the Tshiombo area found that water from springs is the most used after canal water and it is used untreated and directly from the source (HJPA/VD/FGD1 Men 19052017, 2017). This poses a danger as the source may be contaminated. The source was not covered or protected and the quality of water as it appeared to the eye was not clean. This type of source could be detrimental to consumers' health and wellbeing as they are exposed to water-borne diseases such as cholera, typhoid, and bilharzia. Image 5.4 shows a collage of pictures with different views of spring water in a mountain in Tshiombo.



Image 5.4: Spring water for household use.

Photograph: HJPA/VD/ Natural springs 30052017 (2017)

The man in the picture (bottom, right) is pointing at a spring in another location where villagers fetch water for household purposes. It is evident that some rural areas in Vhembe District are water insecure and locals are using water sources that are hazardous to the wellbeing of families. The infinite cycle of panarchy helps to explain how the actions that occur in systems to stabilise itself when facing challenges may either lead to growth and stability or lead to the collapse of the system making it face even more challenges (Berkes & Ross, 2016:187; Gotts, 2007:2). When systems face imminent collapse and have no reliable resources to rely on, they are forced to remember past challenges and coping strategies to foster resilience. The use of spring water is a traditional way of sourcing household water and traditional ways of purifying it for consumption such as boiling are applied.

Water harvesting is an alternative source of water in the rural areas. Water harvesting is most prominent during the rainy season where containers placed under the roof collect water. Households with personal boreholes do water harvesting; they harvest water into big tanks when the water table is still high for use during the dry season. When boreholes dry out or the water level recedes, they run short of water and stored water helps them for a while (HJPA/VD/Official water 25052017, 2017). Higher income households use 1000ℓ or larger tanks to store water, whereas most rural households use 200ℓ containers (*Mafagi*) for water collection and storage. The women revealed that they find a day when they make several trips to water sources to fill the available containers and this water lasts for three days or more (HJPA/VD/FGD1 Women 18052017, 2017). This gives them time to pursue other household activities. Image 5.5. shows Jojo tanks that are used by some households to pump and store water for their household needs.



Image 5.5: Jojo tanks used for storing water from personal boreholes.

Photograph: HJPA/VD/Water harvest 25052017 (2017)

Areas chosen for the study varied in the availability of local water sources. Women's choices of water are informed by the available source at any given time.

One woman in an interview in Gombani said:

The water situation in this place is serious such that we do not have wells or rivers and we get water from the boreholes. In a time when the borehole is not functioning, we buy water from water vendors for R2-R5 per 20ℓ, depending on the severity of the water scarcity situation. Water tankers do not come often and sometimes we go without water for weeks (HJPA/VD/W7 03062017 Interview, 2017).

Some households that are economically better off, have reliable access to water. Moreover, these households have access to better and safer options for water. Some households persistently experience water insecurity challenges. They use unprotected and unsafe sources. Water tankers and water purchasing are not reliable sources of water for rural households (HJPA/VD/FN FGDs Officials, 2017). Some households using springs reported that these were in mountainous places and the climb to fetch water is exhausting.

5.4.1.2 Household choices of water sources

The study found that choices of water sources depend on the available sources. In Vhembe District, the most preferred sources are boreholes and taps, which offer good quality and safe treated water. However, in most cases, these are broken and not working due to various challenges, making households less resilient to water-related challenges. The choice of water sources depend on seasonality; certain sources are only available depending on the season of the year.

In both areas chosen for the study, community-protected boreholes and taps are the most preferred sources of water. One woman said:

The taps are the best choice for water to use. However, there are setbacks associated with taps such as breakdowns, disconnections due to cost-related challenges and lack of funding for fuel/energy to pump water in communities (HJPA/VD/W2 25052017 Interview, 2017).

In most cases, these boreholes are not working, which forces women to seek alternative sources. It was discovered that in most cases households use the same source for all household needs, even backyard gardening and livestock, especially in Gombani. This limits productivity and forces households to keep little or no animals. It influences negatively on household asset accumulation and conservation, which reduces their resilience capacity when faced with challenges.

Rural women in Vhembe showed that their preference for tapped or borehole water is not affected by seasonality. They have knowledge of the advantages of water that is protected. They reported

that they would resort to buying water for drinking and cooking in some areas. Those in areas where boreholes have been broken for a long time said:

(We) would use any water as long as it is available due to the lack of protected sources (HJPA/VD/FGD2 Women 23052017, 2017).

In Gombani, this study found out that the only choices of water the women have are taps and boreholes. In Gombani, one borehole caters for more than 100 households and this borehole is diesel-powered (HJPA/VD/FN Vhembe, 2017). Women reported that in many cases, the borehole is not working due to breakdowns or lack of fuel to pump water. The government as part of the brick-making project for the youth in this area drilled another borehole. However, the community does not use the water for household purposes (HJPA/VD/FGD2 Men 17022017, 2017). When the community tap breaks down, people buy water from individual households with boreholes or from a local brickyard. It is only during the rainy season that people do water harvesting. The seasonality of some of the water sources, without proper water harvesting techniques, is a challenge for rural households. Water shortages in the rural areas can be reduced by formulating effective coping strategies that reduce the vulnerability of rural households.

During times of water crisis, women in Gombani travel between one and three kilometres to fetch water from the brickyard project (HJPA/VD/FGD2 Women 23052017, 2017). This distance influences the amount of water collected. Women commented that apart from the brickyard, the only available option is to buy water from vendors. In other villages around Gombani, water tankers are an option, though they are reportedly not reliable.

In Tshiombo, villagers had options to use the canal water. Irrigation water is sourced from Mutale River and it is unprotected, untreated and therefore unsafe for drinking and washing. Springs are another water option available in some villages. Spring water is the source used for long periods. In a village in the Tshiombo area, the community permanently depends on water from natural springs (HJPA/VD/FN Vhembe, 2017). These springs provide households with the water needed for household consumption. In an interview, one woman said:

We use the springs because they are the only option we have for water. Most of these springs are in the mountains and households choose any spring closest to these while some households still have to travel a long distance to fetch water (HJPA/VD/W4 26052017 Interview, 2017).

This reduces the amount of water fetched and good ways of managing that water are needed for it to be sufficient. Both men and women complained that the major source of the problem is because people steal pumps, and some vandalise water source infrastructure.

The long-term supply of water at an acceptable distance and quality guarantees water availability (DWAF, 2008:1). The findings of this study showed that rural communities are vulnerable to water insecurity. Water insecurity is due to a lack of access in terms of lacking infrastructure and high costs related. Water insecurity is due to community members who vandalise water infrastructure (HJPA/VD/FGD Water officials 29052017, 2017). Poor service delivery, caused by poor governance structures and inefficiency, cause water insecurity for rural households. Rural people in Vhembe District agreed that their household choices rested on what source of water was available. They would be happy to have a continued supply of tapped water. However, due to various constraints as alluded to above, there are times when they have to seek other sources.

Livelihood options such as backyard gardens and livestock rearing relied on the same source used for households. In Tshiombo, livestock rearing is not allowed. Therefore, water needed is mainly for household consumption and irrigation farming (HJPA/VD/FGD1 Men 19052017, 2017; HJPA/VD/FGD1 Women 18052017, 2017). In this case, the villagers use irrigation water for household purposes or seek alternative water sources, such as buying water from water vendors. In Gombani, three households out of 17 sampled had backyard gardens (HJPA/VD/FGD2 Men 17022017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). Four households were keeping goats, and none had more than five goats at a given time. One woman said:

It is difficult to have a backyard garden or livestock if you do not have the labour or human resources to fetch water for both (HJPA/VD/W10 04062017 Interview, 2017).

This shows that water stress in this area has an impact on local households. It causes serious food insecurity challenges, trapping households in panarchy cycles of insecurity that could be detrimental to their wellbeing, hence, the need to promote household resilience.

Furthermore, women in rural areas such as Gombani do not have access to water within their compounds. The whole community uses only one borehole. Some women travel for more than a kilometre to the borehole and conditions worsen during times of water infrastructure breakdowns. Alternative sources of water such as buying from vendors and project sites require that women travel as far as three kilometres (HJPA/VD/Tribal leader 06062017, 2017). This adds to their vulnerability as they may be exposed to dangers such as theft, assault, and rape in search of water. The second burden is the transportation of filled water containers (*mafagi*) from the main roads to households, as transportation has to be paid for. This shows that water security is still to be achieved in rural areas and measures need to be taken to reduce the impact water security has on the lives of people.

5.4.1.3 Water collection

The time spent collecting water influenced choices for water source. The study sought to find out the roles that women and other family members play in fetching household water. Most households in the rural areas do not have private sources of water such as taps (inside homes) and private boreholes. They rely on open access sources such as community taps and boreholes, springs, rivers, and dams (HJPA/VD/FGD1 Women 18052017, 2017).

Women respondents reported that they have to travel a long distance, up to two kilometres, to fetch water (HJPA/VD/FGD2 Women 23052017, 2017). This requires and takes up a lot of time. The women reported that they spend approximately up to two hours every day fetching water for the household (HJPA/VD/FGD1 Women 18052017, 2017). They also reported that time spent on fetching water has an impact on other household activities such as engaging in livelihood activities, fetching firewood and engaging in food preparation (HJPA/VD/W1 24052017 Interview, 2017). Without access to adequate water resources, people do not have the means to feed themselves or improve their wellbeing. In most households in the rural communities the study found that, women are the principal water collectors and users in the households. Some households reported that children sometimes helped with water collection. However, these initiatives were limited to weekends when children were not at school (HJPA/VD/FGD1 Women 18052017, 2017). The researcher observed that the majority of people who went to fetch water at any time of the day were women. It was the researcher's observation that men helped to fetch water in households with elderly women unfit to carry a load of water (HJPA/VD/FN Vhembe, 2017).

One woman in a focus group discussion said:

Fetching water for (the) household use is a woman's job. Women arrange and make up time for all the tasks to be done in a day (HJPA/VD/W3 25052017 Interview, 2017).

In some households, children collect water for their own use, e.g. for personal bathing and for washing of school uniforms. They fetch water after school to make sure the children are not overburdened. In some households, women reported that their children helped to fetch water over the weekends. The fresh supply will then be used for the ensuing week (HJPA/VD/FGD2 Women 23052017, 2017). This lessens the burden of fetching water every day, but it may lead to water contamination if the water is not stored and handled correctly.

One woman reported that:

We have big 200ℓ drums that we use to store water outside the home. This drum is filled with water during the weekend and it can last for up to three or four days since I have a small family (HJPA/VD/W5 26052017 Interview, 2017).

The availability and distance of water sources have an influence on the choice of water sources for most households. However, for the areas chosen, women reported that they chose a source as long as it could give them water for free and was closer to home. In the rural areas visited, the ability to choose sources of household water is limited. Women use whatever available source of water they have at their disposal. In most cases, breakdowns, vandalism, theft of major parts of water sources infrastructure are the main challenges that reduce access to water for rural people. In addition, women as managers and principal water collectors, carry the burden of water insecurity.

5.4.1.4 Perceptions of water availability

This study revealed the perceptions of rural women on the availability of water for households. In the research area, it was found that the availability of water should be categorised using household water uses. Women in Gombani classified water for households as scarce and inadequate for their needs (HJPA/VD/FGD2 Women 23052017, 2017). Women around Tshiombo classified water for household use as moderately adequate, but water for livelihoods as scarce and inadequate (HJPA/VD/FGD1 Women 18052017, 2017).

The villages around Tshiombo rely on irrigation as a livelihood and people complain about water shortages for irrigation. Women spoke passionately about how difficult it is to access and secure enough water for their small plots. They reported that they went through hard times just to ensure they have water for their crops.

An official from the Department of Agriculture and Rural Development supported their claims by saying:

Women sometimes have to sleep outside their homes, watering their crops and guarding their water so that some people who have diverted water to their homemade irrigation farms would not steal the water. These women have to expose themselves to all kinds of danger in a bid to ensure that as soon as water is supplied, they water their crops. This demands more time, labour from women, and shows that water for irrigation is not adequate (HJPA/VD/FGD ARD officials 30052017, 2017).

Water for household use is inadequate because of distance from the sources. In an FGD with women in Gombani, the researcher established that the majority of households live more than 500m from the sources of water and spend more time fetching water. The women reported that the community tap serves more than 90 households. This leads to long queues for water and takes more time that is needed for other activities (HJPA/VD/FGD2 Women 23052017, 2017). The women reported that water supply is sometimes hindered when either the boreholes break down due to excessive use, or when they stop working due to lack of diesel supplies. It usually takes longer to get another supply of fuel from the municipality or to get the water infrastructure break down to be fixed (HJPA/VD/FGD2 Women 23052017, 2017). This leads to water scarcity and inadequacy and makes households less resilient to WEF nexus challenges.

In Gombani, both men and women who took part in FGDs reported that they do not practice water-based livelihood options. Of the total number of households represented at Gombani, only a few households had backyard gardens and owned small livestock goats. The rest of the women reported being in no position to own such gardens and livestock since they do not have private access to water such as owning a borehole or a well (HJPA/VD/FGD2 Men 17022017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). Having water-based livelihoods for households increase the burden of fetching water from sources. Most sources of water available in these areas are not adequate for multiple uses. Increasing water access to households promotes new possibilities for production and development (Van Koppen *et al.*, 2009:77). It is imperative to improve water supply for productive use at households as it boosts household food security by approximately 58% (Van Koppen *et al.*, 2009:77). This study shows that lack of adequate water supply limits the productivity of households at Gombani.

5.4.1.5 Access to water

The study found that water access is poor for rural households in the chosen study areas. It limited their choices. Rural women reported that they mainly chose a source for drinking and cooking according to water cleanliness (measured by how it looks to the naked eye). According to rural women, some of the sources give water that is dark and sometimes smelly, which they do not use for drinking (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). A man in an FGD said:

Household choices for water are limited because the natural sources of water, e.g. rivers and springs are far from home and that makes it very difficult and dangerous for women to fetch water. They end up settling for any source closer to home. In some cases, water is scarce close by and people are forced to buy rather than to go to the river and dams (HJPA/VD/FGD1 Men 19052017, 2017).

This explains that distance from home affects choices for water sources in the rural areas of Limpopo.

5.4.1.6 Water security challenges in Vhembe

The study explored the challenges faced in Vhembe District to achieve water security. The study engaged with both the respondents and officials to try to understand the challenges, as they, as stakeholders, perceived them. Findings indicate that rural women, as the users, had their own perceptions on water security challenges. The officials had their own challenges that hinder good service delivery and water security for rural areas.

The local municipalities in South Africa are responsible for service delivery to the people. Vhembe District Municipality is responsible for providing water services, roads and transport services, electricity services, sanitation services and other social services e.g. health, security, safety and community development. It is the mandate of the local municipality to ensure they improve the wellbeing and standard of living of the people (Vhembe District Municipality, 2011a). The district municipality is responsible for water service delivery for people and aims to improve access to water. However, the study findings show that access to water for a rural household in the district remains a challenge. The study explored the challenges faced by the service delivery sector and the challenges faced by rural households and women as resource managers in the household.

5.4.1.6.1 Rural women's perceptions on water challenges

This section looked at the perceptions of rural women on challenges for water security. The perceptions of men gathered from the focus group discussions were included in this section combined with those of the women. The role of men in this study was to provide clarity on how rural people perceive certain things. The challenges that women faced in having adequate water for their household needs influenced actions that people took to cope with shortages. Both women and men noted various challenges. The challenges reported were common among all groups.

The findings of the study on the challenges that compromised water security included:

- distance to water sources (rivers and springs);
- institutional and social restraints (dams are not for household uses);
- erratic climate changes (drought and floods);
- lack of water infrastructure (120+ households per source);
- unreliable service delivery (water tankers), provisions and breakdowns repaired in time;
- types of pumps used to draw water are not user-friendly;
- low rainfalls hinder agricultural production; and

- there is no effective water management for irrigation.

The majority of households in rural areas report that they relied on natural sources of water more than the sources of potable water. This is mainly because of the lack of adequate infrastructure for water service delivery in the rural areas (HJPA/VD/FNFGDs Vhembe, 2017). The Vhembe District Municipality, which is responsible for water service delivery in rural areas, drilled boreholes across the district that should provide households with enough water for their needs. However, there are several setbacks in this initiative. Most of the infrastructure is no longer functioning properly. The water service infrastructure is vandalised and sometimes the type of infrastructure is inappropriate for the rural areas. Most pumps use diesel and electricity. Diesel and electricity require capital for buying fuel or acquiring the energy (HJPA/VD/FGD Water officials 29052017, 2017). The municipality is responsible for providing both diesel and electricity for water pumps. One woman said:

The problem is that we have a diesel pump for our borehole. If the fuel is finished, it takes a very long time to get another supply and during those days, households suffer seriously because of lack of water (HJPA/VD/W7 03062017 Interview, 2017).

Hand pumps are not user-friendly. Women reported that they were heavy and needed two people to use them if you need more than 40ℓ. Boreholes are unreliable in Gombani where the participants reported that most of them would not have water in the dry season (HJPA/VD/W8 03062017 Interview, 2017). The officials said the same thing explaining that the region sometimes suffered from severe droughts and high temperatures. These lower the water table and cause some boreholes to dry up (HJPA/VD/FGD Water officials 29052017, 2017). Local natural sources are unreliable, especially in the Gombani area where the river systems are seasonal. They mostly dry up after the rainy season.

The distance to water sources is a challenge for some households; women reported that not all households were closer to water sources. In some areas around Tshiombo, villagers use natural springs that are a bit far from their homes. This is a challenge because fetching water then becomes a group activity. Women reported that they had to go fetch water in groups to make the task enjoyable and less dangerous. Travelling to fetch water alone was considered dangerous and an exposure to risks such as theft, rape and even murder. Fetching water from a long distance means that people have poor access to water and end up water insecure (HJPA/VD/FN Vhembe, 2017).

Distances traveled to fetch water had an impact in most households where they do not have more labour to fetch water. The burden of fetching water for household uses is a woman's job and in

most households, this causes water shortages in cases where the woman fetches water without the help of other members. The women expressed this concern when one said:

It would be better if the authorities could drill more boreholes for us closer to home. It would enable us to do a lot more because now it is difficult to fetch water from far and have enough (HJPA/VD/W7 03062017 Interview, 2017).

This challenge was also found in a study by Netshipale (2016:39), who reported on the distance from the source as a major concern for villagers in Vhembe District. The distance from homes limited the amount of water a woman could fetch and going to fetch water takes up more time such that they have little time to pursue other economic activities. This creates challenges and may lead to the insecurity of other WEF components that require time.

The lack of adequate infrastructure for water service delivery as well as institutional and social restraints were reported as challenges that hindered water security. Women reported that the infrastructure provided for water delivery was inadequate and inefficient. In the Gombani area, the research participants reported that more than 90 households used the same water source and this creates inconveniences because of long queues (HJPA/VD/FGD2 Women 23052017, 2017). One woman reported:

At times one has to wait in a queue for a very long time before getting water. This takes more time needed for other activities (HJPA/VD/W9 04062017 Interview, 2017).

There is a need to provide infrastructure for potable water delivery to ensure that people have adequate water for domestic uses. The women reported that unreliable service delivery from the water service authorities was a challenge for household water security. In both FGDs, there were women who had long-term water access challenges and relied on the water tanker system. The women reported that these trucks are not always reliable and sometimes they go without water for a long time (HJPA/VD/FNFGDs Vhembe, 2017). The repair of malfunctioning water supply infrastructure takes too long and in cases where the machines use diesel, the supply of fuel is erratic, and these abrupt changes have an effect on households and livelihoods. In the Gombani area women reported that they could sometimes go for weeks or months without having a supply of fuel and service for breakdowns (HJPA/VD/FGD2 Women 23052017, 2017). The lack of funding experienced by the Vhembe District Municipality, remoteness of the area and lack of spare parts to fix the problem are the major challenges. This shows the interactions as panarchy cycles explain, where challenges faced by one sector lead to challenges in another system. The challenges in the water sector also leave footprints in the food sector. Challenges to access energy supply for water extraction put households at risk of water and food insecurity. The coping

strategies used to reduce the effect of challenges may even cause challenges and reduce resilience for WEF nexus security.

Women reported that due to poor rainfall, they do not have enough water even to produce their own food (subsistence farming) (HJPA/VD/FGD2 Women 23052017, 2017). Rural women's views on climate change is derived from knowledge gathered over many years regarding the amounts and frequencies of rainfall, the quality and quantity of yields harvested each year and the signs of seasons delaying or becoming early (HJPA/VD/FNFGDs Vhembe, 2017). In this study, it was gathered that rainfall patterns had changed, and the amount of rainfall received became poorer and poorer over the years, which causes frequent droughts (HJPA/VD/FNFGDs Vhembe, 2017). They reported that they experienced extremely hot weather, especially during their farming seasons, which affected crops. The women reported that there were years that the region has been exposed to severe droughts that destroyed livestock and left sparse dry land, which is not ideal for livestock keeping (HJPA/VD/FGD2 Women 23052017, 2017).

Climate change effects have a negative impact on water security for both household consumption and productive uses (Ziervogel *et al.*, 2006b:4). The effects of climate change reported by rural people included drying up of water sources, poor grazing lands, poor harvests, loss of non-timber forest products, i.e. fruits, plants, insects and small animals; loss of livestock which are very important for the wellbeing of people. Studies done in the same context found out that climate change posed serious challenges to water security for livelihoods and households (Alauddin & Sarker, 2014; Magadza, 2000; Ziervogel *et al.*, 2006b).

Women reported that due to water scarcity for irrigation purposes, the farmers and the Department of Agriculture officials came up with a coping strategy to ration water so that it will be available for all farmers in the functional irrigation schemes. However, there are no effective management strategies or laws to enforce proper use of irrigation water. The officials in the agricultural sector pointed out that the people in the irrigation schemes have water challenges (HJPA/VD/FGD ARD officials 30052017, 2017). Canals are in bad shape, the water is not enough and some irrigation systems have dried up completely. Rosters put in place to ensure all schemes share water properly, failed to improve the water situation as farmers ignored them. Schemes lack proper maintenance; removal of weeds and dirt is required as these cause water not to flow to some areas (HJPA/VD/FGD ARD officials 30052017, 2017). The challenges of water access for irrigation have escalated in Tshiombo area schemes. The schemes are producing less crops each year. The respondents pointed out that there is a need for proper water management systems to avoid illegal connections, wastage of water and promote water sharing (HJPA/VD/FGD1 Men 19052017, 2017; HJPA/VD/FGD1 Women 18052017, 2017).

The challenges cited above all lead to water scarcity for household uses and productive uses. From the discussion, it was clear that water security forms the backbone of wellbeing for rural households through food production and income generation. Because of water scarcity, some women no longer perform any water-based livelihood activities. They have to come up with strategies they can to ensure they have enough water for consumption and livelihoods.

5.4.1.6.2 Officials' perceptions

Officials included in this study were both the service delivery officials and officials responsible for end-user initiatives. Officials interviewed were from the Vhembe District Municipality's water sector, agricultural and rural development, natural resources authority and local traditional leadership. The discussions held with the officials showed there are various challenges that hinder water security in rural some rural areas in Vhembe. These challenges include:

- poor rainfall in the district (climate change);
- poor cost recovery for services delivered (people not paying bills);
- illegal connections;
- ageing infrastructure (continuous breakdowns);
- changing infrastructure components (asbestos is not in use);
- demand exceeding supply capacity;
- raw water over-abstracting;
- difficulties in acquiring good management strategies (for sources);
- lack of participation in following rules (water management rules);
- poor water management strategies for irrigation;
- dam siltation;
- lack of adequate groundwater resources; and
- red tape administrative procedures.

Discussions and interviews with officials in the district were conducted. In the water service delivery, there are various challenges raised which made it difficult to provide adequate water and improve access. The VDM is a water service authority that provides access to water for people in the rural areas. The major challenges it is facing as a water service agency, is failure in increasing access to safe water for rural people (HJPA/VD/FGD Water officials 29052017, 2017). The organisation does not have enough funding to buy equipment and build new infrastructure for water access. It is important to note that the district has a population increase that has put more pressure on resources and funds availability.

One official said:

The current infrastructure we have is old and worn out. The pipes used are made of asbestos, which is no longer available. Initially, the infrastructure was built to service a water demand of 4 million Kℓ/a but the demand for water in the rural areas only is estimated at about 12 million Kℓ/a. Approximately, 97% of the people in the district reside in the rural areas, which shows that the majority of the people are water insecure. The available sources are insufficient to meet the water needs of the people in the rural areas (HJPA/VD/Official water 25052017, 2017).

The VDM's annual report for 2016 points out that water consumption is high in the rural areas and the available water plants are not adequate to cater for the demand. The municipality does not have the funds to build new infrastructure. The report claims that VDM is the municipality with the least water resources and infrastructure in the whole province (Vhembe District Municipality, 2016:33). The demand for water supply is more than the supply from water treatment plants, which leads to water shortages in the district.

Ideal WEF nexus security conditions rely on the availability of water and the capacity for increased access to water resources for both domestic needs and production. The challenges that are faced by the municipality in water service provision have a greater impact on households. Poor service delivery forces households into cyclical phases of uncertainty and makes them vulnerable. Infinite cycles of panarchy explain the interactions that occur at different levels in the system. Under-supply can either have a revolting effect where systems collapse. Alternatively, there can be a remembrance effect (under ideal circumstances of resilience), where experience of local residents, inform their gradual strategies for growth and stability. In the collapse phase – when water resources are not available – the exposure of rural households to water insecurity force people to either come up with coping mechanisms that foster growth and stability, or they can experience disintegration under uncertain circumstances that hold in little prospects for the better future.

The water service department of the VDM experiences challenges in ensuring water access for all people. This is because of illegal connections, vandalism, water losses through breakdowns, and poor management. One official reported that there are many illegal connections in the district. He estimates that in some areas, 95% of people secure their water supplies through illegal connections. It is difficult to bill the end users and to calculate how much the consumers are using. Thus, basic general water management becomes very difficult because of lapses in accumulating effective data (HJPA/VD/Official water 25052017, 2017). Water infrastructure is old; therefore, it frequently breaks down. The district lacks the skills to fix breakdowns on time. This exposes

people to water insecurity. Lack of qualified personnel makes it difficult to engage in routine check-ups and maintenance of water schemes (Vhembe District Municipality, 2016:33). This exposes households to substantial water insecurity.

Officials reported that over-abstraction of raw water is a challenge (HJPA/VD/FGD Water officials 29052017, 2017). Raw water users are given permission to abstract a certain amount of water for their specific needs, such as agriculture. However, most consumers take more than they are permitted to take. This compromises the availability of water for future use because abstraction rights are given according to the amount of water available in the reservoirs (HJPA/VD/FGD Water officials 29052017, 2017). These challenges reduce the resilience capacity of systems and WEF nexus security becomes difficult to achieve.

Officials in the agricultural sector identified over-abstraction of water as a challenge. Poor management and excessive consumption of water causes a strain on successful agricultural production. One official reported:

Owing to over-abstraction of water, there are serious water shortages for irrigation. Schemes built on the lower courses have difficulties getting enough water for their crops. Some go to the extent of sleeping outside, guarding their water and watering their plants, and this exposes farmers, especially women to dangers (HJPA/VD/FGD ARD officials 30052017, 2017).

People connected illegally to water supply systems and those that have formulated their own irrigation farming, worsen the challenges. These are not registered irrigators. Owners do not pay for the water they use, which is a loss to the water service authority (WSA). This negatively affects the end users who face inconsistent water services due to officials' negligence (HJPA/VD/FGD ARD officials 30052017, 2017). The major problem of excessive reliance on the government for free basic supplies, needs to be addressed and proper channels of communication should be maintained, which can contribute to important information dissemination. Rural people suffer more from the inconsistencies in the systems and lack of access to water services reduces their resilience capacity against WEF nexus challenges.

The district faces the on-going challenge of not recovering the costs of services rendered to consumers. The VDM is the authority responsible for providing water and sanitation services. The municipality buys water in bulk, and then treats, transports and distributes it to end-users, which costs a lot of money (HJPA/VD/FGD Water officials 29052017, 2017; Vhembe District Municipality, 2011b). To ensure good and continued service delivery, outstanding bills have to be paid and be paid on time. However, the municipal officials reported that they have a backlog in payments. This makes it difficult to continue providing adequate water services (HJPA/VD/FN

FGDs Officials, 2017). The major challenge is that the municipality has no effective cost recovery methods. There are also no proper water demand management plans in place. The attitude of most people who believe that water comes free of charge, fails to help matters. There are provisions in the constitution, which make it mandatory to provide free water for very poor households. However, most people still believe water is free (HJPA/VD/FN FGDs Officials, 2017), and thus refuse to pay for it.

Another challenge is climate change problems, which lead to poor rainfall, lack of adequate ground and surface water resources. In turn, these conditions lead to serious human-induced problems such as deforestation, dam siltation and the general irresponsible over-consumption of local natural resources. Due to climate change, the district has been experiencing many droughts. This has placed a burden on water demand for human livelihoods and agriculture. It has led to low water tables, which led to the drying up of some water sources, e.g. boreholes. Climate change has an impact on all sectors and its impact on water security poses a challenge to the wellbeing of people in the district (Mpandeli & Maponya, 2013:55). In some areas, deforestation is high. To ensure food security, people farm close to water sources, causing dam and river siltation, as well as pollution caused by nitrates and phosphates, used in fertilisers. Some dams in the district are no longer in use and others are silted, which increases pressure on water resources.

The district has been experiencing highly erratic climate changes, which include recurring droughts, heat waves and cyclones, which have an impact on the availability of adequate water for consumption. The areas receive very low rainfalls during the rainy season, and at times, the rains are not enough for dry land seasonal farming (HJPA/VD/FGD Water officials 29052017, 2017). The erratic rainfalls have a negative impact on water-based livelihoods such as backyard gardening and livestock production. In most areas, the water table is too low and boreholes dry up (Vhembe District Municipality, 2011a:20).

Insecure water access for productive uses is a challenge for productive livelihoods in rural areas. Water is regarded as an asset and it is the key to enhancing rural people's livelihoods. The major challenge to water security is climate change (Xu *et al.*, 2009:520). The study found that due to the ever-increasing water woes in Vhembe District, the livelihoods of rural women have suffered. It could well be evidence of trends in climate change. Women reported that besides having the water for domestic uses, they needed water for livelihood purposes. In drought conditions water security is often compromised (HJPA/VD/FNFGDs Vhembe, 2017).

The study found that the Vhembe District faces challenges to water access. The challenges are caused by erratic climate trends that cause droughts and poor rainfalls. The weather is unpredictable. It places constraints on water access for livelihood purposes. In this light, the study

sought to find out what rural women do to cope with the challenges of water shortages for productive uses. The district households in the rural areas are mainly farming households. It was reported that in recent years the district has been receiving low rainfall. To make matters worse, there are insufficient long-term storage facilities, such as dams. (HJPA/VD/FGD ARD officials 30052017, 2017) and this impacts on livelihoods.

The researcher asked if the officials would rate water access of rural women as adequate to which the officials agreed that water was not adequate. One official explained:

Water access is a challenge for most people in the rural areas. The municipality even goes to the extent of using tankers to ensure these people have a water source (HJPA/VD/Official water 25052017, 2017).

The problem of ensuring water security is compounded by the red tape administrative procedures. One official said:

There is a need to combine service delivery expertise as one department. It takes a long time to make repairs and to do damage control because of red tape procedures; there is a different office for each section of water service delivery. There is an office dealing with water purchasing and treatment, one office for infrastructure and maintenance, an office for water supply and a technical office for seeing to all the technical issues. The person who maintains the infrastructure is not the one who purchases the spare parts and makes allocations. This complicates most issues as it takes time to have approvals, purchase and receive things needed to deliver services. In some cases of breakdowns and leakages, it will take a long time to purchase and fix a problem that would end up causing water losses amounting to huge sums (HJPA/VD/Official water 25052017, 2017).

From the perspective of the officials, the rural population did not have adequate supply and access to water for both consumption and agricultural activities. Some of the rural areas are remote, making it difficult to provide water services.

5.4.1.7 Coping strategies for water challenges

Water security depends on individual perceptions and practices on water challenges and opportunities focusing on water impact on individuals' lives (Meissner, 2018:10). The important aspects of water security are the individual's perceptions, the challenges, the opportunities available that influence water uses, and needs in the peoples' daily lives (Meissner, 2018:10). This study found that rural households in Vhembe District are facing water security challenges.

These challenges affect both household water and livelihood purposes. This study focussed on rural women as the managers of water in the home, as they are actively participating in the day-to-day livelihood activities. Provision and acceleration of WEF nexus resources access for rural people is a governmental concern in South Africa. However, governments face challenges of lack of funding, poor infrastructure, climate change, broken infrastructure, theft and vandalism, seasonality as well as droughts. (Vhembe District Municipality, 2016:5).

In the face of these obstacles, rural people have measures that they put in place to alleviate the effects of WEF nexus challenges. The challenges may lead to changes in lifestyles and water uses. Some coping strategies help to alleviate the challenges in the short term. The previous sections has looked at accessibility and availability of water in the study areas. The coping strategies reported showed that there were ways to cope with water for household uses and water for livelihoods. Water for household use include cooking, drinking, washing and hygiene purposes. Water for livelihood needs includes water for agriculture, irrigation, livestock, gardens and brick making (HJPA/VD/FNFGDs Vhembe, 2017).

Coping strategies ensure continued supply of water for household needs and they mitigate the effects of disasters and challenges that households face. Coping strategies are resilient pathways used to alleviate the impact of certain threats to maintain the existence and survival of certain systems (Basu *et al.*, 2015:48; Maxwell & Caldwell, 2008:3). Rural women may need to adapt to situations in a manner, which results in less detrimental effects to households. The coping strategies were formulated and used according to the local understanding of situations and memory of past occurrences and how rural people responded to the challenges and occurrences (Vonck & Notteboom, 2016:311). Building resilience relies on local knowledge of the problems and perceptions of causes, responses and effects. Therefore, the use of a strategy is based on the conditions in which the system is situated. The resilience of a system lies in its capacity to respond to challenges in a manner that it would cause little fatal damage or change to the current state. Resilience, as explained in terms of panarchy cycles, is the capability of a system to organise itself and recover. Even though there may be help from outside, the people have their own devised methods of surviving in a situation.

5.4.1.7.1 Coping strategies for domestic consumption

The study found that the majority of households represented use an average of 80-100ℓ of water for domestic needs such as cooking, drinking and washing. Challenges cited include prolonged droughts that caused water shortages as boreholes and rivers dry up. The water table goes down during droughts and sometimes need long periods for proper recovery. The FGDs and in-depth interviews conducted in the study areas found that there are various coping strategies used by

rural households to ensure that they survive. Though some coping strategies mentioned did not ensure increased quality or quantity of water, they ensured the effective use of available water to maintain a certain level of wellbeing for households.

In this study area two categories of household water coping strategies were found. First, there were strategies to promote water supply for households and second, strategies that promote adequacy for household water use. Table 5.3 shows the coping strategies reported for domestic water needs.

Table 5.3: Coping strategies for domestic water

Strategies for water supply	Strategies for water use
Local connections	Water rationing (households)
Water harvesting	Reduce water use activities
Water storage	Use of inferior sources
Water purchase	
Water tanker system	

Source: HJPA/VD/FNFGDs Vhembe (2017)

The findings showed that rural people’s coping strategies for water include: local connections to reduce distance from sources; water harvesting and households water storage; water purchasing and use of water tankers provided for them by the government. There are indications of water conservation where households reduce water use activities and ration the available water. In both FGDs conducted with women, the research found that women resort to the use of inferior water sources that are unsafe for health, such as canal water and open springs.

Local connections

The study found that in one area, women had devised innovative ways to bring water closer to their households. FGDs brought to light that in a village around Tshiombo, the local community had devised ways to draw water from springs to households using pipes (HJPA/VD/FGD1 Women 18052017, 2017). In an FGD with men, they reported that due to unsafe conditions, women travelled to fetch water from natural springs after the failure of municipal water supply units (HJPA/VD/FGD1 Men 19052017, 2017). Some households devised ways of bringing water closer to home. They bought pipes, which enabled the flow of supplies to households. The more pipes you have, the closer the water would be to your household. This method was effective for local residents. It helped to ensure continued water supply and reduced time and labour spent in fetching water. The spring has a natural force and the pipes were mounted in such a way that water flowed directly from the spring into the pipes to houses.

One man said:

The pipes are expensive to buy, such that people have to come together in teams and contribute. These will have water access in a central position where all households can access water. However, there are some households that lack funding for the process and these still use the springs for collecting water (HJPA/VD/FGD1 Men 19052017, 2017).

The FGD held with the water department at district level revealed that these officials did not have knowledge of such community innovations in the area (HJPA/VD/Official water 25052017, 2017). Even though this strategy is effectively improving household water access, the researcher observed that there were water losses occurring along the pipe lines due to leakages. The households were using raw water, which is of poor quality since the sources are open and unprotected (HJPA/VD/FN Vhembe, 2017).

Water harvesting

Findings indicate that most households reported that during rainy seasons, they harvested rain water for household uses. Water harvesting was reportedly one of the most common practices of collecting water easily. Water harvesting is done using household utensils like buckets and dishes big enough to hold 10ℓ or more and using big drums 200-250ℓ (*Mafagi*). The most common type of water harvesting is roof top water harvesting. One woman said:

During the rainy season water is not a problem as we collect water from the roof tops using containers (HJPA/VD/W7 03062017 Interview, 2017).

This reduces the impact of water shortages for household use. The women reported that in order to ensure that they collected clean water (measured by sight); they collected water from the third rain of the season onwards. They allow the first and second rainfall to clean the roof tops and remove dust and other dirty particles before they start to collect water (HJPA/VD/FNFGDs Vhembe, 2017). Water harvested from rainfall is for all household needs including drinking and cooking.

Water storage

Water storage is a coping strategy to ensure continuous household water supply for various needs and reduction of time spent in collecting water regularly. The women reported that water collection took most of their time and energy, making it difficult to conduct other household activities. In order to cut on time spent on water collection, they reported that they make several trips to collect water and fill the bigger storage containers that are at home (HJPA/VD/FNFGDs Vhembe, 2017). This water is used in the course of three days to a week. For rural households, storing large

quantities of water at home, saves them from making several trips to water sources every day. It helps them to manage the available water effectively in order to reduce wastage of water. Rural women reported that most households invested in a 200ℓ drum, which they use to store water at home. One woman supported this by saying that:

Every week I make several trips to fetch water until I fill the three 200ℓ drums at home. It is not an easy task and it is very exhausting such that it affects other energy demanding activities. However, it is an advantage because the water collected lasts up to a week, managing it well thus allowing me time to work on other things. (HJPA/VD/W2 25052017 Interview, 2017)

The type of materials for drums used is plastic because they claimed that metal drums rust with time. However, this coping strategy does not increase the resilience of households in times of long-term water challenges. The coping strategy is ideal for situations of water shortages in the short-term and it copes with the challenge of distance to sources. Storing water at home requires cleanliness and good water handling practises or the water may become contaminated and unhealthy.

Water purchasing

Purchasing of water where people do not have access to public water supply systems helps to cope with water insecurity. The study found that 80% of households purchased water during times of water shortages. As a way of ensuring they have water for household needs, purchasing water is the most difficult and burdensome coping strategy. The women who participated in this study still believed water is free and acknowledged that it is the most important resource needed in any household (HJPA/VD/FNFGDs Vhembe, 2017). Rural women reported that access to water is a challenge, sometimes they have to buy water for drinking and cooking, which is demanding, as they do not have the income to spend on purchasing water. The women reported that they would buy water for R3-R5 per 20ℓ from individuals who own personal boreholes (HJPA/VD/FNFGDs Vhembe, 2017). An average family using 80ℓ would then spend R12-R20 per day on water. They reported that sometimes they buy water from afar and have to contribute or pay for transportation charged per amount of water, R50 per 200ℓ (HJPA/VD/FNFGDs Vhembe, 2017). This is a burden for many households that have constrained budgets. Water purchased is stored in containers at home. All households that purchase water reported that they had to adjust their lifestyles to promote less water consumption in households.

Water tanker system

Water tankers are a coping strategy for water scarcity provided by the government. The focus group discussions conducted showed that the municipality provided water tankers for those with

broken water systems (HJPA/VD/FGD Water officials 29052017, 2017). This helps to have clean water for drinking and cooking, but it is not reliable. The major challenge for reliability of the water tanker system emanates from lack of adequate funding. One official said that:

The major problem in the provision of water to villages through tankers is because the department has no funds. The people in the communities believe water should be free and therefore many have not paid water bills. This creates a setback when we need the funds, and the department cannot afford. People should be made to understand the need to pay for their bills in order to have good water service supply (HJPA/VD/FGD Water officials 29052017, 2017).

Even though the tanker system is random, women have ways to effectively use water from tankers for only drinking and cooking and use water from other sources for household needs.

Water rationing and reduction of water consumption

Household water rationing is a coping strategy for household water security. In an FGD, women reported that they reduce amounts of water use per activity to ensure they have a continued supply. They reported that they skipped some household water-based activities for a day or two to reduce water use. For instance, they prioritised water for cooking and drinking over water for household hygienic purposes such as bathing, washing clothes and mopping the house. One woman reported that:

The most important thing is to have water to cook food and to drink. Washing dishes after a meal is very important. The activities we can skip include bathing, washing clothes and bedding and mopping the house (HJPA/VD/FNFGDs Vhembe, 2017).

Water rationing helps to manage available water and to reduce the amount of water used. This strategy lessens the burden of fetching water and allows the household to have more time for other activities. Water rationing is a potentially useful coping strategy for water security in the household.

Rural women reported that they managed the available water by reducing water-based activities. They reduce the number of meals cooked and reduce household and personal hygiene chores. Some households resort to cooking once a day. They bought mostly bread and cheap soft drinks that they used for the day and then cook one meal in the evening (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). This is done to promote water security; use less energy for cooking; and spend less on food. Cooking a variety of meals consumes more water and more energy and leads to spending more on food. It reduces the

amount of water needed to wash dishes and reduces labour for food preparation, as reported (HJPA/VD/FGD1 Women 18052017, 2017).

Furthermore, women emphasised that they reduce the activities that would call for water use by cutting down, changing and skipping some personal and household hygiene chores. One woman reported that:

Reducing the washing of clothes to once a week, mopping of floors to twice a week, washing hair once a month, washing bedding once every two months for blankets and once every three to four weeks for bed linen (sheets) is a useful coping strategy (HJPA/VD/W4 26052017 Interview, 2017).

Children wiped their bodies with a wet towel instead of bathing when going to school and grown-ups would take a full bath three times every week. One woman said:

If you were to ask directly if we do skip baths, people might say, we bath every day because of the stigma attached to not bathing. However, the truth is in times of water challenges, most people bath (full bath) only two times per week. Some days they might use two litres or less to wipe effectively the most important areas (HJPA/VD/FGD2 Women 23052017, 2017).

Skipping important chores and hygiene processes is a sign of water scarcity. It shows insufficiency of water supply to people and make them less resilient to health-related challenges.

When systems are resilient, they are capable of maintaining their stature and mitigate challenges. The coping strategies used in resilient systems support stability, sustainability and development. Cooking less food expose households to dangers of famine and malnutrition. This explains the WEF nexus and its interaction processes. The exposition given shows that the rural households are mainly in the alpha stages of the panarchy infinite cycle, where systems are facing challenges and the coping strategies used are failing to promote growth, thus systems continue to collapse (Vonck & Notteboom, 2016:310).

Inferior sources of water for domestic purposes

Rural households' use of inferior water sources that are unprotected, unsafe and untreated for their daily needs, however this have negative impacts on health and wellbeing. In the Tshiombo area, women use canal water intended for irrigation for household consumption (HJPA/VD/FGD1 Men 19052017, 2017; HJPA/VD/FGD ARD officials 30052017, 2017). This water flows freely during watering time but form a stagnant pool in the lower end of canals. People collect water from the pools that they use for household purposes. This water may be contaminated and can cause bad health (HJPA/VD/FNFGDs Vhembe, 2017). In Gombani, water challenges and

shortages are long-term challenges. The area is usually very dry. Sources, such as rivers springs are not readily available. In the absence of water tankers rural households in Gombani resort to purchasing water from individuals and project sites (HJPA/VD/FN Vhembe, 2017). This water could well be contaminated. There does not seem to be any oversight of health authorities in the area.

The distance to water sources and the dangers involved in collecting water cause women to fetch water in groups. The fact that these communities could come together to devise solutions promotes good resource management. They could potentially be briefed by expert officials on health and effective resource management, as an extension of the services rendered by water governance authorities. It can constructively contribute to better communal knowledge of water. For the women it would be of particular value. Resilience is driven by the capacity to identify problems and come up with actions that are friendly to the ecosystem (Gunderson & Holling, 2002:27). The success of most strategies requires the availability of capital and assets (Adger, 2000:349; Basu *et al.*, 2015:48). Piping requires money to purchase the pipes; the water tanker system requires money; and refurbishment of water infrastructure is based on the availability of funds. Having more people in the household that can help in water collection. It lessens the burden, especially on women. Child labour is difficult to avoid in these areas because women need help in water collection. There are much better and modern ways of water harvesting, but projects of that nature need funding. Due to the lack of adequate assets, rural women resort to using strategies that are not sustainable and have negative impacts on their health and the wellbeing of their families.

5.4.1.7.2 Coping with water for livelihood water-based activities

The importance of livelihoods in WEF security cannot be underestimated. Water is a very important component in the successful implementation of most rural livelihoods (Campbell *et al.*, 2002; FAO, 2008b:9; Frost *et al.*, 2007:1963; Gumede, 2013:50). The livelihood options available to people enable them to respond to various threats. Income generation at household level plays an important role in providing access to resources for household needs (Ellis, 2000:289). The rural economy is mainly agricultural, focusing on both irrigation and seasonal subsistence farming. Information gathered in the research fieldwork phase, showed that households rely on agriculture as the base of household income. Most livelihoods in the rural areas are water-based and these include irrigation, seasonal farming, and backyard gardens.

There are many challenges that threaten the livelihoods of rural people, such as water shortages. Due to continuous droughts, lack of and poor-quality water infrastructure, most water-based livelihoods are affected. Some households have managed to diversify their livelihoods.

Diversification of livelihoods implies adopting various occupational strategies for income by adopting off-farm or non-farming occupations that they can maintain for extended periods of time. Livelihood diversification is a coping strategy worthy of adopting in areas where there are water shortages that make it difficult to maintain water-based livelihoods (Ellis, 2000:293).

Irrigation

Findings indicated that there are households that conduct irrigation farming activities, whilst simultaneously doing seasonal dryland farming. Women reported that most of the water-based livelihood options are not viable; therefore, they (in many cases) stopped livestock rearing in the form of keeping goats and cattle because these would need daily water. The perceptions of officials and men regarding water security coping strategies were important.

The study found that to cope with water for irrigation, farmers and officials have three main strategies. These strategies are short-term and ineffective over extended periods. In one FGD, rural women reported that they schedule times to water their plots; sleep outside in the irrigation scheme guarding so that other farmers will not use or divert their allocated water; and reduce their plot sizes to ensure the water allocated to them will be adequate for the plot size they have (HJPA/VD/FGD1 Men 19052017, 2017; HJPA/VD/FGD1 Women 18052017, 2017).

One official said:

One of the schemes has women as the majority of farmers. Because of water security, they sleep outside, guarding their water so that they can water their crops. This is very dangerous and unhealthy and puts women and children at risk (HJPA/VD/FGD ARD officials 30052017, 2017).

Though this is a coping mechanism, it is very risky and difficult to maintain. One woman reported:

The irrigations are divided into four blocks and the last block rarely gets water for their crops. The farmers in the first and second blocks are better off than the last blocks (HJPA/VD/FGD1 Women 18052017, 2017).

The women blamed the water fights and disputes on the shortage of irrigation infrastructure, each block should have its own independent supply of water directly from the dams.

Some households went as far as creating their own individual irrigation using their own plots of land. This was reportedly illegal as they divert water from waterways to their farms. The manner in which they did it led to loss of water. Most of it is not paid or accounted for. This creates a problem for the municipality as the water supply authority. Attempts to make these people follow correct procedures have proven futile (HJPA/VD/FGD Water officials 29052017, 2017). This coping strategy have detrimental effects on their WEF nexus security in future. The exploitation

of resources for security today should simultaneously secure resources for a sustainable tomorrow. Panarchy cycles of resilience in terms of the WEF nexus share the common objective to ensure resources should be used sustainably. It implies that local communities should play an active role in conserving their ecosystems to minimise the unpredictable outcomes of disaster conditions. Resource security ends with utilisation which has an impact on the continuity of resources availability.

The use of timetables is a way of coping with shortages of irrigation water in Vhembe. One official in the agricultural sector said:

The use of timetables for watering plots would be very effective if farmers would follow their timetables. The timetables have worked for some time but because there are some farmers that do not respect them, most people now have to do whatever they can to have water for their crops. (HJPA/VD/FGD ARD officials 30052017, 2017).

The study found that the local dams were not sufficient to cater for all the irrigation activities. The slow progress in upgrading the Nandoni Dam, intended to ease irrigation water challenges, is not helping matters (Vhembe District Municipality, 2011a:18). Regular meetings between the agricultural department and the farmers led them to create a timetable that would guide each scheme in the area on when to water their crops. However, few farmers respect timetables. The major reason for water shortages, besides poor rainfall and lack of water resources, is illegal individual irrigations that have found ways to turn their plots into irrigable land and divert water to their plots.

The Department of Water and Sanitation (DWS), which is in charge of bulk water and resources, came up with regulations to allow these individual irrigators to register their farms and to be able to pay for water that they are using. One individual said:

We did not know that water is paid for until we had a meeting with officials. We just thought that water is free if it is coming directly from the dams and rivers (HJPA/VD/W4 26052017 Interview, 2017).

The major disagreements are mainly caused by the fact the people believe it is their right to have water for their crops. They believe that water (in the form of rain) comes free and should therefore be accessed free of charge.

One man explained that:

The worst thing for us is that the rates for water, if we want to use it for agriculture, are the same. The rich and the poor, we are all required to pay the same amount. The government should be able to help the poor people so that at least we can begin from somewhere (HJPA/VD/FGD1 Men 19052017, 2017).

The study found individual irrigation operations are quite productive. They can produce food and surpluses for selling. However, it is illegal for individual households to create their irrigation plots and practise without following the proper channels of securing an irrigation water supply from the Vhembe District Municipality. In order to secure adequate food for their households' rural people end up indulging in illegal connections. This makes it difficult for Vhembe District Municipality to effectively manage the available water resources and can lead to water losses, wastages and misuse. In the quest to irrigate and have enough food for their households, these rural individuals make it very difficult for the WMAs to account for the water resources leading to more water challenges in the district. This further explains how security for one resource cause major insecurities for the other WEF nexus resources.

Reducing the size of farming plots helps rural households cope with water shortages. Through reducing their plot sizes, they have an impact on the yields that they produce. The farmers on irrigation schemes reported that it was better to reduce the plot size since irrigation was their only source of livelihood. Most women reported that they reduced the plot size to half a hectare and they planted groundnuts/peanuts more than maize, as these crops do not demand as much water as maize (HJPA/VD/FGD1 Women 18052017, 2017). One official stated that some of the areas in the irrigation schemes have become dry when they are used during the farming season (HJPA/VD/FGD ARD officials 30052017, 2017). Farmers were forced by water shortages to stop irrigation production on some land to alleviate the water challenges. Reduction of plot sizes meant that they would use a reduced amount of water for irrigation. In some households, farming completely stopped and they rely on non-farming activities for income. In the irrigation schemes surrounding the study area e.g. Matombotsvuka, Tshiombo, Marabwe and Mbaelamore than 100 hectares in each area are dry and are only used during the rainy season (HJPA/VD/FN FGDs Officials, 2017). This shows that water for irrigation is a challenge and the farmers and responsible officials can only do what they can to survive with the challenge.

The problems of poor access to water and water resources are persisting in spite of the coping strategies that are used. The coping mechanisms that are used showed that the people rely on the availability of household assets. The women in Tshiombo said it would be better if they could have money to invest in a different type of irrigation technology that was less expensive (HJPA/VD/FGD1 Women 18052017, 2017). They reported that the irrigation water is pumped

using electricity that is very expensive for them because of the reduction in crop production. The type of irrigation (floppy irrigation) was reportedly expensive to maintain and in most cases, the irrigations have breakdowns that take too long to get fixed (HJPA/VD/FGD1 Men 19052017, 2017).

Livelihood diversity

The study found that the areas under study received little rainfall. These conditions do not promote farming. In the Gombani area, even though all households reportedly rely on farming as their main livelihoods, the study found that water challenges affect farming operations. Local women reported they had no means of maintaining their farm production in times of droughts (HJPA/VD/FGD2 Women 23052017, 2017). The best response they have to water challenges is to adopt less water-based livelihoods and opt for non-farming livelihood options. Most of them reported that they maximised their opportunity given through grants to start up small businesses (HJPA/VD/FGD2 Women 23052017, 2017). Globally, livelihood diversification is common in most rural areas for its positive contribution to poverty reduction (Ellis, 2000:289). Non-farming livelihoods provide funds to invest in agricultural activities such as buying input, e.g. fertilisers and seeds. The absence of adequate funding for agricultural purposes and lack of access for small-scale farmers have led to diversification from agricultural-based livelihoods.

The study explored the perceptions of rural people and officials based on the water security issues. The study found that the Vhembe District lacks adequate water resources and water supply infrastructure. The study area relied mostly on rainwater for agriculture. Respondents perceived their water situation as highly insecure. Officials, in turn, reported that water security was still a challenge and the majority of rural households did not have access to potable water (HJPA/VD/FN Interviews Officials, 2017). The major challenges reported for water security included the erratic climate changes, lack of funding for water delivery services, as well as, poor and inadequate infrastructure (HJPA/VD/FN FGDs Officials, 2017; HJPA/VD/FNFGDs Vhembe, 2017).

The type of energy used for pumping water for irrigation and household was electricity or diesel, both of which were reportedly expensive. Officials reported that people felt entitled to receive free basic water deliveries. The government-must-do-it-for-us syndrome was apparent in the responses given where people believe the government should do things for them. Theft and vandalism of infrastructure led to water scarcity. Illegal connections were apparently a problem and the lack of expertise in connections led to water losses and wastages. There was a reported lack of motivation, poor commitment and lack of skilled personnel in the service provider agencies for both water and agriculture. Poor record keeping exacerbated the challenges as records of water extraction and usage and average yields of farmers were not available.

Water challenges have an impact on food security. Energy was reported as having a major impact in promoting access to water for both household consumption and livelihood. Therefore, the interlinkages and dependencies between the WEF nexus elements cannot be repudiated. Each element has a role to play in ensuring the security of another. Decisions made in one have a negative or positive impact on security of another. These linkages can be traced even at household level. The challenges such as climate change, which directly affects the availability of water, has a negative indirect effect on the security of food and energy. Poor access to food affects the health and wellbeing of people and so does water and energy. The coping strategies thereof for challenges faced by women in rural areas should be considered within the nexus context. Resilient ways of coping with challenges are able to cushion the threats and risks passed without damaging or compromising resource availability in the future. Most of the coping mechanisms opted for are used in the short term but there is a need for long-term measures that enhance water security for household and productive uses. The whole water management system should opt for resilient water management strategies that respects the local social ecosystem.

5.4.2 Food security

The study based its findings on the perceptions and views of rural people (women, men, and officials), who were participants of this study. The study found that most households perceived themselves as food insecure because they lacked access to food. The availability and stability of supply and modes of food utilisation were not satisfactory. In this research project, the questions asked during the focus group discussions and the in-depth interviews were based on food security indicators. The survey explored the general food security situation of households based on their experiences regarding food access, dietary diversity, the stability of supply and food poverty. The responses from participants made it possible to form an impression of the general food security situation of rural households in Vhembe District.

5.4.2.1 Food availability

The study explored rural households' perceived source of food. The findings showed that the rural households relied heavily on agriculture and the availability of income. The households' capacity to have food is determined by livelihoods, availability of capital, and social support initiatives e.g. grants. Respondents reported that subsistence farming provided households with the staples and sometimes surplus which could be sold or exchanged for other food-related consumer goods (HJPA/VD/FNFGDs Vhembe, 2017). However, due to drought and lack of input, the dependency on farming has reduced (HJPA/VD/FGD ARD officials 30052017, 2017). Respondents stated that subsistence seasonal farming, irrigation farming, food purchasing, and the environment, facilitated provision of food for their households.

The researcher asked respondents to state the main sources of food for their households. It emerged that all households relied on more than one source. Table 5.4 shows the main sources of food for the households.

Table 5.4: Distribution of households according to perceived main food sources

Source	No. of households	%
Seasonal farming	30	100
Irrigation farming	13	43.3
Food purchasing	30	100
Other	20	66.7

Source: HJPA/VD/FNFGDs Vhembe (2017)

In Table 5.4, the reported food sources showed that all households perceived subsistence seasonal farming and food purchasing as their sources of food. Irrigation farming was reported by only 43.3% of the households. There were other occasional sources of food that were reported such as gifts from other people; food borrowing and begging; food aid from occasional donors; seasonal wild foods; and group saving schemes (HJPA/VD/FNFGDs Vhembe, 2017).

Seasonal farming

The findings showed that all households under study practiced seasonal farming. They perceived it as their main source of food even if they had been having setbacks over the years. Even though households were active in farming, the drought and low rainfall seasons have reduced the people’s zeal to invest fully in farming. This, combined with the lack of input for farming, has made agriculture difficult. One woman reported that:

Farming is still our main source of food and every household works on an allocated piece of land. However, we do not harvest much because the soils are poor, and we cannot afford fertilizers (manyoro). Some years have serious droughts and poor rainfalls that reduce our yields. Sometimes we invest in seeds and fertilisers only to have the crops destroyed by the sun or cyclones. This would be a loss to a household and it will be difficult to recover (HJPA/VD/W8 03062017 Interview, 2017).

The research found that the farmers, both in irrigation and individual households, do not keep any records of crop yields, so it was difficult to find out how much each household harvested each year (HJPA/VD/FNFGDs Vhembe, 2017). Officials, interviewed at the time of research fieldwork, agreed that agriculture is the main source of food and income in the rural area and most households practiced it. However, people lacked information, wisdom and motivation to adapt to climate change and adopt farming ways that would increase their food production capacity. Agricultural production has been declining, presumably because of climate change, threats to

economic stability, and increasing population and urbanisation, which, in turn, caused social changes. Climate change has led to droughts, erratic rainfall and excessive heat waves that affected agriculture (HJPA/VD/FGD ARD officials 30052017, 2017). Social and economic changes brought forth risks that exposed people to poverty and reduction of asset bases. Government and research entities have recommended ways of combating risks to agricultural production. Nevertheless, the rural people are slow to adjust and adapt to alternative strategies.

Conservation farming

Conservation farming or agriculture is an integrative approach to farming, which involves minimal soil disturbance, maintenance of soil cover and crop rotations, sequencing and association (Stevenson *et al.*, 2014). It is a complex farming method and involves use of specialised equipment that reduces soil disturbance. Conservation farming is a method in contrast with conventional methods of farming where there is soil disturbance and manipulation when ploughing and weeding; where farmers make use of various chemicals to induce plant growth, and in most cases, farmers focus on specific plants each season (Andersson & D'Souza, 2014; Giller *et al.*, 2011; Giller *et al.*, 2009). Previous studies by Andersson and D'Souza (2014), Giller *et al.* (2011), Giller *et al.* (2009), as well as Stevenson *et al.* (2014) have applauded conservation farming as a method that promotes the stability of the ecosystem. Conservation farming method promotes production and can possibly promote food security and water security as it uses low water quantities by preserving soil moisture. One official said:

Conservation farming is one way, which can be used to improve agricultural production. The downside is that conservation farming requires intensive labour and the machinery is expensive and not readily available on the market (HJPA/VD/Official EA 25052017, 2017).

There are certain technologies used when doing conservation farming. These technologies make it easy for farmers to plant their crops and the strategy reduces wastage of fertilisers and manure. However, rural people do not have access to these and lack the capacity to acquire the machinery. Conservation farming helps to reduce soil tillage and create an atmosphere for ecological environmental resilience. It promotes healthy soils and fosters crop diversification and rotation (HJPA/VD/FGD ARD officials 30052017, 2017). One official applauded conservation farming as being one of the best solutions for reducing the risk of dry seasons. It reduces water loss (HJPA/VD/Official EA 25052017, 2017). The women reported that implementation of conservation farming required them to have viable seeds and input which they could not afford unless the government gives them funding (HJPA/VD/FGD1 Women 18052017, 2017).

Therefore, in as much as all households practiced seasonal farming, they did it because of social norms. One man said:

We know we have a farming season each year and we do not know what it holds for us. Therefore, we all plough our fields with the hope that we will harvest better each year (HJPA/VD/FGD2 Men 17022017, 2017).

The study found that produce from seasonal farming is primarily for household consumption. Household respondents reported that they preserve the produce and use it throughout the year. They do not have big plots. Therefore, they cannot commercially produce surplus crops. This causes most households to rely on other forms of income to purchase food items.

Irrigation farming

Irrigation farming is practised on average by 43.3% of households. These households reported that irrigation provides food for their households as well as income. The government-initiated irrigation schemes and many people around Tshiombo area rely on them for food and income. However, these irrigation schemes are reportedly facing challenges that are posing food insecurity risks for households. Locals reported that some sections of irrigation schemes were completely dry due to water scarcity causing some farmers to stop farming, which increases the risk of food insecurity. One official said:

The major challenge for irrigation and food scarcity are water based, i.e. poor rainfalls, poor infrastructure for irrigation, expensive irrigation technology and lack of water resources. Lack of input for farmers, poor access to funding schemes, loans and credits impact negatively on the general output of irrigation schemes (HJPA/VD/FGD ARD officials 30052017, 2017).

Therefore, even though irrigation can be a source of food, most households were reportedly at risk of food insecurity. One woman said:

It is different now. Irrigation used to be more viable than it is now; we now have to find other means of acquiring food and other needs for our households (HJPA/VD/W4 26052017 Interview, 2017).

Respondents testified to water-based challenges for food security. Due to the siltation of dams, their capacity to hold water was reduced and in turn reducing access to water for food production. This shows the WEF nexus linkages and interactions. The challenges in one sector of the WEF nexus affects the other resources and there is a need to foster WEF nexus resilient ways of coping with challenges.

Food purchasing

Food purchasing is a source of food in rural households. In the FGDs conducted, women reported that most food they consume is obtained through purchasing. The reduction in food production has led to most households resorting to food purchasing. One woman responded that:

In the past, we used to grow our own food and keep our own livestock for meat and milk. However, nowadays there are so many challenges that have made food production difficult and very few households manage to keep livestock (HJPA/VD/W7 03062017 Interview, 2017).

Food purchasing requires of households to have an income that meets their needs (Altman *et al.*, 2009; Baiphethi & Jacobs, 2009). Rural households have to embark on various livelihood options to raise income for household need. Food purchasing was reportedly taking more than half of the typical household's income every month (De Cock *et al.*, 2013; Shackleton & Shackleton, 2004). The government of South Africa regularly revises the prices of basic foodstuff. Items usually exempted from tax are those that make part of basic commodities and it applies to products not purchased as part of a meal. This is to promote access to food even by the poor in the societies. This tax-free condition is only for basic foods. Tax-free goods include the most basic food commodities such as such as dried beans, samp, maize meal, fruits, milk and rice. However, the family size of each household determines the quantities needed. Women reported that food purchasing made it difficult for households to have enough food (HJPA/VD/FNFGDs Vhembe, 2017). The study found that food was increasingly becoming too expensive and the rural households had no means (livelihoods) to increase their household incomes.

Other sources of food

The study found that 66.6% of households had other sources of food. They relied on gifts from family members working in urban areas. The environment is a source of food with variables of food species in different seasons such as mopani worms and wild vegetables that grow during the rainy season. One woman said that there were organisations that provided food for households in very poor states and directly affected by HIV/AIDS (HJPA/VD/FNFGDs Vhembe, 2017). A home-based care project in the district used to provide hampers for needy households, but there has been inconsistency due to funding. In addition, other charity initiatives promote food for households in worse food insecurity circumstances (HJPA/VD/FNFGDs Vhembe, 2017).

The women reported that the availability of food on the markets for purchasing is consistent and stable, but the major challenge is the distance to towns (HJPA/VD/FNFGDs Vhembe, 2017). Another delimiting factor is having enough income to purchase the food. Food production is not very stable due to the various challenges they face. The availability of food in both households

and on the markets for purchase does not translate into household food security (Abdu-Raheem & Worth, 2011:91). Food security is about the quality and nutritional value and equitable distribution of food within households (Abdu-Raheem & Worth, 2011:92). A food secure household should have adequate access to food at all times. Access is important as it ensures that people have adequate quantities and quality of food at all times.

5.4.2.2 Rural households' access to food

Food access is the most prominent category of food security. Food access promotes the ability to obtain and acquire good quality food in a socially acceptable way without resorting to the implementation of emergency ways (Abdu-Raheem & Worth, 2011:93; Altman *et al.*, 2009:347; Du Toit, 2011:2). Food insecurity, therefore, would occur when food is not easy to obtain, and households have no better means to get enough food for them. The availability of food on the markets does not translate to food access for households. Food access is promoted by production or household income that can be used to buy or exchange food (Baiphethi & Jacobs, 2009:460; De Cock *et al.*, 2013:270). Households in the study areas produce some of their own food; however, they still need to have an income to buy other food commodities to supplement their diets for better nutritional value. Rural households mainly grow maize and peanuts. Food access insecurity caused by poverty in rural areas, is alleviated by employing sustainable livelihood strategies (Oni .S *et al.*, 2010:2292). There is a need to improve rural people's access to food by providing accessible markets and regulating food prices.

The study discovered that households faced different challenges to food access. The study found that the major challenges to food access reported included, distance, lack of income, food pricing, remoteness, seasonality and preferences (HJPA/VD/FNFGDs Vhembe, 2017). The access to markets for the women in Vhembe proved to be a major problem (HJPA/VD/FN Vhembe, 2017). The distance from town makes it difficult for women to purchase fresh food, and transport to town is not reliable making it difficult to access markets. One woman reported that:

This place is too far from any growth point. We have a bus that comes every day, but the roads are not good. This limits other transport providers to service this area. It means one cannot decide to go to town without proper planning. Even if something is needed one has to wait until the bus is available or maybe get private transport to town (HJPA/VD/W10 04062017 Interview, 2017).

This limits the access of rural households to markets and it limits their ability to provide enough food for their families at all times. It has an impact on their resilience capacity when faced with sudden food scarcity challenges.

The distance to growth points is a challenge limiting access to fresh food and varieties in the surveyed areas. Villagers travel approximately 20km from Tshiombo to Sibasa, which they said was the nearest urban centre (HJPA/VD/FN Vhembe, 2017). From Gombani, they travel almost 90km to Sibasa (HJPA/VD/FN Vhembe, 2017). Long trips absorb too much time. The FGDs exposed that these women have to store food for a long time and that they have to limit their journeys to town to at least once a month. This shows that rural households' access to food is limited.

Most women rely on selling their surplus farm produce from (fresh or dried) at the vegetable market in towns, but distance as well as costs of transportation for the long distances, made it very difficult (HJPA/VD/FGD2 Men 17022017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). In an FGD in Tshiombo, irrigators reported that access to markets was a challenge because they were too far, and they had to hire expensive transport. This has a negative effect on the household's ability to raise income for purchasing supplementary food. These challenges reduce household income capacity (HJPA/VD/FNFGDs Vhembe, 2017).

The households then rely on child and pensioner's grants and remittances. The child social grant pays R380 per child, and women reported that it has led to early childbirths and large families in the rural areas (HJPA/VD/FNFGDs Vhembe, 2017). Childbirth is not a sustainable way of raising income for household needs as it contributes to increasing household burden and adds to population increase. They reported that these grants payments are irregular and during times of late payments households become highly food insecure (HJPA/VD/FGD2 Women 23052017, 2017). Other channels of raising income, like having small shops and take-away shops are not viable due to the poor purchasing supply systems and lack of funding. This shows that households in rural areas are vulnerable to food access insecurity due to poor income channels.

5.4.2.3 Stability of food supply and utilisation

Another important component of food security is stability of food supply and utilisation for households. About, 86.7% of households reported that they experienced transitory food shortages (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). The causes for this food insecurity condition was reportedly due to late payments of grants and pensions, late reception of gifts and remittances, and poor sales returns. Seasonal variations, e.g. poor rainfalls, droughts and other natural disasters are major causes of food insecurity. Limited livelihood options, price fluctuations and increases, distance from markets, remoteness and unreliability of transport systems cause food access challenges (HJPA/VD/FNFGDs Vhembe, 2017). Officials reported that in spite of the external challenges to food security, some rural people are not self-reliant. They refuse to work for their needs but rather focus on receiving increased grants from the government. They do not want to work hard and shy away from jobs that need

labour investment. They have some resources at their disposal but refuse to work hard and use them for their empowerment, growth, and development. (HJPA/VD/FN Interviews Officials, 2017). One official said:

Many people have the potential to do better, especially in the irrigations, despite these challenges. However, most are opposed to hard work and have the government-must-do-it-for-us mentality. In some cases, people given inputs would even sell them and not plant (HJPA/VD/FGD ARD officials 30052017, 2017).

Most of the above causes of food insecurity show reliance on household income and assets to improve access to food. Low-income capacity reduces household capacity to cope with challenges and trap households in a cycle of WEF nexus insecurity. There is a need to come up with coping strategies that foster households' resilience and adaptation capacities when facing challenges.

Some women reported that their households faced chronic or extended food insecurity situations. Some of the households (13.3%) would go for long periods without enough food for the family unit (HJPA/VD/FNFGDs Vhembe, 2017). The major cause of this prolonged food insecurity is due to poor income and lack of assets to fall back on in times of crisis. In situations where they have erratic climate conditions that affect their farming crops, many households do not have other income avenues (HJPA/VD/FNFGDs Vhembe, 2017). In addition, HIV/AIDS has affected some households by increasing the number of orphans and vulnerable children. It has led to the death of breadwinners and able-bodied family members. Households end up having only the elderly and very young children (sometimes). In some cases, they have to render home-based care for ailing family members (HJPA/VD/Tribal leader 24052017, 2017). This negatively affects household income and livelihood activities. A household can go for months at a time without having sufficient food for family members (HJPA/VD/FNFGDs Vhembe, 2017). The manner in which a household requires food determines how the food will be utilised.

Utilisation of food is a broad spectrum that includes food preparation, food distribution, and value of food, nutritional content, and dietary diversity. The ability to acquire the desired food and dietary components influences how the food will be prepared and distributed. One woman said that:

Having adequate food determines meal preparations and diversity. If we can afford meat, vegetables and staples it would be a choice whether to include both meat and vegetables, but in cases where food is scarce people eat to survive, without thinking of what they want to eat. You have to live on what you have (HJPA/VD/W6 03062017 Interview, 2017).

This corresponds with other studies which found that having access to food and increased food availability have an influence on household consumption and utilisation (Guo, 2011; Labadarios *et al.*, 2011; Pereira *et al.*, 2014; Thompson *et al.*, 2010). Households in Vhembe District experience short-term or long-term food insecurity at some point. It has a marked influence on food utilisation and stability of supply.

5.4.2.4 Coping with food insecurity

Insecurity is a challenge for every household in this study. It differs from household to household and from time to time, depending on the drivers of change or challenges people faced (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). Coping strategies include changes in consumption behaviours, adoption of activities that foster access to food and reliance on available assets. Households use one or more coping strategies depending on the severity of the situation (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). Changing consumption behaviours includes changing diets and skipping meals, rationing and taking inferior food and borrowing from others (HJPA/VD/FNFGDs Vhembe, 2017). They have adopted other activities that have improved their access to food through income generation, such as non-farming livelihood activities, community, and group savings (*Chiseve-seve*), and part-time work in neighbouring towns (HJPA/VD/FNFGDs Vhembe, 2017). They reported that most households relied on inferior foods for survival, selling off household assets, as well as migrating some family members. The households reported that they relied on the environment/ecosystem’s natural resources such as wild vegetables, fruits, and insects (HJPA/VD/FNFGDs Vhembe, 2017). The strategies that were reported in this study correspond with the studies done by Aliber and Hart (2009:434), Hunter *et al.* (2007:327), and Ofoegbu *et al.* (2016:37). The findings on coping strategies for food are presented in the Table 5.5. This table shows the number of households that have resorted to a reported coping strategy in their time of need.

Table 5.5: Coping strategies used for food in Vhembe

Coping strategy	No of households		Percentage (%)	
	Yes	No	Yes	No
Changing consumption behaviours	30	-	100	-
Use of inferior and cheap food	30	-	100	-
Migration	30	-	100	-
Non-farm activities	27	3	90	10
Community or group savings (<i>Chiseve-seve</i>)	20	10	66.7	33.3
Borrowing from others (money/food)	16	14	53.3	46.7
Use of NTFPS	13	17	43.3	56.7
Selling of household assets	2	28	6.7	93.3

Source: HJPA/VD/FN Vhembe (2017)

One of the interview questions asked rural women about their coping mechanisms for food insecurity. Male focus groups were asked about their own perceptions of how rural households cope with challenges of food insecurity. The manner in which rural women employ coping strategies and the ability to come up with measures to minimise threats determine the resilience level of a system. The coping strategies of rural women discussed above, show reliance on household income and livelihood options. The household consumption patterns of WEF nexus resources is driven by the availability of resources, household income, and options available for rural livelihoods. Panarchy helps to understand how the lack of food in the home lead to the lack of energy and water (Vonck & Notteboom, 2016:308). Food is important in the production of physical energy needed for the collection of both water and firewood. Physical energy is necessary for various activities that households embark on to raise income to purchase energy sources and pay for water rates or purchasing. Actions that people take to cope with food scarcities, such as streambank farming pose threats to water security. Thus, panarchy explains these coping strategies for food security and the general impact they have on the future of WEF resources security.

Changing food consumption behaviours and patterns

All households (100%) reported that they change consumption behaviours during food shortage situations. These consumption behaviours would include changing meal times and reducing the number of meals, food rationing and drinking water to increase satisfaction. One woman clarified by saying:

We change meal times in order to reduce meals. Breakfast is taken late around 11-12am and supper is taken between 6-7pm. Taking late breakfast merges in with lunch which significantly reduces meals and food quality intake (HJPA/VD/W8 03062017 Interview, 2017).

Food rationing was reportedly a long-term measure to cope with food insufficiency. The women explained that they give smaller portions to household members during food crisis periods (HJPA/VD/FGD1 Women 18052017, 2017). One commonly used strategy to feel satisfied with small meals caused by rationing is to drink water before and after eating. The women reported that food rationing allows them to eat three meals a day even if the meals are smaller than usual. This they said prevented them and their families from feeling too hungry during the day (HJPA/VD/FGD2 Women 23052017, 2017). This coping strategy helps the management of food in the house. However, households cannot be resilient if access to food is not improved. Rationing helps to keep the available food for a longer period than it should but is not a resilient pathway, as it does not improve access to food resources.

Use of inferior food products

Rural women (100%) reported the use of inferior and cheaper foods as a coping strategy (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). The main challenge that leads to the undertaking of this strategy are the increasing prices of food in South Africa. Being resilient means having the ability to minimise threats, to reduce the impact of threats or a crisis (Jabeen *et al.*, 2010:415; Perrings, 2006:417; Quinn *et al.*, 2011:2). In order to build their resilience to the increasing prices of food products, women chose cheaper foods. However, it leads to reduced nutritional value and quality but cheaper foods provide for household food needs.

One woman said that:

It is difficult, the prices of food products and other goods and services have given us challenges. The prices are going up but the avenues for household income are not changing. This has made it difficult to acquire enough food for our households. We end up buying inferior food, buy foods that are on clearance sale, which may no longer be very fresh or have been sitting on the shelves for a long time (HJPA/VD/W7 03062017 Interview, 2017).

This explanation shows that the resilience level of rural households is very low. Buying inferior and inexpensive food as coping strategies, though widely used, show that households are vulnerable. Rural women resorted to inferior foods when they lack the capacity to purchase or access good quality foods that are highly priced (HJPA/VD/FNFGDs Vhembe, 2017). Cheaper foods are bought at the markets and pavement stalls if it is vegetables and crop products. Meat and fish can be bought from informal sources selling on street sides, local markets or individual homes (HJPA/VD/FNFGDs Vhembe, 2017). Most of this foodstuff is of poor quality and unhealthy due to exposure, poor storage conditions and lack of hygiene practises. The reliance on these unhealthy sources for food shows the vulnerability of rural households. The use of poor food sources cause diseases and promote unhealthy situations for households.

Borrowing from others

The study found that 16 (53.3%) households reported borrowing money or food from other households. Whilst 14 (46.7%) of the households reported not using this strategy (HJPA/VD/FNFGDs Vhembe, 2017). Borrowing of food is an emergency strategy that is used to cope with food shortage for a very short period. For other households that have no means of acquiring food, borrowing food is the most common way of dealing with food availability challenges. It is reportedly normal to borrow money for foodstuffs from others and pay back later (Maxwell & Caldwell, 2008:6).

Lack of food and poor income, unplanned family gatherings or emergencies and the poor access to shops are causes of borrowing and begging (HJPA/VD/W9 04062017 Interview, 2017). From a resilience perspective, borrowing successfully from others shows that households have support bases/social capital, which they can rely on in a crisis. This finding generally resonates with other studies focusing on coping strategies for food in rural areas. Social support networks and safety nets provide resilient pathways to cope with emergencies and short-term challenges even for food security (Perrings, 2006:417). However, borrowing money and food cannot mitigate food challenges in the long term.

Adoption of non-farming activities/ livelihood diversity

The study found that 90% of households resort to non-farming activities to cope with food insecurity. Rural women reportedly use a variety of non-farming income generating activities to cope with food insecurity (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). Most rural homes rely on self-production of food through seasonal subsistence farming. However, due to numerous challenges, such as water scarcity, shortage of enough inputs and labour that make life difficult, farming has become an unreliable food source. One woman explained:

We do various activities to raise money since we buy most of our food. Some have brick projects; others sell fat cakes, while others engage in group savings and do piece jobs, working for food or money (HJPA/VD/W8 03062017 Interview, 2017).

The FGDs suggest that rural women work on the farms and houses of other people in exchange for money or food. Some migrate temporarily to nearby towns and live-in as house cleaners for a few days every week. Some perform temporary labour in, for instance, construction work, brickmaking, house chores or farm work. It emerged that there are large commercial farms in Limpopo that employ people weekly, especially during harvests where people from these rural households go to sell their labour (HJPA/VD/FGD ARD officials 30052017, 2017). The major challenge of this coping strategy is that it is mainly labour intensive, with very low wages, which are insufficient to cater for household needs. This coping strategy does little to ensure household resilience to food challenges.

Other studies support this finding. Rural people often resort to other income generating projects and activities as a coping strategy for food (Chagomoka *et al.*, 2016:2; Indu *et al.*, 1998:600; Mabuza *et al.*, 2016:209; Pereira *et al.*, 2014:417). Income generating activities for food are useful in countries such as Ghana and Tanzania. The activities such as brickmaking, as reported by rural women in Vhembe, demand physical fitness and are labour intensive. However, the income

derived from it is very little as there are no ready markets for their bricks (HJPA/VD/FNFGDs Vhembe, 2017). This makes rural women and their households less resilient to food insecurity. The unavailability of viable income-generating activities places these societies in uncertainties about their future, and the actions they resort to have very little effect on their food insecurity situations. In contrast to the 90% of households, the 10% who reported not doing the above mentioned income-generating activities, stated challenges related to sickness, having young children, difficulties in getting jobs and lack of funding to start small businesses (HJPA/VD/FNFGDs Vhembe, 2017).

Group saving schemes

The results show that rural households in Vhembe cope with food shortages by doing Group Saving Schemes commonly termed *Chiseve-seve* or *Stokvels* (HJPA/VD/FNFGDs Vhembe, 2017). Women reported these group formations as a major way of saving and creating food reserves for their households. One woman said:

We contribute the same amount of money each month, which is contributing to buying food items (groceries) in bulk. At the end of six months or a year, we share the items equally among group members. There is usually enough food and toiletries to last a household for months if the commodities are used sparingly (HJPA/VD/W4 26052017 Interview, 2017).

The households that use GSS (*Chiseve-seve*) as a coping strategy reportedly have better income or surplus income that they can contribute towards the activity. Approximately 66.7% of the households reported using this coping strategy for food. However, 33.7% of the households reportedly do not use this coping strategy for food (HJPA/VD/FNFGDs Vhembe, 2017). The reasons for not using this coping strategy were lack of enough funding and a constant under-supply of funds. One woman reported that:

GSS requires a constant supply of funding every month for contributions. It is usually done by households that constantly receive grants, gifts, and remittances (HJPA/VD/W2 25052017 Interview, 2017).

From the discussions held, it was clear that the GSS does not make rural households more resilient to food shortages. Even households practicing GSS reported that it only gives them the items needed in bulk and allows a woman to ration and save groceries by using them sparingly to make them last longer (HJPA/VD/FGD1 Women 18052017, 2017). Having the food items reserved in the home was reportedly not a measure to ensure food security, as they had to use more coping strategies to ensure the available resources would stretch and last longer. They employed the change of consumption behaviour as discussed above.

Migration

All surveyed rural households reportedly employed temporary migration of household members. Temporary migration as a coping strategy refers to sending some household members to other places either to live or to work there (Shariff & Khor, 2008:29; Snel & Staring, 2001:8). All households in this study reported that they have family members who went to live in other areas either as workers or as guests with relatives. Women reported that temporary migration eases the household food burden as it reduces the number of people in need of food (HJPA/VD/FNFGDs Vhembe, 2017). More than 50% of households surveyed were female-headed with men in towns and cities looking for work or working there. In addition, children were reportedly sent to live with wealthier relatives in towns and cities where they would have access to good schools (HJPA/VD/FGD2 Women 23052017, 2017). Though this eases the pressure on food shortages, it does not improve the resilience of households. It does not empower households to effectively adjust and cope with food shortages.

Selling household assets

Few households reported selling household assets as a coping strategy for food. The study found that only two households in the survey (6.7%) sold household assets as a food insecurity coping strategy. The remaining 93.3% of the households reported that they do not resort to this coping strategy anymore because of lack of assets (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). The common household assets in the rural area under study are livestock. It was reported that for the areas around and in Gombani the shortage vegetation and water made livestock keeping very difficult, thus most households no longer keep livestock (HJPA/VD/FGD2 Men 17022017, 2017). In areas around Tshiombo, communities rely on irrigation schemes. Livestock keeping has even been banned in order to protect the crops (HJPA/VD/FGD1 Men 19052017, 2017). Rural women reported that due to the remoteness of the area, there were very little chances of buyers who come to buy their livestock, and this made it less of a coping strategy (HJPA/VD/Tribal leader 06062017, 2017).

The challenges that surround livestock keeping and farming prevent households from acquiring other assets they can rely on in times of food shortages. The poor/low income levels related to most households prevented them from accumulating tangible household assets that they can rely on in times of food shortages. The fall back on assets during food shortages was reported in other studies where households sold assets to cater for food shortages (Indu *et al.*, 1998; Quaye, 2008; Shariff & Khor, 2008). The selling of assets makes rural households vulnerable to future threats and setbacks if there are no measures to replace and build on their asset reserves. It reduces the future resilience of the rural households to future challenges. The households that rely on selling assets reported that they sold goats and poultry in exchange for either money or food.

Use of non-timber forest products (NTFPs)

The study found that 43.3% of households in Vhembe District rural area rely on NTFPs as a coping strategy for food. NTFPs are the other products and services that are produced by and in forests (HJPA/VD/FNFGDs Vhembe, 2017). These include wild vegetables, fruits, nuts, fish and animals, insects and grasses. Households reported that they use one or more of these products to complement and supplement food needs in their household (Hunter *et al.*, 2007:327; Ofoegbu *et al.*, 2016:37; Paumgarten & Shackleton, 2011:109). The NTFPs are used for consumption or income generation in the households. The reliance on NTFPs promotes household resilience for food shortages and poverty in general (Paumgarten & Shackleton, 2011:109). However, due to various challenges such as droughts, desertification, changes in the ecosystem's composition, and the availability of NTFPs for rural areas is threatened. This lessens the resilience of households in the face of food insecurity and pushes households into a state of uncertainty regarding the availability of food in the future and their ability to access it.

Rural women in Vhembe named a variety of vegetables, fruits, and insects that are at their disposal. The most commonly used wild vegetables included wild jute (*Delele /Corchorus hidens*), Bitter gourd (*Tshibavhe/Momordica balsamina*), blackjack (*Mushidzhi/Bidens pilosa*), African cabbage (*Murudi/Cleome gynandra*), jelly melon (*Tshinyagu/Cucumis africanus*), Smooth amaranthus (*Vowa/Amaranthus spinosus*) (Bvenura & Afolayan, 2015; Mavengahama *et al.*, 2013; Nesamvuni *et al.*, 2001; Steyn *et al.*, 2001). The leaves of vegetables are cooked and consumed as part of a meal. The vegetables are not cultivated but grow naturally without the aid of human care. The availability of wild vegetables differs. Some are seasonal and mostly grow during the rainy season and some grow wild throughout the year. The availability of these vegetables is highly affected by the availability of rainfall each year. One woman said that:

In our culture, we have consumed wild vegetables for a long time. Some of the vegetables no longer exist (became extinct). The wild vegetable has lost popularity to the modern type of vegetables. Most households use them in times of food crisis (HJPA/VD/W4 26052017 Interview, 2017).

People eat wild insects as a coping strategy for the food crisis in rural households. Rural women reported the use of insects as highly desirable as food, when in season (HJPA/VD/FNFGDs Vhembe, 2017). These insects are a great choice and source of protein. Eating these insects is reported as a coping strategy because the insects are not the first preferred food but come in handy to supplement food diets.

One woman reported:

The collection of wild insects is labour intensive and requires lots of patience, skill and time, such that people only resort to using the insects for food in times of food crisis (HJPA/VD/W8 03062017 Interview, 2017).

Insects mentioned include grasshoppers (*Nzie*), termites (*Madzhulu*), caterpillars (*Neme-neme*), mopane worms (*Mashonzha*), and other edible worms (HJPA/VD/FNFGDs Vhembe, 2017). Their availability depends on rainfall, mostly during and just after the rains, or farming season. This means that they are not reliable as food sources off-season, unless the women dry and store them. Though reported as a coping strategy for food, fishing is not as prominent in these areas because of the distance travelled to rivers (HJPA/VD/FNFGDs Vhembe, 2017). Rural women and men reported that some people could fish in the Luthethe River for food and sell the fish to other households if there is a surplus, to secure an income. However, the river is situated a long distance from their villages. Not many people can have access to fishing opportunities (HJPA/VD/FNFGDs Vhembe, 2017). The whole system of NTFPs shows a reliance on water and physical energy to collect, and process food. It shows the interdependency of the WEF nexus, and the resilient pathways available to rural people. Due to the reliance on the availability of both rainfall and forests for breeding, challenges such as drought bring forth uncertainty within households.

The study found that 56.7% of the households in Vhembe do not rely on the NTFPs as a coping strategy for food. The women explained that due to the reliance on food purchasing, the preferences for wild vegetables have been reduced and people now prefer modern vegetables like cabbages and kale (HJPA/VD/FNFGDs Vhembe, 2017; HJPA/VD/W2 25052017 Interview, 2017). Poor rainfall seasons and low soil fertility have changed the environment and some vegetables, fruits and insects have become extinct. Even in the rainy season, these vegetables are not easily available as in the past, forcing people to spend a long time searching for these vegetables (HJPA/VD/W5 26052017 Interview, 2017). The need for wild vegetables was reported to be significant in times of food shortages but unavailability has led most households to not think of them as coping strategies. The high reliance of wild foods on the availability of water shows the connection of food and water in the ecosystem. As argued by the WEF nexus approach, these connections cannot be ignored and should be considered in the quest for either of the nexus components. The availability of wild vegetables increases the resilience capacity of households in food insecurity and periods of uncertainty.

Wild fruits are used to avert the crisis of food in rural households. The use of wild fruits to sustain the family helps save time. One woman said:

Wild fruits can be picked and used as a healthy snack in between meals. Usually, it enables the households to make use of two meals per day instead of three meals (HJPA/VD/FGD2 Women 23052017, 2017).

The major challenge is that most fruit trees no longer exist, having been cut for firewood. This has made the availability of wild fruits scarce. It shows the importance of conserving the available resources and understanding the cycles within the ecosystem. The need for energy lead to the over exploitation of forests which impact negatively on the food supply system and services of forests. Having compromised the ecosystem structures for one resource lead to uncertainty of availability of other ecosystem services and access to them. It shows how imperative it is to understand the cycles and occurrences within systems to improve resilience.

Other wild fruits mentioned include, rubber vine (*Mavhungo/Saba cornorensis*), blue sorghum (*Thanzwa/Ximania Americana*), green monkey (Maramba/*Strychnos spinose*), black monkey-orange (*Thwathwa /Madagascariensis*), marula (*Marula /scelerocarya birrea*) and baobab (*Mbuyu/Adansonia digitata*). There was general agreement among respondents that they relied more on exotic fruits than indigenous/wild fruits. One woman said:

The Vhembe area is now famous for its avocados. Households planted avocado trees and they are a good source of food. Avocados were planted because they are fulfilling and healthier, as reported. The adoption of exotic avocado fruits is ideal. It takes fewer years to grow avocado trees than a baobab tree or mukwakwa tree (HJPA/VD/FNFGDs Vhembe, 2017).

This shows how important it is to conserve the environment and sustainably manage the resources available. The planting of exotic trees has been adopted in order to ensure a continuous supply of fruits and food on tables. Planting fruit trees that are easier to grow and quick to bear fruit shows household innovation and strategy to cope with the dwindling supply of wild fruits.

The above discussion focussed on food security status and the coping strategies employed by households to curb challenges relationships within the WEF nexus. The findings show how highly dependent on each other the WEF nexus resources are. The relationship begins from the availability of resources, water is important for food security production, processing and consumption. Energy is important for production, processing, and transportation. The availability and accessibility of water are reliant on energy, e.g. for pumping. The coping strategies for food that are used by rural women are less resilient due to challenges in both the water and energy resource sectors. The whole package of coping strategies with regard to shortage of food shows

components of recovery and innovation, by learning from experiences. There is a need for systems to promote the WEF nexus resilience to challenges faced by rural households in the short or long term. This helps to ensure the WEF nexus security of households, the sustainable and positive use and management of resources and, ultimately, development.

5.4.3 Energy security

The WEF nexus promotes the understanding of the major role played by energy in the lives of people. Energy is an important need for sustenance of human lives. It promotes the availability, accessibility and utilisation of both water and food. The need for energy is predicted to rise, even for household uses. Access to clean, reliable and affordable energy sources, even at the household level, continues to be an overall socio-economic driver of development in a country. However, access to efficient and affordable energy resources is restricted for people in rural areas.

Energy is directly used for example in cooking, such as electricity, wood and gas. Households also use energy indirectly, for example petrol, diesel and human energy is used for transportation. In addition, energy is used in the household in the pumping, purification, and provision of water, working in the fields, cooking, and collection, preservation and transportation of food.

In livelihoods, there is reliance on energy for labour, transportation, machinery for production processes. This further exacerbates the need for WEF nexus and promotion of resilience for sustainable development, economic growth, and resource security. The relationships among the resources push for good resource management, which needs innovative systems that can predict, learn, conserve and cope with challenges in a resilient manner. Resilience pushes for the use of resources in a manner, which promotes security for the future by understanding interactions between systems. This study explored the availability, accessibility and security of energy supply, and the fuel preferences and uses by rural households in Vhembe District.

5.4.3.1 Availability and access to energy sources

This section presents the energy resources available to rural households in Vhembe. It looks at the accessibility of these resources. The interviews and focus group discussions found that most households in Vhembe have been electrified. However, this does not mean that the rural households are energy secure. The study found that though respondents had access to electricity, they still relied on traditional fuels, e.g. firewood. In 2000, the government of South Africa passed the bill for the provision of free basic services for poor households, which include water and energy (Department of Energy, 2012:19). Each household selected to have free basic electricity (FBE), receives between 25-50 kilowatt tokens of electricity that is regarded enough for lighting

and minimum cooking and heating needs (Department of Energy, 2012:19). This amount was reported as not being sufficient to cater even for the purposes it has been intended for. The respondents reported that any amount of electricity needed above the free basic grant is available on purchase by households (HJPA/VD/FNFGDs Vhembe, 2017). This has led to reliance on firewood for cooking, heating and space warming in rural areas.

The reported energy uses for direct household needs and uses are electricity and firewood. The rural women reported having knowledge of other energy resources such as gas, solar, kerosene, and other fossil fuels, which they, however, do not use (HJPA/VD/FNFGDs Vhembe, 2017). The reasons reported for not using them ranged from costs related, to hygiene costs of infrastructure. Gas was reportedly costly to rural women because it needs special stoves, it is not readily available in the areas and it is expensive for them to purchase (HJPA/VD/FGD1 Women 18052017, 2017). Few selected households use solar panels as back up for electricity. When their FBE is finished, they use solar lamps for lighting. Even though the use of biomass fuels, e.g. cow dung and crop residue are common in other rural areas as other studies, in this study the use of biomass fuels such as cow dung has not been reported. The women explained that crop residues and cow dung are associated with bad smells, too much smoke, and poor fire quality (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). The availability of firewood though at a distance promotes the use of firewood.

The households reported that firewood is collected from nearby forests. The officials in the natural conservation department argued that this continuous use of firewood leads to deforestation, increased erosion and changes that are negative in the ecosystem.

One official said:

The continuous felling of trees for firewood is detrimental to the ecosystem and may lead to future inconsistencies. There are laws that guard against the cutting down of trees for firewood in South Africa. However, the cutting down of trees is still high, leading to deforestation (HJPA/VD/Official EA 25052017, 2017).

The official reported an excessive exploitation of wood resources. This can lead to other challenges, e.g. erosion and deforestation that have an impact on the WEF nexus security.

5.4.3.2 Household fuel choices, challenges and security of supply

The study explored household preferences for energy sources for different uses. The main objective of this section is to find the energy sources and uses within rural households. The driving force for household energy use in Vhembe rural households includes cooking, heating, and lighting. Rural household energy use is driven by productive activities and livelihoods,

transportation, communication and public services. In this study, uses of energy such as transportation, communication, and public services were classified under other needs. This is because these are indirect household uses of energy. The other types of energy that are used less frequently or indirectly were categorised as other fuels. The findings on the household energy preferences are represented in the Table 5.6, which represents data on households that have used a certain type of fuel at some point.

Table 5.6: Distribution of households according to energy used at one point

Type of fuel	Cooking/Heating	Lighting	Income generation	Other
Electricity	10	30	3	30
Firewood	30	-	13	-
Candles	-	30	-	-
Solar	-	10	-	-
Gas LPG	2	-	-	-
Others(petrol, diesel, animal, human)	-	-	18	30

Source: HJPA/VD/FNFGDs Vhembe (2017)

The study found that all of households (100%) represented used electricity for lighting. One-third (33%) of households reported the use of electricity for cooking and heating during firewood shortages. Three households (10%) who use it for sewing reported electricity use for income generation. All households reported that they have other energy uses. Energy is used directly for cell phone charging, entertainment, and indirectly for pumping water from boreholes and transportation. The use of energy for water pumping, transportation and cooking, collection and in the production of food show the relationships of WEF nexus. Shortages of electricity or its unavailability lead to water shortages for domestic use and irrigation. Water pumped is necessary to aid in the production of food for sale or for consumption. One woman reported:

The challenge we have is a shortage of electricity to pump water for irrigation. The transformers we have are too big and consume a lot of energy. This affects irrigation production in times where there is no funding to purchase more tokens (HJPA/VD/FGD2 Women 23052017, 2017).

Unreliable and scarcities of energy for livelihood purposes, such as irrigation, hinder households from building an asset base they can rely on in times of crisis. This reduces the resilience capacity of households, which can rely on their asset base to recover and cope with challenges. During stable times, systems conserve resources and when they face challenges, they rely on those resources to recover. In the absence of such resources, the system may collapse (Benson &

Garmestani, 2011:1421; Berkes & Ross, 2016:186). This explains the conditions of panarchy cycles in resilience.

The study found that there is an increased reliance on firewood for cooking and heating. All the respondents (100%) reported using firewood for cooking and heating as the main fuel type. Firewood is preferred in this rural community as it is a free resource. About 13 (43.3%) of the respondents use firewood for income generation (HJPA/VD/FNFGDs Vhembe, 2017). Activities such as brickmaking and fat cake making require the use of firewood. The belief that firewood is a free commodity shows a lack of understanding of interactions in the ecosystem. Panarchy helps to explain the interaction between humans and the natural environment (Benson & Garmestani, 2011:1421; Berkes & Ross, 2016:186; Gotts, 2007:2). It explains how the actions and decisions taken on interacting with the system could lead to either the growth or collapse of another system. The increased quest for firewood lead to extinction of special species that are used for food security such as wildlife, wild fruits, and fisheries.

The use of solar energy was reported by 10 of the households (33.3%) which used it only for lighting. The use of solar energy in times of electricity shortages was reported. Most households rely only on the basic electricity (FBE) grants, and when they use all of it before the end of the month they seek, alternative energy sources (HJPA/VD/FNFGDs Vhembe, 2017). One woman said:

In times of energy shortages, an alternative is the solar lamp. The lamp is ideal as it has a part for recharging all phones. Though it is expensive, we strive to buy it to help with lighting (HJPA/VD/W2 25052017 Interview, 2017).

The use of solar latent is an ideal alternative as it relies on renewable energy and increases the resilience of households. However, respondents reported that not all households could purchase it because it is expensive for them. One woman said:

The solar lamps are good but too expensive. My household cannot afford to buy it as most of the income we have goes to purchase food for the family. In good shops, the solar lanterns are ranging from R200 upwards. It is almost a grant for one child and we cannot afford it (HJPA/VD/W9 04062017 Interview, 2017).

This shows that households may be less resilient because of a lack of income and assets to fall back on. Income and assets thus play a role in fostering resilience of the system to certain vulnerabilities.

In times of electricity shortages, households used candles, which are cheaper but not readily available in areas where rural people live. All 30 households (100%) reported that they benefited from the free basic electricity plan that is provided by the government. The free basic electricity policy was established following the government's intent to provide free basic services to indigent households and the provision was done from 2003 (Mapako & Prasad, 2005:3). Women in this study reported that the FBE grant is inadequate for a whole month in an average household; they reserve electricity for cell phone charging, lighting, and powering entertainment gadgets like TVs and radios. In times of energy shortages, those who can afford them, use candles and solar lamps.

Two households (6.7%) reported that they use LPG for emergency needs and when it is inconvenient to light a fire. The women who reported the use of LPG, also reported that they have very young children attending primary school and use gas to cook and heat water in the morning. It makes it faster to prepare children for school and cook for them (HJPA/VD/FGD1 Women 18052017, 2017). The poor usage of gas in this area relates to the cost of purchasing the gas and the infrastructure needed to use it.

Other forms of energy needed for household indirect uses, include diesel, which is used for pumping water at local boreholes. Diesel is used for income generation when pumping water for irrigation, and powering tractors and other machinery that need diesel fuel. Petrol was reportedly used for the same purpose, as well as for transportation. Transportation is needed for transporting farm produce to markets, to purchase food needed for the family and to transport water to households in times of water crisis. The households who pursue brickmaking cited a lack of adequate transportation and expense of transportation as limiting factors to brickmaking as a sustainable livelihood option (HJPA/VD/FNFGDs Vhembe, 2017). This reduces the households' income-generating capacity. The general use of transport to and from urban centers for various reasons shows an indirect use of petrol, diesel and other related fuels. Human energy is very important as it provides the ability to execute and complete tasks within households. The use of animals for energy, though it may exist, is relatively low due to modernisation. People in these communities no longer rely on animal power and only looked towards modern technology and machinery to execute tasks.

Preferences for energy sources therefore, is related to local availability and accessibility, as discussed above. The costs involved in obtaining an energy source play a role. Firewood was highly used because it is faster to get and cheaper, as reported. The use of kerosene, though it may be useful for both lighting and cooking, was not reported. The respondents claimed that kerosene had a bad smell that lingered in the house even when used for lighting. Other studies concluded that household energy preferences are driven by costs, beliefs, preference and

readiness of availability and access to a resource (Arthur *et al.*, 2012; Davis, 1998; Desalu *et al.*, 2012; Johnson & Bryden, 2012b). This study came to the same conclusion. The study found that modernisation plays a significant role in the energy preferences. Rural households choose their sources depending on their income capacities. Households used firewood for cooking even though they have access to electricity. The drivers of energy preferences are important to note when advocating for an energy resilient society. The WEF nexus interactions can be seen because energy is essential for food security, income generation, and water security. The various challenges discussed are WEF nexus related.

Availability of firewood for household use is through collection and women reported traveling long distances to the mountains to fetch firewood. Women reported that due to the long distances it has become difficult to collect firewood at any time. Therefore, there are times households experience energy shortages. Diminishing forests make it difficult to get good quality firewood (HJPA/VD/FNFGDs Vhembe, 2017). The costs involved in purchasing other alternative fuels like solar, electricity and gas has increased the energy poverty of rural households who do not have adequate and reliable sources of income. This means that households are less resilient to energy insecurity and poverty. These challenges often lead to transformations within societies. Resilience fosters the learning and innovation of human systems to adapt to the changes they face. Despite all the challenges faced human societies continue to come up with ways to reduce the impact of challenges. The rural women have a way of reorganising themselves during the collapse in vulnerability phases to survive in panarchy cycles, as explained. The resilience of the rural households to threats is enabled by learning, remembering and being innovative in coming up with good coping strategies.

5.4.3.3 Coping strategies for energy challenges

This study found that the total household in the Vhembe District area is not energy secure. The findings show that rural households lack adequate energy supply for their needs. Energy needs include cooking, heating, and lighting (Uhunamure *et al.*, 2017:26). It was also found that energy is needed for other indirect uses, such as transportation, communication, and productive labour. Furthermore, findings indicated that energy is essential for income generating activities (productive uses). The need for energy in these rural households shows a clear WEF nexus. Shortages of energy lead to food and water insecurity as well. Increasing access to energy resources lead to growth and security in the food and water sector. As resilient panarchy cycles suggest learning from past experiences and remembering help to foster resilience and sustainable use of resources available (Berkes & Ross, 2016:187). In this study, coping strategies of rural women were explored. The previous sections concluded that rural households are not energy secure.

The reliance on firewood for cooking and heating lead to overexploitation of the natural systems. Sustainability of the natural ecosystem will be based on the nature of firewood collection (Matsika *et al.*, 2013:717). Local governance can be used to monitor the ways in which human interaction with the natural system proceeds through passing laws. The study found that firewood and electricity are the major types of fuel in the rural households. Gas, solar energy and candles are alternative sources when the other energy sources are scarce (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). Economic, physical and behavioural circumstances of a system (human, society, and communities) and the environment drive energy insecurity. The economic driven energy insecurity is related to household wealth and income (Hernández, 2016:6). Physically driven energy insecurity is related to the availability of good energy infrastructural systems (Hernández, 2016:6). The energy infrastructure includes having access to good household appliances for heating, cooking, lighting, and space warming. Behaviour-driven energy insecurity relates to how people use the available energy resources (Hernández, 2016:7). The behaviour of rural people plays a role in ascertaining energy security. Behaviour includes the strategies that people formulate to cope with threats, and to counteract the effects certain challenges may have on their lives.

There are positive coping strategies that foster environmental and economic benefits, and negative coping strategies that diminish stability, sustainability and general wellbeing (Hernández, 2016:8; Matsika *et al.*, 2013:718). The participants in this study stated varied strategies used to cope with energy insecurity. These include household energy saving, conservation strategies, and changing energy consumption behaviour. The respondents reported that a household employs more than one coping mechanism to ensure they have enough energy (HJPA/VD/FNFGDs Vhembe, 2017). Table 5.7 shows households that have used a stated coping strategy.

Table 5.7: Household coping strategies for energy

Coping strategy	Number of households	Percentage (%)
Energy preservation	30	100
Changing energy consumption patterns	30	100
Multiple energy uses (fuel, switching)	30	100
Conservation and management of natural resources	30	100

Source: HJPA/VD/FNFGDs Vhembe (2017)

Rural women reported energy management techniques as a way of coping with energy insecurity. All households use these techniques though actions vary from one household to another. The coping strategies outlined are energy preservation; changing energy consumption patterns; multiple energy source uses; conservation and management of natural resources

(HJPA/VD/FNFGDs Vhembe, 2017). Trade-offs are reportedly done within households, such as not buying food, not paying water rates, not buying inputs for farming, in order to purchase electricity tokens or even firewood. Studies of similar context found that there are measures that households take to ensure they have the constant provision of energy for domestic uses (Davis, 1998; Department of Energy, 2012; Hernández, 2016; Uhunamure *et al.*, 2017).

Energy preservation

Energy preservation includes ways of conserving and reducing household energy use. According to Fischer (2008:82), energy conservation is done through changing energy consumption behaviours. All households under study reported that they have energy preservation strategies such as switching off lights in the unused rooms, and reserving electricity for charging cell phones, watching TV and lighting only. One woman said:

I ensure that all gadgets that consume energy are switched off when in use. Electricity is never used for cooking in any house to ensure that it lasts longer (HJPA/VD/W8 03062017 Interview, 2017).

They do not use electric heaters to warm up the spaces but prefer to sit around the fire until it is time to go to bed in the evening.

One woman said that,

In our areas, we do not have too much problem with access to firewood since we collect it ourselves free of charge. Each household collects as much firewood as it wants. The limiting factor on firewood collection can only be lack of labour to cut down trees and to carry. Therefore, we have no limitations in the use of firewood. We can heat our water for bathing at will as long as water is available, and we can cook as much as we want provided food is available (HJPA/VD/W6 03062017 Interview, 2017).

The main reason for preserving firewood is the lack of water or food, as reported. Women around Gombani agreed with this perception. However, in areas around Tshiombo, most of the land has been converted into farms; therefore, firewood is not readily available (HJPA/VD/FGD1 Women 18052017, 2017). Women reported that they walk long distances of more than 2km to fetch firewood in both areas (HJPA/VD/FNFGDs Vhembe, 2017).

One woman pointed out that in most female-headed households, fuel/energy conservation is practiced due to lack of adequate labour to collect firewood (HJPA/VD/FNFGDs Vhembe, 2017). Energy conservation can lead to effective ways of using fuel/energy in the home. However, in Limpopo, they still use traditional open fires and iron legged stoves, which are used to hold the

pot. Open fires waste a lot of energy and resources (HJPA/VD/FN Vhembe, 2017). Though they have challenges in the collection of firewood, rural women reported that they do not limit themselves to the use of firewood for cooking and heating. They all agreed that collection challenges such as distance and risks involved are solved by going to collect firewood in groups, talking and laughing, which makes the task enjoyable (HJPA/VD/FNFGDs Vhembe, 2017).

The study found that in the area under study, the conservation strategies were formulated mainly for electricity because of the costs. Due to the low income of rural households, as reported, women change behaviour patterns and those of their household family members to save electricity (HJPA/VD/FNFGDs Vhembe, 2017). The perception that firewood is free and can be collected at will puts the ecosystem at risk of overexploitation of forests and alter the sustainability of natural resources in the future. Panarchy explains the interactions between systems. The actions of human and social norms and practices have negative impacts on the ecosystem. Non-conservatory ways of using fuelwood lead to less resilient systems that lead to the loss of important resources, which create pathways for resilience.

Conservation and management of natural resources

The natural and environmental management agencies push for sustainable uses of natural resources. Laws and policies push societies to adopt sustainable ways of interacting and benefiting from the environment. Cutting down of trees, hunting and fishing may only be done after getting a special permit either from responsible ministries or local leaders. The Natural Forest Act of 1998 was formulated to protect forests and certain species in South Africa (Robertson & Lawes, 2005:64). According to this Act, it is an offense to cut down trees, especially the indigenous species. The Act aims to promote sustainable management and development of forests (Robertson & Lawes, 2005:65). It requires one to have a license in order to cut down trees in the state-owned forests. In Vhembe, the local leadership enforces the law and often people dodge the system and continue to cut down trees (HJPA/VD/Tribal leader 06062017, 2017; HJPA/VD/Tribal leader 24052017, 2017). The government promotes the setting up of tree plantations where each area is encouraged to plant trees to maintain the balance of the ecosystem. Even though laws are there, people avoid them, as they believe forests are free and are for all people to benefit from at any time (Hernández, 2016:8). This reduces the resilience of both the human and ecological system. The unsustainable use of resources leads to resource insecurity in the future.

The study found that there are conservatory strategies that promote good and sustainable management of natural resources. The study found that all participants were aware of and educated on the need to conserve their forests. They explained their knowledge and awareness of laws regarding the use of forests timber and non-timber services/products. All households

indicated that they practiced conservatory strategies that support the sustainability and stability of the ecosystem. The men explained:

We are not allowed to cut down trees for firewood. We are encouraged to use firewood from naturally dead trees, or to take out branches that will promote regrowth (HJPA/VD/FGD1 Men 19052017, 2017; HJPA/VD/FGD2 Men 17022017, 2017).

These strategies are used to promote the stability of the ecosystem without causing energy poverty to rural households.

Household behaviour changes in energy consumption

Consumption patterns in households refer to the types of activities a household engages in, which rely on energy. The study found that rural households choose to reduce activities that demand a lot of energy. To save electricity, the women reported that they do not use it for cooking and heating, and they do not use it regularly for ironing as they explained that:

All the activities that involve heat or warmth use a lot of energy and therefore, we try to cut them out (HJPA/VD/FGD1 Women 18052017, 2017).

The study revealed that rural households resort to consuming instant foods that are easy to prepare, usually taking only ten minutes or less to cook. Most of the food does not require to be cooked but only to add boiling water. These foods included soft porridge, instant coffee, instant noodles and use of over-processed food and parboiled products that do not require a lot of energy for preparation (HJPA/VD/FNFGDs Vhembe, 2017). An FGD held at Tshiombo brought to light that rural women consume soft meats such as chicken hearts, feet, gizzards and livers that are both cheaper and quicker to cook, instead of beef, pork, and poultry. One woman explained that:

We reduce our meals for the day. This leads to consumption of concentrated drinks and cheap snacks serving as meals, which do not require cooking. This coping measure saves energy. The reduced cooking leads to a reduction in energy use (HJPA/VD/W1 24052017 Interview, 2017).

The research found that rural households change their methods of cooking, opting for fast foods, and quick cooking methods than stewing but may lead to undercooking of certain foods. The explanations given showed the WEF nexus relationship and how action taken in one resource sector have either negative or positive effects on the security of another. That is why panarchy is used for an understanding of cycles and interactions occurring within systems in order to build sustainability and resilience of societies.

Multiple energy uses and energy switching

The study found that rural households in Vhembe use multiple sources of energy in their households. Even when they have access to electricity, these people still rely on firewood for cooking and heating. The push factors for multiple energy uses were reportedly costs attached to the use of electricity for all purposes (HJPA/VD/Official Energy 01062017, 2017). All households reported that it was better for them to use firewood for cooking and heating, which reduces the cost burden of using electricity. Uhunamure et al. (2017:26), who reported that rural households in Vhembe District prefer to use firewood for cooking and heating, echoed the same results in another study.

The perception of rural people is that firewood is free and cheaper (HJPA/VD/FNFGDs Vhembe, 2017). The only effort was to have time for collection. Firewood collection is typically a women's role, as reported, and helps to save income, which is then used to purchase food or access other basic services. Use of candles, gas and solar energy was reported by few households and was resorted to during power cuts and blackouts. Two households reported using gas for convenience and to manage the little time they have preparing children for school (HJPA/VD/FNFGDs Vhembe, 2017). The results show that though there is knowledge of other energy alternatives, rural areas in South Africa have limited energy avenues.

The modernisation of societies in South Africa has led to changes in the perception of energy sources. The use of biomass fuel such as dung was reportedly not an option due to smells and dust associated with it. Kerosene is not popular despite being cheap; the women reported that it emitted an unpleasant smell (HJPA/VD/FNFGDs Vhembe, 2017). This shows that rural communities in South Africa have limited choices and action avenues in times of energy scarcity or shortages. Free electrification of the rural areas and provision of free basic electricity have created a dependency syndrome for free handouts. The communities look up to the government to improve their ways of living by giving them more benefits and adding to the quantities of free basic services.

In an FGD, rural women expected of the government to hear their plight and increase free basic services such as electricity. One woman said:

The free basic electricity granted is not adequate for household needs. Even when using wood for cooking and heating, the electricity is not adequate. The major problem is lack of income generating activities; we cannot afford to buy more electricity tokens. We still need money to buy food and sometimes water. This makes it very difficult to ensure WEF security (HJPA/VD/FGD2 Women 23052017, 2017).

Similar studies established that the highest number of people (66%) in rural areas was not satisfied with the provision of electricity in terms of pricing. They felt that electricity prices were too high (Department of Energy, 2012:40). Therefore, use of other fuels for high-energy consumption activities is used as a coping mechanism.

Interviews with officials established that though most households in the rural areas of Vhembe are electrified there are still backlogs (HJPA/VD/Official Energy 01062017, 2017). Some of the rural areas have come up with measures to ensure they reduce energy poverty in rural areas. The government established the free basic alternative energy (FBAE), which subsidises alternative energy sources for poor rural and electrified households. Subsidised energy resources include solar home systems, paraffin, liquefied petroleum gas, coal and bio-ethanol gel (Department of Energy, 2012:40). The FBE and FBAE policies were meant to promote human wellbeing, especially of women and girls responsible for firewood collection. The policies aimed to promote household access to energy and to ensure that the poor households are not pushed further into a cycle of energy poverty.

The study found that the rural Vhembe District area has energy-related challenges driven by a lack of income, a lack of access to markets for alternative sources, the preferences and lifestyles of rural people, as well as over dependency on the government for social services subsidies. The study found that rural people employ energy-saving coping strategies largely by reducing energy use. The other coping strategies all complement the energy saving coping strategy. Changing consumption patterns by choosing instant foods, low-quality foods, quick cooking methods and easy-to-prepare meals promote energy saving but have negative effects on health and the wellbeing of people. Multiple energy uses and fuel switching are coping strategies that help in saving energy and aid in times of energy shortages. It emerged that a household could benefit from either FBE or FBAE, but not both. This limits the electrified rural households in accessing other alternative energy sources at subsidised rates. The cycle of energy poverty can be broken by improving access to all forms of energy. There is a need for improved access to reliable, sufficient, clean, safe, affordable and sustainable energy sources. The government should increase investment in health and environmentally friendly alternative energy sources (Department of Energy, 2012:19).

5.5 Conclusion

This chapter gave an extensive presentation of findings on the current WEF nexus situation in Vhembe District. The coping strategies that are used for the security of each WEF nexus resource were discussed. The objectives of the chapter were to provide an in-depth understanding of the current WEF nexus security situation as perceived by the rural women, men, and municipal

officials. The chapter gave an exposition on the WEF nexus situation in the district using related literature. The relationship of the WEF nexus and inter-linkages are undeniable. The processes for coping and adapting to challenges show that management and securitisation of WEF nexus components cannot be done in isolation.

The chapter gave an exposition on WEF nexus coping strategies of rural women in Vhembe, and the positive links with the theoretical perspectives of this study. It also described how the modified theory of WEF nexus resilience could help in the understanding of WEF resources use, management and security for rural households. The WEF nexus linkages existed from the availability, access, and utilisation of resources. Water promotes food and energy security for households. Energy increases access to water and food resources. Food resources and productive activities contribute to wellness, health, and an increase in household income that contributes to household access to water and energy resources through improved income and livelihood.

Potential household livelihoods for rural women relied on the WEF nexus resources as inputs for production and as outputs for household use. Water is paramount for agriculture, brickmaking, livestock keeping, gardening and other livelihoods. Food acts as an input for wellbeing and improves the capacity of women to work in various livelihoods. Energy is important for promoting access to and availability of water and food production, processing and transportation. Their inter-linkages were traced in the coping strategies where it showed that coping strategies for one resource have the potential to improve the security of other resources or may lead to potential risks for them. Water security coping strategies improve food security and livelihoods, which improve energy and the household capacity to access and afford energy resources. The need for sufficient firewood for household needs can lead to deforestation which impacts negatively on water through erosion and siltation of open sources of water. The constant cutting down of trees leads to poor soil composition leading to poor harvests, and potential destruction of forests, leading to loss of wild and natural food resources.

The coping strategies were explored in isolation of each of the WEF nexus resources. This helps in understanding the way rural women interact and cope with challenges for each resource. The coping strategies reported included changing consumption patterns, saving, falling back on household assets, relying on social services support, community initiatives and trade-offs. The footprints of the reported coping strategies were found in all WEF nexus resources. Coping strategies in South Africa showed short-term coping strategies and long-term coping strategies. The choice and preferences for coping mechanisms in South Africa showed influences of modernisation as rural women reported not using some sources for both water and energy because of the smells they have and the level of hygiene surrounding them. The study found that

challenges in the areas under study, Gombani and Tshiombo, were persistent and coping strategies used were not mitigating the WEF nexus insecurity.

Data collected showed that WEF security is still a challenge for rural households in Vhembe District. There is a need to learn and remember past experiences and how responses to the crisis were formulated. There is also a need to collect and build upon local knowledge and resources available for resilience against possible threats. Rural women as managers of resources in the home need to be empowered and fashioned with knowledge on how to cope with the threats and measures to cope with possible WEF nexus crisis. The coping strategies that have been reported ensure survival and containment of challenges faced by people for the WEF nexus security. It is necessary to build on resilience and adaptive capacity of systems in particular rural households and the environment. The promotion of resilience provides avenues for WEF security, economic growth, sustainable development and sustainable use of available resources. Resilience pushes for stability and sustainability of systems for the future.

CHAPTER SIX

COMPARING THE COPING STRATEGIES OF RURAL WOMEN TO WATER, ENERGY AND FOOD SECURITY IN A SOUTHERN AFRICAN SETTING

6.1 Introduction

In this chapter, the predominantly empirical aspects of the study will be discussed and the similarities and differences in WEF nexus security and coping strategies of rural women are revealed. The WEF nexus theory and its importance in the achievement of resources security have been discussed earlier. Chapters 1 and 2 showed how imperative it is to understand the interactions between resources and why it is important to ensure that integrative measures be taken to ensure resource security. This study focused on the local level to see how the security of WEF nexus resources can be achieved for rural households using the WEF nexus resilience framework. From the literature, it was found that WEF nexus security ultimately is representative of global risk that is expected to intensify in future. Though these predictions are done at the global level, it is imperative to give special attention to real-life events at the lowest scale of human activity. A good starting point is to take an explorative view of localised rural households who are vulnerable to WEF nexus insecurity in selected locations in Zimbabwe and South Africa.

In Chapter 2 of this study, a framework was proposed to explore the WEF nexus security and the coping strategies that are used to secure a special focus on rural women. The modified WEF nexus resilience framework combined important aspects proposed in the WEF nexus theory and resilience framework using panarchy cycles. The modification was done in order to build upon the WEF nexus and help in our understanding of WEF nexus interactions in rural households and communities. Chapters 4 and 5 dealt with theoretical and empirical evidence derived from the two case studies, one in Chivi District, Zimbabwe and one in Vhembe District, South Africa. These chapters provided expositions on the current local WEF nexus security status and the challenges faced by rural households and people's coping strategies. The analysis and presentation of data in Chapters 4 and 5 were done in broad sectoral Water, Energy, and Food security themes. The discussion gave an exposition on the availability, accessibility, utilisation, and stability of supply, challenges faced, and how rural women cope with those challenges.

There is an outline of similarities and differences between the two locations and diverse households. The chapter presents a summary of the socio-biographical aspects of rural women and the challenges that they face, revealing similarities and differences. Cumulatively the insights

gained contribute to our understanding of the actions that rural women resort to in their engagement with the resource components in the WEF nexus. A comprehensive analysis of coping strategies is delivered analysing the differences and similarities that are revealed to provide sound conclusions and avenues that can be learned from each case.

Therefore, this chapter compared the coping strategies used in each sector and explored the impact on the WEF nexus. It sheds light on possible avenues for resilient responses of adaptation to ever-changing circumstances. Coping strategies are actions that are taken by people to reduce the severity of challenges they face (Maxwell & Caldwell, 2008). These are influenced by both severity, frequency and longevity of the challenges (Maxwell *et al.*, 2003). The study found that most coping strategies used for one sector, might influence the security of other resources. In the research fieldwork sessions of engagement with communities, the respondents did not know the term WEF nexus. However, they acknowledged that they knew there were inextricable links between water, energy and food (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017).

6.2 The role of women in the WEF nexus security

The study explored the roles and responsibilities of women in the domestic environment, to find out how women participated in the acquisition and management of WEF nexus resources in the household. WEF nexus components interact in a variety of ways in the household. WEF resources are more interdependent in households than in the broader community space. The insecurity of one component of the nexus has an impact on the security of all WEF family members.

Access to resources is important for not only consumption and hygiene but also the wellbeing of household members (HJPA/VD/FNFGDs Vhembe, 2017). Shortages in water lead to household poverty in rural areas as they rely on water-based livelihood incomes that give members buying power to choose foods and types of energy sources they need. Food provides people with the physical energy they need to carry out their daily chores and perform both productive and/or reproductive work (HJPA/VD/FN FGDs Officials, 2017; HJPA/VD/FN Vhembe, 2017). In focus group discussions conducted, women discussed their daily routines of activities related to WEF nexus. Women spend a lot of time in both productive and reproductive work. In the next sections, findings from each case study area are provided.

6.2.1 Findings from Chivi District

Women are actively involved in the production activities. In addition, they manage the utilisation of WEF resources in the home. However, the roles they play have been largely undermined and undervalued. They are active in the production roles as farmers and indulge in various income

generating projects to provide for their families. They play an active role in the reproductive sphere through childbearing, child rearing, and caregiving and ensuring the wellbeing of the whole family. They are food producers and primary energy and water collectors in the home.

The society in Chivi District is patriarchal and people live by defined standards where there are roles of men and women. Women spend more time doing work such as cooking, washing, fetching water and firewood. Most women alluded to the fact that these chores require lots of energy, such as fetching water and firewood. Water and firewood collection were described as strenuous and time-consuming as they carry the loads on their heads. These are the primary roles of women in the rural Chivi area. Men were reportedly helpful by cutting down trees and fetching water when they have wheelbarrows and scotch carts. One woman said:

Most men do not want to fetch water because the areas where we get water are usually crowded with women queuing for water or washing, therefore men feel uncomfortable. In addition, water collection is regarded as the role of a woman and children. It is difficult indeed and increases the household burden for women (HJPA/CD/W10 12022017 Interview, 2017).

On top of this, women are involved in childbirth, caregiving, and raising children. A gender analysis study done by Care International in Chivi District, showed that women spend most of their resting time performing gender roles and responsibilities (ENSURE, 2014:27). Women in Chivi District are subordinate to men and lack sufficient power to make major decisions on livelihood and income options. According to a study by ENSURE (2014:29), women spend five hours more time working than men. This shows the importance of women in the WEF nexus security and their role in the households.

Rural women in Chivi District play an active role in productive work. For most households, women are the breadwinners and have to fend for their families in the absence of husbands. There are indications of a shift in the gender roles where men are the major breadwinners in the family. This shift is caused by the need to supplement the income generated by husbands, remittances from family abroad or in towns, and generally, to raise income to fund various needs (HJPA/CD/FGD3 Women 07022017, 2017). The drivers of this shift in gender roles include socio-economic changes, for example, the economic meltdown in Zimbabwe at the start of the new millennium in 2000. These changes have caused men to migrate to South Africa in search of jobs (HJPA/CD/W8 12022017 Interview, 2017; HJPA/CD/W9 12022017 Interview, 2017). This has increased the workload of women and it has an impact on the acquisition of WEF resources for rural households.

6.2.2 Findings from Vhembe District

The study found that women are involved in both productive and reproductive work. They are breadwinners and engage in various productive activities, even those traditionally regarded as male jobs, such as brickmaking (HJPA/VD/FNFGDs Vhembe, 2017). Most household chores are regarded as the women's responsibility. This includes fetching water and firewood, preparing food and taking care of children and old people within the home. It is the role of women to provide home-based care for ill members of the household (HJPA/VD/W4 26052017 Interview, 2017). Rural women are active in childbearing, caregiving and ensuring the wellbeing of the family unit.

Women in an FGD in Vhembe District reported that it is the traditional norm for a woman to take care of her family through cooking, washing, sharing resources, cleaning and ensuring family wellbeing (HJPA/VD/FGD2 Women 23052017, 2017). Men's roles traditionally were to make major family decisions and to be in charge of major resources such as land and produce from farms and related aspects of family life. Men are responsible for taking care of their families by working and providing for them (HJPA/VD/FGD2 Men 17022017, 2017). This has since changed due to changing global patterns in economics and social views where gender equality has gained significant ground. Women, in many cases, are involved in productive work such as irrigation farming, formal employment and other income-generating activities previously dominated by men.

However, in the rural areas of Vhembe, communities remain ostensibly patriarchal. The man, if around, is still the head of the household by default. One woman said:

I am married, my husband is unemployed, therefore cannot raise much income. I am doing various activities such as piece jobs, Chiseve-seve (GSSs), selling fat cakes (magwinya) and fruits that raise money. However, the man is still the head of the house and makes decisions on how we can use the money in the home. The husband is to be respected, even if I earn more money than he does (HJPA/VD/W7 03062017 Interview, 2017).

This shows that the societies regard men as heads and women as subjects in rural households. This practice contributes to the vulnerability of women to increased poverty (Bentley, 2004:250). The researcher probed to find out if there were men who were involved in domestic chores in rural households represented.

One man commented:

It is the role of the man to be a breadwinner for his family. However, a man cannot be seen doing day to day chores of women such as cooking, washing

and household care, unless the wife is sick or travelling (HJPA/VD/FGD1 Men 19052017, 2017).

This shows that though women are now involved in productive work, it has only increased the number of household chores and hours they have to spend working for productive and reproductive purposes. It is still somewhat of a cultural view that a woman's place is in the home and men should be out there looking for resources for their families.

According to Raidimi (2014:17), most women spend eight to nine hours per day on farming and doing farm work. This leaves little time for other household chores such as fetching firewood and water and maintaining hygiene. The massive clearances of land for agricultural purposes and resettlement influence the availability of fuel wood for households. Most rural homes are far from woodlands, which means women need to create time to fetch firewood rather than collecting it on the way from farms (Chikava & Annegarn, 2013:68). Combined WEF resources collection and production requires lots of time. It means women work longer hours. One woman explained that:

I complete all the chores for the day; I have to sleep as late as 11:00pm. Moreover, I wake up as early as 4am to start preparing for the day. It is easier though for households with more able-bodied members as they can share work (HJPA/VD/W4 26052017 Interview, 2017).

This affect the health and wellbeing of women and puts them at risk of long-term illnesses.

6.2.3 Synthesis on the role of women from Chivi and Vhembe Districts

Women in Chivi and Vhembe districts showed similarities in the roles they play in the WEF nexus. In both areas, women are an integral part of the rural household economy, wellbeing, and survival. Similarly, women are the ones that do hands-on management of resources in households. Where there are WEF nexus security challenges, women come up with both immediate short- and long-term solutions to cope with the challenges. It emerged that in both areas, women's roles in households are to ensure the wellbeing of the family by sourcing resources, managing and distributing them to last longer.

Gender roles and responsibilities are influenced by social norms and institutional rules for rural communities. These norms and values constructed by communities have an influence on the decisions and choices made by both men and women in households (Morrow, 1999:5). In rural communities, there are socially defined tasks, roles, and responsibilities that are based on gender. Productive tasks are for men and reproductive tasks for women. However, poverty has caused a major shift to happen in gender roles. Women started to conduct productive tasks and men started

to help in the home (Bwerinofa & Chiweshe, 2016; ENSURE, 2014; Gaidzanwa, 1995; Mehretu & Mutambirwa, 1992).

Studies show that women play a role in productive work and activities, while at the same time still performing the reproductive work as per custom (Chikava & Annegarn, 2013; Oberhauser & Pratt, 2004; Raidimi, 2014). Women contribute to income generation and food production activities alongside men. All households in rural areas use firewood as energy for heating and cooking (Chikava & Annegarn, 2013:67). Rural women fetch firewood from woodlands using their heads or the wheelbarrows as the conveyance methods. This form of labour requires physical energy, which relies on food consumption (Chikava & Annegarn, 2013:69). Therefore, increasing rural women's access to resources and building their capacity for productive work through technology, improved transport and communication may build on household resilience capacity for WEF nexus security.

The women should be empowered to be able to predict the challenges and find resilient ways to cope with the challenges in a manner that promotes stability, sustainability, and development. Local knowledge they gain from past experiences and the coping strategies they use against WEF nexus challenges could be used to promote resilience and avoid the collapse of households and even community systems. Empowerment should feature the input of husbands, family members, communities, NGOs, governments and other systems that can foster the women's role in the household and community.

6.2.4 Rural women's access to productive resources

Access to resources for rural women accentuates their roles in both productive and reproductive workspaces, as well as the WEF nexus security. Access to resources creates an enabling environment for women to create innovative ways of responding to WEF nexus security-related challenges. In both Chivi and Vhembe, it emerged that women do not have adequate access to resources essential for production (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). These resources or factors of production include land, labour, and capital. The disadvantaging factors are the socio-cultural issues that govern the roles and livelihoods that women can do. Culture limits the power of women in decision making, and the accumulation of wealth and assets. According to studies by Aggarwal *et al.* (2001), Ajadi *et al.* (2015), Chitja *et al.* (2016), as well as, Gumede (2013), rural women play a part in the development and productive economic sectors by providing labour. However, the lack of access to productive resources hinders their development, empowerment and emphasises the importance for women to have access to these resources.

Land ownership in the areas of study was under tribal authority. Rural people, therefore, have to seek permission to occupy and usually the tribal leaders reserve the right to allocate land. Women in both study areas have limited land ownership rights in the communities that are ostensibly patriarchal in nature. In Vhembe, the women could have land allocated to them by the chief in their name, whereas in Chivi women did not have this privilege (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). It was possible in Vhembe to have a piece of land allocated to a woman, however most women had access to land through marriage and family owned land (HJPA/VD/FNFGDs Vhembe, 2017). In Chivi District, women owned land through marriage and not all unmarried and divorced women have the privilege of owning land individually (HJPA/CD/FGDs Field Notes Chivi, 2017). In both areas similarly, women could own land due to spousal death or family allocation where the family leader chooses to give a piece of land to a woman. This, however, does not give the woman full rights to the land. The ownership rights remain in the hands of males. A female child cannot inherit land upon the death of parents, but can continue to use the land with the permission of male relatives who will assume the rights to the land. Thamaga-Chitja et al. (2010), who also found that rural women face challenges of equality in access to and ownership of land, support this finding. It has a negative impact on their productive capacity. The lack of access to and control of land limits the productive scale of rural women. It increases their vulnerability to poverty and particularly WEF nexus insecurity.

Access to capital resources is a challenge for rural women in both case studies. In Chivi District, women reported that they do not have access to credit and other financial facilities (HJPA/CD/FGDs Field Notes Chivi, 2017). The major challenge in accessing the capital emanates from a lack of collateral, which can be used to source investments and loans for productive purposes. Rural women in Vhembe exposed their limited access to credible loan facilities and other investment strategies (HJPA/VD/FNFGDs Vhembe, 2017). In both case studies, women have limited capacity for production due to a lack of capital. According to Ajadi *et al.* (2015:3), having adequate access to productive resources such as capital, raw materials, knowledge, markets, communication, and relevant infrastructure is an avenue for the creation of livelihoods, and poverty reduction for rural women in Africa. This fosters the improvement of WEF nexus security.

Considering the role played by women in the home, there is a need to ensure women's economic empowerment, access to, and control over productive resources. There is a need to build on social values and norms in order to create initiatives that are readily acceptable socially and create an enabling environment for both equality and development. Economic initiatives should embrace gender equality and push for equity in access to land, property, other productive resources, and social protection and should move to create a gender-sensitive economic environment. Women in rural areas should be prioritised and educated on their rights and on gender equality and they

should be educated on all technologies availed to them which they are supposed to embrace and make use of to improve their productivity. Women should be educated on resources management initiatives related to water, energy, and food to ensure sustainable resource use and development.

6.3 Livelihood systems and sources of income in rural areas

The study explored the livelihood opportunities available for rural women in both case studies and indicated how many respondents rely on each livelihood option. This data is presented in two categories, one for agricultural-related activities and another option for livelihood diversity. Table 6.1 indicates the agricultural activities and the number of people practicing in each area.

Table 6.1: Agricultural-based livelihoods per households practicing

Livelihood option	Type	Chivi District	Vhembe District
Farming	Seasonal	30	24
	Irrigation	09	13
Gardening	Community	23	-
	Home	04	5
Livestock rearing	Cattle	03	-
	Goats	07	-
	Free range chickens	24	-
Commercial poultry project	Broiler chickens	01	-

Source: HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe (2017)

The study revealed that agriculture is the backbone of household livelihoods in Chivi District. The distribution shows that all households practice seasonal farming, the majority keep free-range chickens and are active in community gardens. Community gardens and commercial poultry projects in Chivi area are funded by NGOs in a bid to promote livelihoods of rural women in the district (HJPA/CD/FGD1 Women 16012017, 2017). In contrast, not all households practice seasonal farming in Vhembe, though the number of women who practice irrigation farming is more than those in Zimbabwe. In Vhembe, livestock keeping is difficult and households that were participating in this study did not keep any livestock. This was reportedly due to the poor grazing areas and limited water supply services. In the irrigation areas in Vhembe, livestock keeping is forbidden in an effort to protect crops (HJPA/VD/FGD1 Women 18052017, 2017).

The keeping of livestock for people in Chivi is attributed mostly to cultural norms and values, rather than the viability of livestock keeping. The study revealed that it is a part of their culture to keep livestock at home mainly as an asset base that the household can use in a crisis. The women reported that it is important for women to keep free-range chickens as their personal assets to use in times of need (HJPA/CD/FGD3 Women 07022017, 2017). This was not so prevalent in

Vhembe District where women responded that it would be difficult to keep free-range chickens as an asset base, as the market for selling them is poor. Table 6.1 shows the minimum involvement of rural households in Vhembe in agricultural-based livelihoods. The lack of sustainable livelihood options for rural households reduces their resilience capacity when faced with challenges. Resilience building relies heavily on assets and livelihoods, which increase the access to resources and services (Perrings, 2006:418; Quinn *et al.*, 2011:2; Vonck & Notteboom, 2016:310).

Similarly, women in both case studies voiced their concerns over diminishing agricultural activities in providing enough produce and income to meet the needs of a household. This has pushed rural people to engage in off-farm income-generating activities to substitute or complement agricultural activities (Ellis, 1998:2; Scoones, 2009:172). The shift from agriculture to other off-farm activities for livelihoods is termed diversification and people choose activities depending on the opportunities they have. These opportunities allow people to adapt to the changing conditions that disrupt the viability of agriculture as a livelihood option for rural people. Resilience is about adapting and coping with contending issues that disrupt the wellbeing of people in societies. In panarchy, this adoption of diverse coping strategies for livelihoods in search for WEF security is explained within the alpha stage of reorganisation (Allen *et al.*, 2014:579; De Haan, 2017:27; Devereux, 2001:508; Ellis, 1998:2; Gotts, 2007:2).

The study revealed that there is a reliance on funded projects and remittances in Chivi District, whereas in Vhembe they rely more on group saving schemes and grants (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). Various funded projects that provide a livelihood means are spearheaded by non-governmental organisations. These include food-for-work projects that motivate people to work in return for payments (HJPA/CD/Official 2 NGO 20170215, 2017). The people are recruited to work in various community development projects, and in return, NGOs pay them with money or goods, such as food (HJPA/CD/Official 1 NGO 20170214, 2017). Remittances from family members, especially in neighbouring countries, were reported as important. Rural people look up to the family members that migrated to other areas in search of jobs to send money home for the provision of household needs (HJPA/CD/FGD3 Women 07022017, 2017). However, in Vhembe the women reportedly rely on grants provided for the poor and the old by the government, and the child and pensioner grants are the most common (HJPA/VD/FGD2 Women 23052017, 2017).

Table 6.2 shows the other livelihoods options available to rural women in both case studies and the number of households participating in a certain activity.

Table 6.2: Alternative livelihoods available per rural households

Livelihood option	Chivi District	Vhembe District	Total
Funded projects (Governmental, NGOs and other)	17	2	19
Informal trading (cross-border, sewing)	4	3	7
Temporary informal work	8	11	19
Village/ Group saving schemes (<i>Mukando</i>)	6	20	26
Selling firewood	2	8	10
Grants (child and pensioners)	-	27	27
Remittances	21	5	26
Informal fruit and vegetable market stalls	7	-	7
Fast food selling (fish, chips, fat cakes)	-	3	3
Brickmaking	-	2	2
Maintenance (child and spousal)	-	12	12
Other (e.g. food preservation, peanut butter making, formal employment)	2	5	7

Source: HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe (2017)

Group saving schemes were reportedly popular as a means of saving income and making a small profit through lending it out at interest to other people. However, most households reporting to use these options are the ones receiving a reliable income every month from grants (HJPA/VD/FGD2 Women 23052017, 2017). The options available for people in rural areas create a dependency and do not build any resilience capacities, based on personal capabilities. The study revealed that whilst in South Africa they do not have varied agricultural-based livelihoods, they have grants, knowledge of maintenance systems, fast foods sales and avenues for formal employment (HJPA/VD/FGD1 Women 18052017, 2017). In Zimbabwe, the other varied livelihood options' viability is poor, and the presence of aid organisations reveals the vulnerability of these households. The capability to cope with challenges is promoted by having resilient livelihood options. It implies that there is a constant awareness of the need to adapt to changing circumstances, be it for the better or the worse.

6.4 WEF nexus security challenges

The study revealed that, both in the Chivi and Vhembe districts, rural households are facing WEF nexus insecurity. The WEF nexus challenges are interrelated and the increasing pressure on the natural resources increases the risk of insecurity. The global challenges for WEF nexus security such as climate change, are increasingly putting pressure on the operations of the WEF nexus resources. Global challenges have footprints at the local level, making people more vulnerable to WEF insecurity. There are a number of challenges reported in this study that rural women face, making them vulnerable to WEF insecurity. Previous studies in the fields of water, energy, and

food security posit that rural households are vulnerable to increased WEF insecurity (Adkins *et al.*, 2012; Altman *et al.*, 2009; Eneyew & Abddisa, 2015; Howells *et al.*, 2005; Kinsey *et al.*, 1998; Majuru *et al.*, 2016). To counter these challenges there is a need to understand and manage WEF nexus linkages. The understanding will enable the formulation of coping strategies that foster resilience. There are various challenges reportedly faced by rural households that affect availability and access to WEF nexus resources. The WEF nexus is essential for the wellbeing of people and is the major resources needed for living.

There are challenges that rural women reported that cut across the three securities of all three resources. The challenges in this section are perspectives of rural women only in the Chivi and Vhembe districts. It is important to understand that the main driver of WEF nexus security, in terms of resources, is water. Water is the basis for the WEF nexus security for rural households and it complements the major factors of production, such as land, labour and capital to increase production. Energy and food have their respective roles to play in the WEF nexus and it is difficult to separate their roles due to interlinkages within the nexus.

6.4.1 Drivers of water insecurity

The study found that there are several drivers of water insecurity in rural areas. Interviews and focus group discussions done reported on causes, including climate change, poor water resources, lack of water infrastructure, lack of irrigation infrastructure, distance to sources, water technologies not being user-friendly, restrictions (rates, policies, and laws), poor service delivery and poor irrigation management. Table 6.3 outlines the mentioned drivers of water insecurity for each case study. The table (6.3) also reveals similarities and differences in challenges as perceived by rural people in Chivi and Vhembe districts.

Table 6.3: Drivers of water insecurity in Chivi and Vhembe districts

Chivi District	Vhembe District
Climate change	Climate change
Poor water resources	Poor water resources
Lack of water infrastructure	Lack of water infrastructure
Lack of irrigation infrastructure	Lack of irrigation infrastructure
Distance to sources	Distance to sources
Unfriendly for user water technologies	Unfriendly for user water technologies
Restrictions (rates, policies and laws)	Restrictions (rates, policies and laws)
	Poor service delivery
	Poor irrigation management

Source: HJPA/CD/FGDs Field Notes Chivi (2017); HJPA/VD/FNFGDs Vhembe (2017)

In both areas, people are facing challenges caused by climate change. People make assumptions about climate change that include their views on poor rainfall, droughts, cyclones, heat waves and sometimes flooding. In both areas, the main challenges emanating from climate change are droughts and poor rains that affect water access and availability in the rural areas. In addition, in both areas, respondents complained that droughts leading to poor rains affect the availability of water, since most natural resources dry up and water tables decrease leading to water shortages (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). The knowledge of climatic changes for rural people is therefore based on their knowledge of the former times. The study found that in both areas, women narrated the changing patterns in rainfall and temperatures from the past. They reported that the amount of rain they received in the 1980s and 1990s was much better than what they have received since 2000. They commented on the unpredictability of rains, temperatures and the uncertainty that was accompanying each season (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). The rural people's perceptions of climate change are thus formed by the indigenous knowledges looking at what their conditions were like in the past. In patriarchy, this is explained as remembrance, and information derived from this concept is used in creating coping or adapting solutions that promote systems resilience (Gunderson & Holling, 2002:29). In Chivi District they reported that they either receive too little rain or too much rains caused by cyclones (HJPA/CD/FGDs Field Notes Chivi, 2017).

One woman from Chivi District explained:

Since 2000, we have had four experiences where we had too much rain that destroyed crops, and sometimes destroyed houses. In the years when we do not have this excessive rain, we received very little, temperatures will be too high, and farming is made impossible. Most households have permanently dropped seasonal farming because of these problems (HJPA/CD/W7 12022017 Interview, 2017).

The women in Chivi District explained the importance of water in their households as "life", arguing that there is nothing achievable without water. In Vhembe, they reported on most aspects related to drought conditions (HJPA/VD/FNFGDs Vhembe, 2017).

One woman in Vhembe explained:

The amount of rains we receive now is far less than what we used to receive. It seems even our seasons are changing too. In the past, September we received the first rains that showed that farming season has begun, and we start preparing our farms. October and November months, we planted the first crops that would be ready for consumption by February. In December and January, we plant the second crops that would be ready by April and May. In the last few years since 2000, we do not receive the first proper rain until November sometimes. The farming season that used to be approximately eight months is now reduced to about four months. The amount of rains received is mostly too little to support proper farming, which have made some people to look for other livelihood options, as farming has become very unreliable (HJPA/VD/W7 03062017 Interview, 2017).

Studies on the impact of climate change on water resources support the claim that climate change has a bearing on the water resources, which leads to water insecurity. Climate change leads to droughts, flooding, erratic rainfall, low water tables, and even cyclones (Ngoran *et al.*, 2015:185; Urama & Ozor, 2010:2).

The main differences in the challenges related to climate change were revealed where rural women in Chivi reported that they were affected by the constantly interchanging and continuous cyclones and droughts that destroyed crops, and increased erosion leading to the siltation of dams and rivers. One woman said:

The major challenge is we are affected by droughts and cyclones that increase the vulnerability of rural households. Since 1998 up to 2016, we have constantly had either cyclones that bring too much water, become destructive, and make water sources dirty, or droughts that make water scarce as water sources dry up and affect livelihoods as well (HJPA/CD/W8 12022017 Interview, 2017).

In Vhembe, they reported that their major problem was drought conditions. Droughts affected their direct water access for consumption, as well as for livelihoods (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). This showed that sometimes the same challenge might have a different impact on each system. The resilience and adaptation process is promoted by the ability to remember and learn from experience, which influences the manner in which responses are formed (Vonck & Notteboom, 2016:308). It is imperative to know in which stage of the panarchy cycle these rural people will be that enables the formation of sustainable and resilient coping strategies to challenges (Benson & Garmestani, 2011:1429;

Gotts, 2007:2). A water resource is an asset that is used as an input for improving livelihoods, as well a resource for household consumption.

The study revealed that all other challenges that were reported were either exacerbated by, or caused, by climate change. The impact that climate change has on the availability of water as a resource increases the pressure on other resources. Poor access to water driven by climatic changes limits the availability of water needed for household consumption and production. In both case studies, respondents reported the lack of water resources for production and household needs which in turn creates challenges for women as the managers of water in the household (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). Officials in both areas supported the reports given on shortages of inadequate water resources to cater for the rising demand for more water (HJPA/CD/FN Interviews Officials, 2017; HJPA/VD/FN FGDs Officials, 2017). From the discussions with officials in Vhembe, it was evident that the district did not have enough infrastructural resources for water. It potentially determined people's access to water for domestic consumption. In Vhembe, dam water is not used for direct household purposes as reported in Chivi District. The households have no permission to use the water from the dams for household needs like cooking and washing. This restricts access to some households that can use dam water (HJPA/VD/FN Interviews Officials, 2017). However, in Chivi District, water resources are affected by receding water tables that cause dams, rivers, boreholes and compound wells to dry up, exposing rural households to greater water scarcity (HJPA/CD/Official ZINWA 20170214, 2017).

Poor water resources are caused by poor water infrastructure. The protected sources of water include taps, boreholes and protected wells, and unprotected sources are those that are open sources like rivers, springs and open wells that are not enclosed and are easily polluted on the surface (Urama & Ozor, 2010:4). In both South Africa and Zimbabwe, respondents reported that they have a paucity of water resources. There is no reliable water supply for household needs (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). In Chivi District, respondents revealed that they have different sources depending on the season, whilst in South Africa they had erratic sources of water when faced with water challenges (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). For example, in Vhembe, respondents reported that they have water infrastructure, but it is insufficient and inadequate to supply them with water needed which compels them to resort to impromptu measures such as buying water, or to turn to unsafe natural water resources (HJPA/VD/FNFGDs Vhembe, 2017).

There is a big difference in the two areas. In the Vhembe rural areas, the government has put water infrastructure in place for villages (HJPA/VD/Official water 25052017, 2017). These include community taps or boreholes. The main challenge is service delivery where repairs,

replacements, and deliveries are inconsistent and projects take time to be completed. In contrast to this, the rural households in Chivi District have a permanent challenge of inadequate and unreliable water infrastructure. Most of the boreholes and taps that were put in place are no longer in use (see Image 6.1). This has forced people to rely on natural water resources (HJPA/CD/FN Interviews Officials, 2017). Where the government take measures to provide safe water using tankers in Vhembe, the rural people in Chivi have to come up with their own strategies to get water for their needs such as resorting to digging wells in wetlands and riverbeds (HJPA/CD/FGDs Field Notes Chivi, 2017). Image 6.1 shows a community tap constructed by the government in Chivi District ward 11 (Zimbabwe) that is no longer in use.



Image 6.1: Community tap in Chivi District that is no longer in use

Source: HJPA/Field Notes FGDs Chivi (2017)

The poor service delivery by the responsible authorities has a bearing on access to safe water supply in Vhembe. The study revealed that the boreholes in rural communities use either diesel or electricity for pumping water. In Gombani, women reported that the major challenge is the use of diesel and the costs related to it. Water insecurity occurs in times when the municipality takes too long to bring fresh supplies of diesel for the pump (HJPA/VD/FGD2 Men 17022017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). This period can be weeks and even months, meaning weeks or months without water for the households. During this time, villagers have to come up with measures to ensure their households have continued water supply. In other areas of Vhembe, they resort to the use of irrigation water for household needs. This may not be a safe option (HJPA/VD/FGD1 Men 19052017, 2017; HJPA/VD/FGD1 Women 18052017, 2017). Furthermore, the tankers intended to meet the rural household needs for water during the crisis, are not reliable and inconsistent in their deliveries, which makes rural households uncertain about water security for the future (HJPA/VD/Official water 25052017, 2017). The differences in occurrences of challenges show that though these rural households are facing the same challenges their environments shape the coping strategies they use to adapt to prevailing conditions.

The achievement of rural water security in terms of availability and access is important for the achievement of both food and energy security. Water is an input for the security of the other two WEF nexus resources (WEF, 2011b:3). The achievement of food security requires water for production purposes in livelihoods and for household consumption in food preparation. The challenges discussed above undermine livelihoods, household consumption and the general wellbeing of people. Due to water scarcity and the lack of proper water resources, people either pay high prices for water or travel long distances to natural sources, such as rivers and springs (HJPA/VD/Tribal leader 24052017, 2017). The time taken to collect water have a negative impact on production and wellbeing (Graham *et al.*, 2016:2). The demand for water lead to the household purchase of water that puts a strain on household income and lead to trade-offs. When women trade off one resource for another, it does not make them less vulnerable but expose them to the insecurity of other resources in the WEF nexus. Resilience building is about promoting the capability and capacity of individuals, households, and communities to adapt and cope with challenges they face without compromising system structures (Adger, 2000:349; Folke *et al.*, 2002:439). There is a need therefore to ensure that proper measures are taken to improve water access for rural households, and to promote community initiatives that can act as the foundations on which resilience may be built.

6.4.2 Drivers of food insecurity

The study revealed that household food insecurity was a major challenge for rural households. Food security entails having reliable access to adequate food that meets the needs of people at all times. Increased access to food requires an increase in food production, water, and the relative fertility of soil on the land, as well as a stable ecosystem for services. From the above description of livelihoods, rural households are vulnerable to WEF nexus insecurities and their coping strategies may be limited. The challenges show major similarities in both Zimbabwe and South Africa. They have the same drivers but the occurrences in each case study may differ. This section provides an exposition of the challenges faced by rural women as reported in both case studies. Table 6.4 indicates the challenges reported by rural people, which put them at risk of food insecurity.

Table 6.4: Drivers of food insecurity

Chivi District	Vhembe District
Climate change	Climate change
Poor livelihoods	Poor livelihoods
Distance	Distance
Increasing food prices	Increasing food prices
Lack of markets	

Source: HJPA/CD/FGDs Field Notes Chivi (2017); HJPA/VD/FNFGDs Vhembe (2017)

Climate change affects WEF nexus security. It causes floods, droughts, cyclones, poor rainfall, and high erratic temperatures that have detrimental effects on food security access and production (Thompson *et al.*, 2010:2720; Turrall *et al.*, 2011:29; Ziervogel *et al.*, 2006b:245). Droughts affect the availability of water for agriculture and livestock, which form the greater part of livelihoods for rural people (Devereux, 2007:47). The people in Chivi and Vhembe districts reported that they experienced more droughts than floods (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). In Vhembe, droughts cause a reduction in yields and make it difficult for the sustenance of households through agriculture (HJPA/VD/FGD ARD officials 30052017, 2017). However, in Chivi District respondents reported that they experienced cyclones that caused storms and too much water that destroyed crops and increased the deaths of livestock (HJPA/CD/Official AGRITEX 20170222, 2017). The effects of droughts affect these two rural communities differently. In Chivi District, there is an increased decline in food production and a decrease in annual yields, whereas in Vhembe, most households abandoned farming because of poor returns (HJPA/CD/FN Interviews Officials, 2017; HJPA/VD/FN FGDs Officials, 2017). In effect they have, in many cases, adapted to a dependency on government grants. Adverse climate changes lead to environmental degradation that have a negative impact on food

security and compromise ecosystem services. The adverse effects of climate change undermine the resilience of systems, especially in the rural areas. It also influences human resilience. There is a need to formulate coping strategies that enable rural communities to adapt and cushion the challenges caused by climatic changes (Adger *et al.*, 2008:336).

Another major driver of food insecurity emanates from an increase in food prices. In both case studies, it was reported that increases in food prices had adverse effects on access to food. These increases affect household income distribution and expenditure leading to an increase in money spent on food. In Chivi District, the women reported that since the 2008 economic meltdown they have experienced high inflation, which made them vulnerable to food insecurity. The preceding chapters revealed that in rural Zimbabwe, the average household income spent on food is US\$550 per annum, whilst in rural South Africa US\$800 is spent on food (StatsSA, 2017a:23; ZIMSTAT, 2013:59). Seeing that most rural households do not have adequate livelihoods to meet their basic needs, an increase in food prices will ultimately lead to an increase in the money every household spends on food. Climate change effects, such as droughts and floods, increase food prices. Poor livelihood options weaken the resilience capacity of households. In both case studies, women revealed that their livelihoods were inadequate to cater for all household needs.

An increase in the cost of acquiring food is worsened by the remoteness of rural areas. In Chivi District, women reported that they traveled approximately 10-45 km to the nearest shopping centre, whereas in Limpopo they travelled 20-80 km to the growth points or towns (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). In Zimbabwe, transport services are poor, unreliable and expensive. It forces people to walk long distances in order to reach the Chivi growth point or other smaller shopping centres (HJPA/CD/FGDs Field Notes Chivi, 2017). In contrast, in South Africa, there is a reliable bus service that services the areas. The major transport woes occur during the rainy season when gravel roads become difficult to use (HJPA/VD/Tribal leader 06062017, 2017). Small shops scattered around villages in both countries, were reportedly expensive, due to a lack of competition. Moreover, they do not sell fresh products (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). This makes rural households vulnerable to food insecurity as it causes shortages and compromises the wellbeing of people. The major solution to the rise in food prices will be to create and promote resilient livelihood options for rural people, which would enable them to spend more on sufficient food needs (Pingali *et al.*, 2005:7).

6.4.3 Drivers of energy insecurity

Energy is an important contributor to the rural household's development and wellbeing. Rural households require energy for direct uses, such as cooking, lighting, and heating (Adkins *et al.*, 2012:250; Barnes & Floor, 2003:499). Furthermore, energy is needed for the basic services it

provides for homes in communication, entertainment, transportation, healthcare, education and income-generation activities. Energy insecurity is a challenge for rural households in Chivi and Vhembe districts (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). In Chivi District, the major challenge is that people do not have access to electrical energy, which is a cleaner and healthier source of energy whilst in Vhembe the major challenge is the costs related to clean energy sources (electricity) (HJPA/Official RDC 25022017, 2017; HJPA/VD/Official Energy 01062017, 2017). In both case studies, rural households are forced to rely on traditional biomass fuel for cooking, heating and sometimes lighting. However, in Vhembe the government has made progress in electrifying the rural areas, but in Chivi District, rural electrification is insignificant as most households are not electrified (HJPA/CD/Official EMA 20170214, 2017). The major challenges faced by women that cause energy insecurity (presented in Table 6.5) show the differences in the perception of rural people in the two case studies. As presented in Chapter 4 and 5, one should bear in mind that rural households revealed they rely on different sources of energy for varied uses, therefore the data presented shows the major challenges affecting overall household access to energy.

Table 6.5: Drivers of energy in rural areas Chivi and Vhembe districts

Chivi District	Vhembe District
No electricity	Cost of electricity
Budget constraints for smart alternatives	Budget constraints for smart alternatives
Scarcity of firewood (<i>distance/ time</i>)	Scarcity of firewood (<i>distance/ time</i>)
Access to markets	Access to markets
Cost related to appliances	Cost related to appliances

Source: HJPA/CD/Observation Field Notes Chivi (2017); HJPA/VD/FNFGDs Vhembe (2017)

Major challenges of household access to energy were income-based in both the Chivi and Vhembe districts. The household income determines the preferences of energy sources in the households in Vhembe District, whereas in Chivi District people make use of the available energy source, usually biomass fuels (HJPA/CD/Official EMA 20170214, 2017; HJPA/VD/Official Energy 01062017, 2017). Income has a bearing on access to a clean and safe energy source such as electricity and solar energy. A stable income is essential to purchase energy services, infrastructure and related appliances to be used. In Chivi, rural households did not have access to electricity, because the rural electrification programme had failed to promote household electrification due to funding (HJPA/CD/FGDs Field Notes Chivi, 2017).

One official said:

The government pushed for a rural electrification programme that failed due to lack of funding. The electrification process requires individual households to pay large sums of money for the electrical infrastructure such as cables, poles and the transformers. This was a challenge. Most households in the rural areas have no viable income to access electricity infrastructure (HJPA/Official RDC 25022017, 2017).

In contrast, in the Vhembe District rural electrification is advanced. Most households have been electrified and access to electricity is limited by income to pay for adequate electricity services (Vhembe District Municipality, 2016:4). The study revealed that rural households in Vhembe use electricity for lighting, entertainment and communication services but rely on firewood for cooking, and heating their homes. In Chivi, biomass fuels, candles and kerosene are used for cooking, lighting and heating.

Household income is a factor that determines what alternative sources of energy will be used (Adelekan & Jerome, 2006:100; Menendez & Curt, 2013:203; Vivoda, 2010:5259). In both areas, respondents reported that the use of alternative sources was difficult due to the costs related to it. The alternative sources, such as LPG, biogas, and solar energy, require special appliances that most households do not have the capacity to purchase (HJPA/CD/Observation Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). In Chivi District, women revealed that they do not use these alternative sources because they are too expensive, and they do not have reliable markets for both gas and kerosene. They have to ask people going to town to purchase kerosene and employ special measures to ensure it lasts longer (HJPA/CD/FGD2 Women 02022017, 2017). In contrast, rural households in Vhembe have reliable markets for alternative sources but lack enough capital to utilise these energy services (HJPA/VD/FGD1 Women 18052017, 2017). Women in Vhembe alluded to the costs related to the appliances that are needed for solar, gas and electricity, citing that the costs related to the purchase of relevant appliances such as stoves and heaters are too expensive for them (HJPA/VD/FGD2 Women 23052017, 2017). Therefore, the availability of energy sources does not lead to household energy security. Energy security in rural areas is related to income, therefore creating the need to foster resilient livelihoods.

The challenges for energy security led to households' reliance on firewood in both Chivi and Vhembe rural areas (HJPA/CD/Official EMA 20170214, 2017; HJPA/VD/Official Energy 01062017, 2017). The reliance on firewood increases pressure on natural resources, such as forests. A study by Hiemstra-van der Horst and Hovorka (2009:1606) stressed that the cutting down of trees has detrimental effects on the stability of the ecosystem, putting the world at risk of WEF nexus insecurity. Similarly, in this study, major challenges caused by the continuous cutting

down of trees has led to deforestation and poor vegetation such that women have to walk long distances to collect firewood (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). The long distances affect households' access to firewood and more time taken to fetch firewood disrupts other activities (Sovacool, 2012:273).

The study found that Chivi and Vhembe districts' rural areas share common challenges for energy security. However, they differ in that most households in Vhembe District have been electrified. In Vhembe District, the electricity supply is consistent unless there are breakdowns in the infrastructure. The availability of electricity is thus consistent, and people can use it. The use of electricity in Vhembe has been promoted by the government through the provision of the free basic electricity grant, which provides 50Kw for each household. Households are also free to use electricity as long as they are able to pay for the excess electricity that they might need above the granted 50Kw. This shows that households in Vhembe have both the infrastructure for clean energy and the availability is certain, it is only access to it that may be hindered by costs. In contrast, households in Chivi District do not have the electricity infrastructure and the government does not have resources to grant electricity or provide electrification infrastructure for households. Therefore, where the residents in Vhembe have challenges relating to the cost of electricity, residents in Chivi District are faced by the challenge of not having the infrastructure for electricity. The perspectives of rural women in Chivi and Vhembe indicated that they share common challenges, such as low income, poor infrastructure, distance and time taken to collect firewood, high costs of connections, high costs of appliances and poor access to markets.

6.5 WEF nexus security coping strategies of rural women in Chivi and Vhembe districts

The sustainable development goals (SDGs) subscribed to by South Africa and Zimbabwe, aim to achieve sustainable water security (goal 6), sustainable food security (goal 2) and universal access to clean energy (goal 7), among others for the benefit of people and the planet (Griggs *et al.*, 2013:306). The SDGs aim to achieve these goals by 2030 and both Zimbabwe and South Africa stood up to the challenge to pursue these goals. The basis of the SDGs is the sustenance of nature, life support systems, and communities for the development of people, economy, and society (Griggs *et al.*, 2013:307). SDGs aim to promote current access to basic needs without compromising access to basic needs of future generations (Griggs *et al.*, 2013:307). This is in tandem with panarchy, which pushes for an understanding of interactions between systems (human and natural) and how the occurrences in one system influences the stability and security of another system (Gotts, 2007:3).

WEF nexus security required an understanding of the WEF resources and human systems and the impact of manifestations in each sector may have on the other sector (Endo *et al.*, 2015:5808;

Finley & Seiber, 2014:6256). The challenges that rural women face in having access to WEF nexus components and the coping strategies that are used to curb or adapt the impact of challenges. These have a bearing on household adaptation, security and sustainability of both systems (Bhaduri *et al.*, 2015:725; Cote & Nightingale, 2012:477). This study found that WEF nexus security challenges are evident in the rural areas of Chivi and Vhembe s and have an influence on the wellbeing of rural families. Women, as managers of the WEF nexus resources in the home, reported that they have varied coping strategies that cushion and reduce the effects of challenges and allow them to adapt to the changing circumstances (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017).

This section compares the coping strategies that are used by women in Chivi and Vhembe rural district to alleviate WEF nexus challenges. The comparison comes after an extensive in-depth discussion of these coping strategies in the previous chapters. For all the WEF nexus resources, common strategies were used, such as: reducing consumption levels; diversifying livelihoods to raise income; selling assets; and an increased reliance on social safety nets (e.g. grants, aid, and conservation of available resources). Some coping strategies used focused on one resource of the WEF nexus, such as: purchasing water in times of crises; as well as relying on the forest products for food and multiple energy uses in households. Therefore, even though there are common patterns in the coping strategies used in Chivi and Vhembe, some of them were different according to each WEF nexus resource. This section explored the differences and similarities in the coping strategies used for each WEF nexus' resource sector.

6.5.1 Coping strategies for water

In most developing countries in Africa water insecurity is a continuous challenge that has plagued the rural residents (Hope, 2006:168; Manzungu, 2004:4). Rural residents are then forced to resort to unsustainable coping strategies to cushion the effects of water shortage challenges in their daily lives (Kinsey *et al.*, 1998:93). The coping strategies vary from place to place and from one individual to another, even within the same localities. Chapters 4 and 5 gave evidence that rural women in both case studies, in the districts of Chivi and Vhembe, used various coping strategies to reduce the negative impact of water shortages. These coping strategies, and examples of adaptation, were devised according to the locally available resources and the capacity of a household to resiliently respond to challenges. The study observed similarities and differences in the coping strategies used for water shortages. The major categories for water shortages that emerged from the study are water for domestic use and water for livelihoods production (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). The following examples of coping strategies were reported: to cope with water shortages rural residents reduce the number of activities that require water in the household. This entail a reduction of meals

cooked per day, which saves both energy and food. This coping strategy is not resilient and only used as a short-term measure. To cope with water shortages for livelihoods, rural women diversify their activities to adapt their livelihood options and use less, or no water; choose crops that are drought resistant; motivate irrigations plans; and contemplate community initiatives for income generation and saving. The use of multiple uses of water sources, water purchasing, looking for alternative sources of water are coping strategies used in the rural areas under circumstances when the need is high for resilient adaptation.

Evidence from the information on coping strategies reported in Chivi and Vhembe showed both similarities and differences. Comparisons can be drawn in the choices of coping strategies and the implementation of these. Table 6.6 gives an exposition of the coping strategies found and whether the rural women in Chivi and Vhembe districts rely on the coping strategy. The coping strategies that were reported in both case studies showed five emerging strategies of choice. Each strategy has a number of activities and actions that rural women undertake to cope with water insecurity.

Table 6.6: Household coping strategies and response actions for household needs

Coping strategy	Main actions/ Responses (domestic)	Main actions and responses (livelihoods)
Changing water use patterns	Reducing water-based activities Water rationing.	Use of drought-resistant crops, diversify to non-water based projects, reducing plot sizes, conservation farming
Water conservation	Multiple uses of water	Home-based gardens
Water harvesting and storage	Use of buckets, drums, and tanks, rooftop rainwater collection	Funded projects for community dams and boreholes
Community initiatives and use of alternative sources	Local based water laws, water connections, community wells, Water tankers, water purchasing.	Irrigation, water rationing, water guarding, duty roasters.
Use of inferior sources	Unprotected sources of water such as rivers, dams, riverbed wells, springs, hand dug wells	X

Source: HJPA/CD/FGDs Field Notes Chivi (2017); HJPA/VD/FNFGDs Vhembe (2017)

In Chapters 4 and 5, it was shown that the most prevalent coping strategy in both case studies is the use of inferior sources for water. Women rely on open, unprotected, and unsafe sources of water for basic household needs, such as cooking and drinking. This reduces the resilience capacity of rural women as individuals and households and communities at large. Unprotected sources of water expose people to water-borne diseases that may be hazardous and even deadly to their health. These sources of water include rivers, springs, riverbed wells and compound hand-dug wells.

The study found that in both case studies, respondents reported that they changed water consumption behaviours by reducing their water-based activities. Water is rationed for domestic needs such as washing, cleaning and bathing. In agriculture, they adapted by reducing plot sizes, planting drought-resistant crops, and conservation farming. They also practise livelihood diversification to reduce water-based activities. Water conservation is the practice of using water sparingly and using the same water for multiple purposes in the home. For livelihood needs, the creation of home gardens in rural Vhembe and the kitchen gardens in Chivi minimised water losses and wastage by ensuring the water used for various hygienic purposes in the home, waters the gardens. Women in both case study areas harvest water for domestic use during rainy seasons. They harvest water from the roofs of houses using deep buckets and basins as shown in image 6.2. The study found that in both case studies, small community dams were funded by the government in Vhembe, and by NGOs and the government in Chivi. The objective is to provide in critical livelihood water needs. These dams are used to harvest rainwater that can be used off-season. Dams were mainly rain-fed in Chivi District, and in Vhembe these dams were river fed, in both case studies, the dams were reportedly in poor condition and could no longer store a lot of water. Major challenges with the dam conditions were reportedly siltation due to excessive erosion that filled dams in these communities with sand and left little space for water storage.



Image 6.2: Rooftop water-harvesting technique used in Chivi

Source: HJPA/CD/Water Harvesting 02022017 (2017)

Water storage is done to promote continued water supply at the home and to reserve water for household needs. The amount of water stored per household depends on the storage facilities available to them. In Vhembe, the most common storage for water was 200ℓ drums (*mafagi*), whilst in Chivi, most households used 20ℓ buckets to store water. In Chivi, water for domestic use

was reportedly stored inside the hut/house, whilst in Vhembe, water was stored outside the house under any available shade. With the increasing need for water for various productive activities, the governments of South Africa and Zimbabwe, as well as NGOs have different funding projects to improve water access for livelihood purposes. The livelihoods water storage facilities in both case studies where the use of 1000ℓ (*JoJo*) tanks to store water pumped from boreholes (Image 6.3). This funded water infrastructure project is for community gardening and poultry projects in Chivi, whilst in Vhembe they are used for brickmaking projects.



Image 6.3: Jojo tanks used to store water for the Brickmaking project in Vhembe

Source: HJPA/VD/Jojo Tank 30052017 (2017)

The study found that community innovations are in place in both case studies that include water regulations and rationing to effectively manage the available water resources. The communities come together to dig wells, make water connections and pursue possible channels for irrigation farming where water resources are available. These measures are taken as a community or as a group to promote household access to water for basic household and livelihood needs. The rural women in Chivi and Vhembe reported their reliance on alternative water sources, such as water tankers, private boreholes of friends and neighbours, water purchasing, and school boreholes, especially in Chivi District. The reliance of rural households on these sources is dependent on the

household income, which allows for spending on water. WEF nexus theory explains the interlinkages between water, food, and energy, even at household levels. The livelihoods options that are pursued by women are an integral part of building their resilience capacity to deal with water challenges in a sustainable manner. The management styles adopted by rural people in managing their resources are important to ensure security for tomorrow. The findings show that rural people in both countries use initiatives that conserve and manage only the available water resources. The way they interact with their environment and the other components of the nexus cause more challenges in the end. Therefore, there is a need for rural people to: understand their environment; understand the impacts of the actions they take when interacting with the environment; and, find possible ways of adaptation to ensure they securitise available resources for the future.

6.5.1.1 Coping with water shortages for domestic use

Chapters 4 and 5 outlined household domestic needs for water, which include water for drinking, cooking and hygiene purposes. The importance of domestic water supply was reported as the most important as it is the pillar of health, wellbeing, and life. The coping strategies used in both Vhembe and Chivi had similarities in the type of coping strategy but differed in the response actions that are taken within each setting. Table 6.7 provides an outline of response actions that are done in each research setting.

Table 6.7: Coping with water insecurity, strategies and responses

Key coping strategy	Response action in Chivi	Response action in Vhembe
Reducing water-based activities	Skipping baths, reducing cooking to avoid dishwashing, washing clothes in bulk.	Reduce the number of times for washing, skipping baths, skipping water-based chores.
Water conservation	Water reuse, using less water for chores, water rationing.	cooking less frequently
Water harvesting and storage	Buckets are used to water, rooftop water harvesting.	100-200 l drums (<i>mafagi</i>), rooftop water harvesting
Community initiatives	Water laws, community water source initiatives.	Local connections, working in groups
Rely on alternative sources and use of inferior sources	River water harvesting, illegal water sourcing, dam wells. Use of open water sources, rivers, dams, hand dug wells	Water tankers, water purchasing, Use water from rivers, springs and irrigation canals

Source: HJPA/CD/FGDs Field Notes Chivi (2017); HJPA/VD/FNFGDs Vhembe (2017)

Table 6.7 provides a brief overview of the actual responses of rural women in managing the available water in times of water shortages. The table shows the channels of coping that are

resorted to by rural women to ensure that they make provisions for water in the households and to manage the water they have. It also shows the difference and the similarities of actions and responses in Chivi and Vhembe districts. The rural people have same end-coping strategies but have different implementations for each as shown in Table 6.7.

Reducing water-based activities

The study found that in Chivi and Vhembe, rural women reduce water-based activities to save the available amount in their households. The reduction of these activities varied from skipping particular activities to reduce the need and number of times a chore should be executed (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). The contrast in the coping strategies was found in the responses or actions that women reported. However, the main goal is to reduce the amount of water used. In both Chivi and Vhembe, respondents reported skipping baths for a certain number of days and times as a way of saving water, reducing water collection times and making sure their households use less water (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). In Chivi, respondents reportedly cook less and prefer to cook food that does not need many dishes, e.g. sweet potatoes and *mutakura* (a boiled mixture of groundnuts, maize, round nuts and cowpeas) (HJPA/CD/FGD3 Women 07022017, 2017). This reduces the amount of water needed for dishwashing and food preparation. In contrast, in Vhembe they prefer to reduce the amount of cooking by using drinks, snacks, and bread (HJPA/VD/FGD2 Women 23052017, 2017). Respondents reported that this saves water by them not having to wash many dishes and prepare food (HJPA/VD/FGD2 Women 23052017, 2017). A common coping strategy for women in Chivi District, as reported, is to wash clothes in bulk, whilst in Vhembe they washed after a long period of time, which entails re-wearing clothes before laundering (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). They reported that it saved water because they used the same amount to wash clothes. Washing after a long period was reportedly a coping strategy that reduces the number of trips to go and wash the clothes at the river springs and other water sources.

Though these are used as coping strategies for water challenges in both cases, they are not sustainable ways of responding to water challenges, as they cannot be used over an extended period of time. In Chivi District, respondents reported that they could not always avoid cooking dishes that require more water to prepare because some of the foods they need are subject to seasonality, such as sweet potatoes (HJPA/CD/FGDs Field Notes Chivi, 2017). Skipping baths and relying on cheap foods increase personal health risks. There is a need for long-term and sustainable coping strategies that eradicate water woes or even promote adaptation in the long term rather than short term. Building resilience for these women and rural households, therefore, begins by increasing access to water. An understanding of the WEF nexus system, its resources

and interactions is needed to combat these challenges without causing further risks to households and individuals.

The resilience capacity of households is dependent on increasing access to water for hygiene and other domestic purposes. According to Tucker *et al.* (2013:128), there is a need to promote reliable access to water for all human needs in order to reduce poverty and increase resilience in sub-Saharan Africa. The increased access to water will help to foster resilience for WEF-related challenges by promoting sustainability of livelihoods and other adaptation strategies for development and growth. It will also help to promote household food and energy security by providing avenues for production and income generation. By reducing water-based livelihoods, the households in rural areas will only be at risk of food and energy insecurity. This coping strategy in panarchy will be leading to the omega stage where systems face challenges that threaten their wellbeing and failure to reorganise themselves would lead to the total collapse of systems or households (Gunderson & Holling, 2002:29).

Water conservation

Water conservation includes all activities that are used to manage the available water to meet both the current and future household water needs (Clark & Finley, 2007:623). Most water saving strategies varied from one household to another and from individual to individual in the two areas under investigation. Conservation strategies aim to reduce the wastage of water, change water use behaviours, and promote water saving and reuse. The methods that were used to cope with water challenges in the home in Chivi includes water reuse, using less water for chores, and water rationing. Whilst in Vhembe they reported that most of the water is used for food preparation and therefore they reduce the number of times they cook.

Water conservation in the home is done by rationing water for various chores around the house. This entails using less water for various needs such as bathing, washing, cleaning, and cooking. In Chivi District, the rural women reported that they try to ration water used for bathing to at least 5ℓ for adults and 2ℓ for children. They reuse their water and make use of their grey water. They reported that they changed their water-use behaviours to be more conservative by making sure they do not throw away dirty or used water but find ways of making sure that they reuse water to either water their small kitchen gardens or use it for other chores around the house. A good example was given of using leftover bath water for mopping the house and washing clothes. Each time a household member takes a bath using a bucket of water, they collect leftover water in a basin and use it around the house. Water used for washing dishes is not thrown out but rather kept safe for use throughout the day. They keep the water in a safe place away from animals and use it each time they want to wash dishes. This helps by reducing the number of trips to the water source and reduces time spent on fetching water.

Water conservation is regarded as one of the most effective ways of coping with water shortage challenges in the home. Water conservation is a good way of managing local water supplies to promote sustainability and increase the resilience of households (Clark & Finley, 2007:617). The major push factors for use of water conservation methods in the home are the costs of water (in monetary or labour terms), the knowledge of the water saving methods, having information and the ability to remember past events, and household attitudes towards water availability. The researcher observed that in Vhembe, people took it as a governmental responsibility to provide water. When service delivery fails, they blame the government. In contrast, in Chivi District the communities mostly devise alternative strategies to get water for their homes. Though they get help from the government and NGOs for borehole drilling, they have community initiatives for digging wells. The attitude that rural people have influences their water handling practices, especially water conservation (Clark & Finley, 2007:623). When water comes at a big price monetarily or by use of intensive labour, it becomes valuable and measures are taken to ensure it is conserved. In panarchy, the creation of successful adaptive and resilient systems is determined by the ability of systems to remember and learn from experiences to implement coping strategies that are sustainable, equitable and long-term. Water conservation methods can help in the formation of such resilient systems if used effectively. The WEF nexus can benefit by conserving water and using it wisely, as it is the main resource needed for increased access to both food and energy.

Water harvesting and storage

In both Chivi and Vhembe, people harvest water as a coping strategy to curb challenges arising from lack of adequate access to local water sources. The water harvesting technique used in both Vhembe and Chivi rural areas was the rooftop technique, whereby water is collected from the roofs using basins, buckets, dishes, drums and other household items (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). Rooftop water harvesting is less costly and easy to implement (Sturm *et al.*, 2009:777). Rooftop water harvesting is a relevant water source in Chivi District where communities under study reported that it is a regular and common practice during the rainy season (HJPA/CD/FGDs Field Notes Chivi, 2017). The women in Chivi reported that even most households that have water sources, like hand-dug wells closer to their compounds, perform rooftop water harvesting during the rainy season (HJPA/CD/FGD1 Women 16012017, 2017). The water is used for all domestic purposes including drinking and cooking. In contrast to Chivi, in Vhembe rooftop rainwater harvesting is done. However, it is not as common as in Chivi District. The study found that in Vhembe they resorted to the practice in situations where they are desperate and have no access to water (HJPA/VD/FGD2 Women 23052017, 2017). The level of desperation, therefore, seems to be the prime driver for stimulating water harvesting options. It was reportedly common among households in Gombani that face regular

water outages even in the rainy season (HJPA/VD/FGD2 Women 23052017, 2017). The major concern for rural women in Vhembe for using rooftop water is the cleanliness of water, citing that roofs contained dirt, bird droppings, dust and other pollutants (HJPA/VD/FGD1 Women 18052017, 2017). In Chivi, the main concern was with households that have grass-thatched houses where they could not harvest water from the rooftops because the water will not be clear but will have a dark colour from the grass. Women in Chivi reported that not having modern rooftops was the only challenge that prevented households from harvesting water during the rainy season. According to Sturm *et al.* (2009:778), water harvesting is an effective solution to water scarcity and investments should be made for proper water harvesting infrastructure.

According to Helmreich and Horn (2009:120), the major setback in rooftop rainwater harvesting as observed is the lack of proper technology for water harvesting as well as lack of good water storage facilities. Though rainwater harvesting may be an effective solution for water scarcity, it is not very effective in the case studies areas. In most cases, people lacked the proper infrastructure for it (HJPA/CD/Observation Field Notes Chivi, 2017). In both case studies, rainwater harvesting is occasional and harvested water is stored for a few days in small containers. This only provides short-term solutions to water challenges for rural households and lead to water challenges even during the rainy season. Water harvesting is an effective avenue to foster food security. Water harvesting can provide water for agricultural purposes (Helmreich & Horn, 2009:119). The use of rainwater harvesting for food security, fostering livelihoods and domestic uses, has gained momentum throughout the world and it may be a good avenue to promote WEF nexus security and resilience of rural households. Various studies have applauded water harvesting as useful to curb water scarcity challenges for both agriculture and household uses (Abdulla & Al-Shareef, 2009:197; Kahinda *et al.*, 2007a:1069; Kahinda *et al.*, 2007b:1051). However, the success of these water harvesting methods relies on building proper infrastructure and having big storage facilities that can store a substantial amount of water for use even off season (Everson *et al.*, 2011:127; Kahinda *et al.*, 2007a:1072). The use of small storage facilities for water harvesting will not help sustain household water needs for longer dry periods. In both Chivi and Vhembe district, women reported that they used water harvested within three to four days of harvest. If larger water harvesting and storage facilities are used it helps to alleviate water shortages for longer periods of time, even extending to months, instead of merely providing for a few days (Everson *et al.*, 2011:127; Kahinda *et al.*, 2007a:1072).

Community initiatives for water

The study found that various community initiatives are used in both case studies to promote access to water for household uses. Depending on the challenges they want to cope with regarding access to water, communities come up with different coping strategies. The main

challenges for water include, distance from available water sources, the inability of water sources to meet the demands or needs for water, lack of water resources, and dangers associated with walking long distances to water sources (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). The Chivi and Vhembe districts case study areas revealed that they have different underlying challenges causing water stress within households. The common challenge found was lack of water resources for household water and distance from water sources. Vhembe women cited that they faced dangers in travelling long distances to water sources. In Chivi District they cited that depleting water tables cause them to spend a lot of time collecting water. They have to wait for water to well up in many instances (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017).

Communities came up with various solutions to overcome challenges. In Chivi, they have local laws to save and ration the available water among households (HJPA/CD/FGDs Field Notes Chivi, 2017). In Vhembe they resort to work in groups when collecting water; they contribute towards transport fees when collecting from tankers (HJPA/VD/FGD2 Women 23052017, 2017). In both areas, they have community initiatives such as digging wells in Chivi and combining to buy water pipes for their own local connections that draw water closer to homes in Vhembe (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). These strategies have promoted coping and adaptation of households to the situations they face. This indicates the recovery or reorganisation stage in the cycles of panarchy, which lead to potential growth and conservation.

The ability to recover from challenges faced shows that the system is resilient and has an ability to adapt or cope with future emerging challenges. In Chivi District, they came up with a solution of digging community wells in wetlands, which the whole community have access to the wells but they are still forced to adhere to specific rules and regulations (HJPA/CD/FGDs Field Notes Chivi, 2017). For instance, during periods of severe water scarcity they have water-rationing laws. A household is then allowed to fetch only a certain amount of water to ensure all households get their fair share. The women reported that they work together communally to find solutions (HJPA/CD/FGDs Field Notes Chivi, 2017). Community initiatives were reported to include dam wells, community hand-dug wells, shallow wells in river beds and, at times, illegal connections that benefited the larger part of the community (HJPA/CD/FGDs Field Notes Chivi, 2017). Image 6.4 shows a man fetching water from a community well in Chivi District.



Image 6.4: An elderly man fetching water for bathing from a community hand dug well named Kwavhanga in Ward 11 Chivi District.

Photograph: HJPA/CD/Observation Field Notes Chivi (2017)

Image 6.4 shows the community initiative in Chivi District to curb water woes. However, the community hand-dug wells are functional during the rainy season and soon after, when water tables are still high. When they dry up the communities are left vulnerable (HJPA/CD/FGDs Field Notes Chivi, 2017). In contrast, women in Vhembe reported that each household would have essentially its own coping strategies for access to water. One quick solution was to buy water. Hand-dug wells are not commonly used in Vhembe (HJPA/VD/FN Vhembe, 2017). The study found that the people in these areas do not have high regard for hand-dug wells due to the intensive labour involved and the dangers of having open wells at their compounds (HJPA/VD/FNFGDs Vhembe, 2017). Women reported that hand dug wells are not hygienic. They reported that it was better to use flowing water from rivers than using water from open wells for consumption without proper means of protecting the water from pollution and contamination (HJPA/VD/FGD1 Women 18052017, 2017). A communal initiative in Mathangari village in Tshiombo area, that seemed to have worked well, was when households operate as a collective to buy pipes to draw water from the mountain springs for their compounds. However, not all households in the village participated, due to the costs involved (HJPA/VD/FGD1 Men 19052017, 2017). Another community initiative in Vhembe was to fetch water in groups for women to avoid the dangers associated with walking alone to fetch water (HJPA/VD/FGD1 Women 18052017, 2017). The ability of a community to come up with a combined solution to challenges shows that

a community has the resilience capacity to reorganise itself for growth as explained in the alpha stage of the panarchy cycle. The WEF nexus theory upholds the creation of resilient systems in the quest for water, energy and food security. This can be achieved when households and individuals are capable of remembering past occurrences, build solutions and reorganise themselves.

The study found that community initiatives do very little in ensuring water security and availability but only temporarily contributed to reducing the risks associated with the lack of water access. Water rationing is only a short-term measure to ensure water is available to all, even in the meagreness of quantities. In cases where there are severe droughts, the communities run the risk of severe water scarcities. The use of hand-dug wells is not reliable. It depends on the level of water tables. There is a limit to what people can do in digging wells. It can be a dangerous task without proper drilling machinery (HJPA/CD/FGDs Field Notes Chivi, 2017). The dangers and unpredictable nature of these water procurement strategies make rural communities vulnerable. This notion is supported by Nyong and Kanaroglou (1999:543), who assert that hand-dug wells for domestic water are an important source in the rural areas which can help alleviate water scarcity. Fetching water in groups only reduces the dangers of being attacked for women, but it does not promote access to water. Similarly, in Vhembe and Chivi rural communities under study, women still have to walk long distances and spend more time on fetching water (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FGD2 Women 23052017, 2017). Long distances and spending more time on water collection has an impact on livelihoods' production and energy security as it leaves little time for other activities. This puts households at risk of WEF nexus insecurity and lead to households facing increasing WEF nexus challenges that make them less resilient.

Relying on other informal water sources

The study found that in order to cope with water insecurity, communities in Chivi and Vhembe districts have to rely on other sources of water. These include river water harvesting, illegal water sourcing, dam wells for Chivi and water tankers or water purchasing for Vhembe. Though they similarly look somewhere else for access to water when facing water scarcity, they have different sources they rely on. In Chivi District, rural communities must come up with innovative ways to survive water woes. In one community, they reported that they harvested river water through a community well by using a trench. In Chivi they create dam wells and illegally fetch water from the ZINWA water works, which has damaged pipelines (Chapter 4). Most alternative water sources are open, unprotected and susceptible to providing dirty and unhealthy water for domestic use. However, the use of rivers, dams, and hand-dug wells, are the most accessible ways for rural households to mitigate water challenges in the areas under investigation in Chivi District.

In a men's group discussion in Chivi, one man said:

The water crisis can be very intense at times. Wells dry up and borehole breakdowns increase the problems. We have a river 3km from the homesteads from which we can fetch water for domestic uses. However, we have lost many of our relatives to crocodiles, such that we decided to dig a very small trench in which water flows from the river to a well that we dug. The well is the source of water for the whole village. The challenge is off-season; the river levels are lower and the trench does not get water leading to water scarcity and shortages. Women will have to travel a long distance to the river for water despite the danger of crocodiles (HJPA/CD/FGDs Field Notes Chivi, 2017).

In Vhembe, residents have alternative sources of water when their water supply systems fail. The study found that rural households in Vhembe resort to the use of open water sources such as rivers, irrigation canals, and natural water springs for domestic needs. In areas like Gombani, these alternative water sources are not available, therefore households have to purchase water and rely on government-sponsored water tankers. The water sources options available provide water; but they are not safe or reliable. These sources are affected by seasonality and availability of water, either in dams or in rivers for supply. There is a need for building strategies that work in the long term and requires the government and donor organisations to make investments towards lasting water supply solutions for rural households.

Bhaduri *et al.*(2015), Finley and Seiber (2014), as well as WEF (2011b) applaud the prioritisation in the context of water in WEF nexus security. It is considered to be the main driving factor in economic growth and development. The promotion of resilience and creation of long-term coping strategies fosters the resilience of households to challenges that they face. The above strategies show that water harvesting and storage are the prime coping mechanisms for rural households. Water harvesting techniques range from river water harvesting, rainfall water harvesting and fetching large amounts of water to store at home in large containers for use in water scarce times. According to Abdulla and Al-Shareef (2009), Everson *et al.* (2011), and Helmreich and Horn (2009), rainfall water harvesting can be fully utilised and explored to provide adequate water for both production and domestic use in rural areas of developing countries.

6.5.1.2 Coping with water challenges for livelihood purposes

Water is a key component in the realisation of WEF nexus security and poverty eradication. Water is important for both domestic and productive use in securing livelihoods. Rural areas in developing countries depend on water-based livelihood options mainly because water is usually sourced free of charge. The increased availability and access to water are essential to promote

rural livelihoods, increase household income capacity and change the lives of people for the better. In the rural areas, most researchers found that people primarily rely on agriculture and other water-based livelihood strategies for income and in providing people's basic needs (Devereux, 2007; Kahinda *et al.*, 2007a; Turrall *et al.*, 2011).

This study found that in both Chivi and Vhembe, rural people rely on the available resources to implement livelihoods and income generating projects such as pottery, brickmaking, farming, gardening, firewood selling and irrigation farming. The main livelihoods chosen all depend on the availability of water in the areas. However, due to excessive and prolonged drought seasons coupled with minimum rainfall, water for livelihoods became a challenge. In order to survive, rural women had to come up with strategies that promote good management of the available water, full utilisation of the available water resource and to make use of strategies that would promote good water use. In order to benefit from the available water resources, rural residents have adopted the use of drought-resistant crops, reduced plot sizes, conservation farming, home-based/kitchen gardens, funded projects for community dams and boreholes, irrigation, water rationing, water guarding, duty rosters. The women reported they have to adopt non-water-based projects as livelihood options.

Chapter 4 and 5 provided an extensive exposition of how these coping strategies are implemented in the respective study areas. The findings showed that in Chivi District rural women reported that they faced water challenges with regards to availability and access to water for livelihoods. They rely on rain-fed water sources and groundwater sources for all their water needs. In the areas studied in the Chivi District, the government and NGOs have made efforts to provide water infrastructure in the form of small-scale community dams and boreholes. Despite these efforts, water woes have persistently plagued the district. The major challenges emanate from the poor maintenance and management of water infrastructure leaving the dams silted and dry. Boreholes often break down and repairs are not done for long periods, poor rains and intensive droughts do not help matters as water tables recede causing the boreholes to dry up. Rural women reported that apart from the rainfall that they rely on for seasonal subsistence farming, they use dams and boreholes for vegetable gardens and other activities. Rural women in Chivi District reported that they adopted conservation farming, irrigation farming, uses of drought-resistant crops, and non-water-based livelihoods. These coping responses were aimed at alleviating water challenges related to livelihoods.

In Chapter 5, an exposition was given of the WEF nexus security situation in Vhembe District. The study found that in Vhembe District access to water for livelihoods is a challenge. The rural women reported that they rely on rainfall for their annual seasonal farming which is the main livelihood option for all households. However, due to poor rainfall and other unfavourable climatic

conditions, they have been forced not to rely solely on seasonal farming. The major problem, as reported by the Vhembe District Municipality (2016:18), is the lack of and poor state of water resources in the district. This challenge has made it difficult to make transitions and adapt to other alternatives. Water is key for literally all livelihood options. The poor access and availability of water, especially in Gombani, have caused households to drop most of the livelihood options that use water a lot, such as livestock rearing and farming and gardening. The government has made efforts in building irrigation schemes in the rural areas to benefit local communities. However, these communities are facing water challenges related to climatic changes that led to poor rainfall in the district. Therefore, the minimum water is available for irrigation and this has affected production. In interviews and group discussions rural people reported on finding innovative ways to cope with these water challenges to promote their livelihoods.

In Tshiombo, rural people have access to the technology of irrigation farming. Irrigation is their main source of livelihood. However, to date, they face challenges of availability of water for irrigation. The water resources available cannot provide sufficient water for irrigation. Climate change conditions have a negative impact on the availability of water for irrigation. Therefore, communities devise ways of coping, which includes: adoption of water management strategies in irrigation schemes; reduction of plot sizes; water diversion; scheduling timetables for watering; individually connected irrigation (sometimes illegal, where people divert water from irrigation canals or illegally extract water from dams and rivers for irrigation purposes); and guarding the water. In Gombani, water resources are poor. No irrigation is available, and subsistence seasonal farming is the prime livelihood option. Women reported they had to adopt non-water-based livelihood options to cope. The government has provided for brickmaking projects for the youth in Gombani and drilled boreholes for this purpose. However, in the dry season the water tables drop and water becomes scarce. The methods used to cope with water challenges are short-term and somewhat unsustainable as discussed in Chapters 4 and 5. They are met with various challenges that make them unreliable and rural women are especially vulnerable.

Panarchy explains that the responses in any systems after a disruption, or when it is facing challenges, contribute to either the wellbeing, or total collapse of a system. The resilience of a system is highly dependent on its ability to cope with challenges and maximise opportunities to maintain the status of the system. The WEF nexus leans heavily on the availability of water for livelihoods as it promotes the availability of food through production and access through income generation. Water for livelihoods improves the energy security of households and the adoption of more efficient and cleaner energy resources when households through livelihood raise more income.

The study found that similar coping strategies are adopted in both Chivi and Vhembe. Irrigation farming was reported to be useful in both areas as it allows people to grow crops for consumption and for sale. Similarly, the irrigation systems in both cases were reportedly affected by lack of proper infrastructure and poor water resources. In Chivi District, dams are silted and dry whilst in Vhembe District, the dams do not have the capacity to provide adequate water for all irrigation activities.

In Vhembe, farmers have water management techniques for the available amounts, whilst in Chivi the irrigation systems are used during the rainy season and few months after the rainy season, as long as water is still available. In Vhembe there were reports of water theft and self-made irrigators that use water allocated and intended for authorised irrigators. This has challenged formal irrigators because they have to share the available water using duty rosters and timetables (HJPA/VD/FGD ARD officials 30052017, 2017). Farmers in Vhembe are then forced to sleep on the farms and guard waterways to prevent water diversion and theft. The conditions are especially risky for women. In Chivi District, irrigation is a good option and communities have mobilised themselves to conduct irrigation in an orderly manner. However, they are challenged by stiff legal protocols for water use and a lack of capital for infrastructure (HJPA/CD/Official AGRITEX 20170222, 2017). In similar situations in Vhembe individuals have unlawfully developed their irrigation systems. Some of these individual irrigators unlawfully divert, or even steal water (as it was termed) from the main irrigators. These actions cause more disruptions and force legal irrigation farmers to reduce their plot sizes (HJPA/VD/FGD ARD officials 30052017, 2017). In Vhembe, reduction of plot sizes for farming is largely as a result of the lack of adequate water. Rural women reported that they have irrigation facilities, however, the water is not adequate for large plots (HJPA/VD/FGD1 Women 18052017, 2017).

In Chivi District, communities that reside in close proximity to the rivers make a concerted effort to develop irrigation strategies. The researcher observed that these irrigation schemes require a lot of labour. Farmers, for example, use buckets and wheelbarrows to fetch water from the dams, rivers. Even the community garden projects promoted by the NGOs require a lot of labour. This forces rural women to work on small plots of land. Image 6.5 shows women fetching water from a drying up community dam for watering a vegetable garden. This dam is located approximately 500m from the garden (Image 6.5) where they grow vegetables for consumption and to sell.



Image 6.5: Pictures show the water source for and the community garden in Chivi District

Photograph: HJPA/CD/Observation Field Notes Chivi (2017)

Image 6.5 shows both the poor state of the gardens in Chivi and the poor state of crops. The garden has beds where different types of vegetables could be planted but the women have reduced the number of vegetable beds owing to the difficulties in accessing water. Where in Chivi they struggle with poor access to water, in Vhembe they complained about the expenses related to the irrigation facilities. They complained that they needed electricity to pump water for their

plots. Due to poor yields over the years, it has become difficult for farmers to maintain irrigation facilities, whilst they also have to work hard at securing access to water. Thus, even if irrigation systems are a good coping mechanism to promote water access and production, there are many constraints in both Chivi and Vhembe. The major impact emanates from lack of adequate water and infrastructure to support the irrigations. In Vhembe, individual unlawful irrigators diverting/stealing water intended for irrigations, exacerbate conditions for lawful irrigation farmers.

Conservation farming is another coping strategy used in Chivi in times of poor rainfall. Rural women reported that they have adopted conservation farming following advice from local agricultural extension officials who work closely with communities. Rural women reported that though conservation farming help to increase yield using the minimum available water it was a difficult farming strategy because it is labour intensive (HJPA/CD/FGDs Field Notes Chivi, 2017). To fully implement it with positive results there is a need for people to have special tools and machinery that make the work easier of which the rural people do not have access to (HJPA/CD/Official AGRITEX 20170222, 2017). Conservation farming is reportedly practiced in Chivi District by most households but on a smaller scale (HJPA/CD/FGDs Field Notes Chivi, 2017). In Chivi District, the study found that various departments worked together to promote good water use and teach the rural people especially women on improved techniques of coping with water challenges for farming. The Department of Mechanisation in Zimbabwe works with the agricultural department and other water boards to disseminate information on new and improved strategies that rural people can adapt to cope with water stresses thereby promoting food and energy security for households.

In Vhembe District, conservation farming has not yet gained momentum among the people in the rural areas. Women reported that they do not have adequate knowledge of conservation farming (HJPA/VD/FNFGDs Vhembe, 2017). However, discussions with officials showed that they had knowledge about the benefits of conservation farming, but had not imparted the knowledge to local people (HJPA/VD/FN Interviews Officials, 2017). The researcher observed that the agricultural department in Vhembe District worked closely with farmers, only in the irrigation schemes. They did not work closely with other rural farmers in the community. This undermines the knowledge base of rural women on new technologies and updates in farming techniques to cope with poor rainfalls and poor access to water during the farming season (HJPA/VD/FNFGDs Vhembe, 2017). There is a need to improve communication and interaction of the government departments with the rural communities in Vhembe, to promote information dissemination and create avenues for challenges faced in the WEF nexus.

Instead of growing crops that demand a lot of water, rural women in Chivi reported how they resorted to growing the drought-resistant crops that require less water (HJPA/CD/FGDs Field

Notes Chivi, 2017). These drought-resistant crops are not new species, but rather traditional species that have been abandoned over time for modern crops, such as maize and wheat. The drought-resistant crops are mostly small grains. These are mostly grass species that thrive under harsh conditions such as high heat weather and low rainfall conditions. In Chivi District, they reported that most households resort to farming these small grains, which require less water (HJPA/CD/FGDs Field Notes Chivi, 2017). In contrast, households in Vhembe District, South Africa, reported they have knowledge of these small grains and explained the use of sorghum, *amabele/Sorghum bicolor* in making soft porridge and traditional beer. They, however, reported they do not grow them since they prefer maize. Some women in the discussions said they did not know of these small grains. They were only familiar with maize as their staple food (HJPA/CD/FGD1 Women 16012017, 2017; HJPA/CD/FGD2 Women 02022017, 2017).

In both Chivi and Vhembe districts, they reported that they rely on non-farming livelihood. The similarity is that rural women in both areas embark on varied livelihood options for income generations, and common to both case studies are temporary work, the sale of various handwork such as sewing, fat cake making and firewood selling (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). The differences are that in Chivi, they depend on donor funding for income generating projects. In Vhembe they rely on government support through grants, pensions, and funding for projects. In Vhembe rural women reported, they had access to loans and loan facilities if you had means of paying back whilst in Chivi women reported they had no access to loans or loan facilities without legal collateral or permanent job (HJPA/CD/FGD2 Women 02022017, 2017; HJPA/VD/FGD1 Women 18052017, 2017).

The above discussion shows the importance of water in the WEF nexus. It helps in the understanding of the WEF nexus, security and the impact of coping strategies on WEF security. The coping strategies discussed above testify to the fact that rural women come up with coping strategies for water challenges that impact on food and energy security. In an endeavour to save water for domestic purposes by reducing water-based activities such as cooking they ultimately save energy and food resources too. The need to store a large amount of water in the compounds for future use requires a lot of energy, physically, and time which impact negatively on time spent on other activities that promote energy and food.

The coping strategies found in this study are short-term methods that are difficult to maintain and implement in a long-term crisis. Therefore, there is a need to foster responses that have a long-term influence with little health implications especially for rural women who are responsible for the collection of water and energy for the household. Building resilience includes creating avenues for rural women to access water for all their needs in reasonable quantities and safely (Benson & Garmestani, 2011; Cote & Nightingale, 2012). In both Chivi and Vhembe, women reported the

risks they faced everyday walking long distances to fetch water, and the health hazards of the open sources they rely on for domestic water (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). Panarchy explains that when a system is faced with challenges, responses are formed which revert to the original state of the system or alter the systems without destroying structures (Gunderson & Holling, 2002:28). Panarchy helps in the understanding of how occurrences in one system have an impact on another. It helps to acknowledge and understand the relationship among systems in their complexity and determine actions in one that cause challenges in another system (Gotts, 2007). In this study, there is a need to understand the interactions of the WEF nexus elements in rural households, challenges for WEF security and the coping strategies used by rural women for each resource. The coping mechanisms or responses used are not independent of the WEF nexus as this discussion showed. The need to secure water for domestic and livelihood purposes has traces in both food and energy security. Therefore, when coping with challenges there is a need to understand the dynamics of change in the WEF nexus systems and management. Coping strategies should aim for stability and sustainability. People should aim to adapt to the changing circumstances and maintain continuity. The WEF nexus resilience framework for this study emphasises the need for adaptation and coping in the resilience process toward achieving WEF security.

6.5.2 Coping strategies for food challenges

Food security is important for the development and wellbeing of communities, households, and individuals. According to Ghimire (2014:1), food is a basic need necessary for human survival, health, growth, and development. Food security has however been difficult to achieve especially in developing countries. It has remained a challenge to increase access to food. Moreover, most sub-Saharan countries struggle to achieve adequate food for their populations (Haile, 2005:2169; Thompson *et al.*, 2010:2720). This study found that food security was a challenge for the households in the areas under study. Chapters 4 and 5 discussed the perceptions of rural women and men on the food security situation of their households in Chivi and Vhembe districts.

Globally, various aspects have been stated as causal factors of food insecurity, and these include climate change, economic crises or meltdown and other disasters (Allouche, 2011:S3; Bizikova *et al.*, 2013:3; FAO, 2010:5; Nawrotzki *et al.*, 2014:284). In this study, the major causal factors in both Chivi and Vhembe rural areas reported included, climate change, lack of capital, poor access to food markets, distance and increases in food prices (as discussed in Chapters 4 and 5). To counter food insecurity challenges, shortages and crises, rural women have to come up with coping strategies. Coping strategies used by women in Chivi and Vhembe showed both similarities and differences either in implementation or in the response that is taken.

The ability of a household to cope with a crisis while maintaining normalcy in the present and not disrupting the stability and sustainability of the future is regarded as resilience. Resilient households should be able to deal with challenges they face daily without creating more challenges for themselves in the future. Households and individuals should be able to help themselves out of crisis conditions or challenges. They should be able to improve their capacity to deal with disruption. Panarchy explains that in times of crisis the responses of a system can strengthen and promote recovery, stability, and sustainability, or alternatively, lead to a total collapse and demise of that particular system (Benson & Garmestani, 2011:1421; Gotts, 2007:1). If coping strategies are not carefully chosen, they totally change a system or even destroy its normalcy. This study is complex in the way it combines both the natural (ecological WEF Nexus) and the social (rural women and households) in trying to understand relationships, interactions, challenges, choices and coping strategies use in a social ecological system.

As discussed in Chapters 4 and 5, the most common coping strategies for food insecurity include: changing consumption patterns; use of inferior and cheap food; use of non-timber forest products; reserving food for children; borrowing money or food from others; food aid, community or group savings. In addition, they use off-farm livelihood strategies for income generation; crop diversification for better crop yields; selling of household assets; and temporary migration of family members (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). Table 6.8 shows the use of the mentioned coping strategies by households in both case studies.

Table 6.8: The percentage total of households that frequently use a food coping strategy per case study

Coping strategies	Chivi		Vhembe	
	Yes %	No %	Yes %	No %
Changing consumption patterns	100	-	100	-
Use of non-timber forest products	100	-	43.3	56.7
Reserving food for children	16.7	83.3	-	100
Borrowing money or food from others	33.3	66.7	53.3	46.7
Food aid	86.7	13.3	-	-
Off-farm livelihoods	56.7	43.3	90	10
Use of inferior and cheap food	-	-	100	-
Community or group savings for food	-	-	66.7	33.3
Crop diversification	90	10	-	-
Selling of household assets	23.3	76.7	6.7	93.3
Temporary migration of family members	100	-	100	-

Source: HJPA/CD/FGDs Field Notes Chivi (2017); HJPA/VD/FNFGDs Vhembe (2017)

Table 6.8 shows the coping strategies. The table gives an exposition of the number of households that have at some point resorted to using a certain coping strategy to curb food insecurity challenges. Table 6.8 provides a comparative overview of certain coping mechanisms and uses in each case study. The most common coping strategies, which are similarly used by all households (100%) in both Chivi and Vhembe, included temporary migration of family members and changing food consumption patterns/behaviours (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). The study found differences in that there were coping strategies used in Vhembe, which rural women in Chivi District did not use (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). Examples are: group saving schemes for food items; and the use of inferior and cheap goods. In addition, rural women in Chivi reported relying on food aid and donations, which was not the case for Vhembe. Therefore, there are both similarities and differences in the coping strategies for food in Chivi and Vhembe.

Reserving food for children

Reserving food for children was reported in Chivi District by 16.7% of households. These few households reported that they set aside some food for the elderly and children to eat since they are not as strong as other adults are. This coping mechanism was used by some households who explained that reserving food has always been the norm in most rural households, however it was not used as a coping strategy for curbing food insecurity but to maintain time management and be able to accomplish other chores before cooking. One woman in a group discussion in Chivi said:

It has been the norm that families cooked extra food so that they can reserve left overs for the elderly and the children who usually complain of hunger frequently. This would reduce the time spent on cooking and allowed people to work. The difference is that now this strategy is to manage the meagre food supplies in the house. Older people will have to go without food while reserving the ones they have for children and the elderly. It is now common to hear in households that food reserves are termed “for children” or “for the grandparents” (HJPA/CD/FGD1 Women 16012017, 2017).

Another woman in Chivi further explained that:

In severe food insecurity situations, the able-bodied family members have only two meagre meals per day and allowing reservation of food for the weaker ones. During drought, most able-bodied members rise up early to go in search of wild fruits that they may eat to supplement the small meals they have (HJPA/W6 12022017 Interview, 2017).

Households, however, reported that they did this in extreme cases of food shortages and only for a short while until they could secure some food (HJPA/CD/FGDs Field Notes Chivi, 2017). In the same area (in Chivi), 83.3% of the households reported that they never reserve food for the children. The results in Vhembe showed that no households use this strategy for food insecurity. The possible explanation was these households preferred using other methods of food rationing which were not as extreme as not eating food while reserving it for children and the elderly.

Borrowing food or money

Borrowing money or food from others was found to be more prominent in Vhembe than in Chivi. More than half of the households (53.3%) reported using borrowing as a coping strategy. The rural women reported that it was common to borrow some foodstuff from the neighbours. They reported borrowing money for food or buying foodstuff on credit. This they resorted to in times of unforeseen crises that can exhaust their food reserves, such as, droughts, illness or death in the family. They borrow food and money for food if there are irregularities for payments of grants and pensions in Vhembe and they run out of food and other basics. In Chivi, only 33.3% of the households used this coping strategy, whilst 66.7% of households did not resort to borrowing. In Vhembe, 46.7% of households did not use borrowing as a coping strategy for food. The explanation for not borrowing was given in Chivi by a woman who said:

Borrowing can only be done when you know you have the capacity to return the borrowed items. Most households do not have a regular income or food sources, therefore, making it very difficult to borrow from people. In the worst case scenarios, people just resort to begging for food than borrowing (HJPA/CD/FGD3 Women 07022017, 2017).

From the resilience, perspective borrowing shows the household have limited capacity to cope with challenges that arise. It shows that households are not resilient if they resort to borrowing from others. However, it helps households to maintain themselves through crises and give them an opportunity to find other innovative ways to cope with food insecurity by providing food for the short time the household faces a crisis.

Food aid

Food aid refers to programmes that give support to food insecure populations with unanticipated emergencies and those who suffer chronic food insecurity (Del Ninno *et al.*, 2007:414). Food aid comes in different ways; there is the programme food aid that gives in kind, the project food aid, that gives funding for projects that can promote food aid and the emergency relief food aid that gives relief food to eradicate the impact of disasters and emergency disruptions (Maxwell *et al.*, 2003:2). The study found that in Zimbabwe, all households had been at some point, beneficiaries

of food but not all actually placed food aid as a coping strategy for food. Food aid was reportedly prominent in Chivi District, where 86.7% of households reported they relied on food aid to cope with food challenges in their homes (HJPA/CD/FGDs Field Notes Chivi, 2017). However, 13.3% of households in the study in the Chivi District did not have food aid for their households. An interview with an NGO (CARE International) official established that the organisation provides food assistance for most households and aims for different beneficiaries with each programme (HJPA/CD/Official 1 NGO 20170214, 2017). Focus group discussions established that most households depend on these food aid programmes and find it difficult to feed their families without food aid (HJPA/CD/FGD1 Women 16012017, 2017; HJPA/CD/FGD2 Women 02022017, 2017; HJPA/CD/FGD3 Women 07022017, 2017).

In Vhembe, food aid was not reported as a coping mechanism for food in the rural households. The possible explanation for not relying on food aid in the few households in Chivi was a result of the terms and conditions attached to the food donations in the search for beneficiaries. These rural women claimed that they did not meet the criteria to be beneficiaries of food aid (HJPA/CD/W8 12022017 Interview, 2017). The food aid programmes target very poor people in the rural areas and vulnerable groups such as the old, children, orphans and the handicapped. If just one person in the household meets these criteria, then they can benefit from the food programmes (HJPA/CD/Official 2 NGO 20170215, 2017). As discussed in Chapter 4, the NGOs in Zimbabwe have been of assistance with income generating projects. These projects have different aims, such as: promoting asset building (the pass on projects of heifers and goats); income generating projects (gardens, poultry, peanut butter making and money saving); and the food-for-work projects where households were encouraged to work for their food and income (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/CD/FN Interviews Officials, 2017).

From the resilience perspective, a resilient household has the capacity to face challenges and have the means to deal with them in a manner, which maintains its present stature (Jabeen *et al.*, 2010:416). The presence of food aid and donor-funded projects points to the vulnerability of some communities. Food aid over the years has been criticised as projects that compel households to be dependent and not be able to solve their own challenges (Del Ninno *et al.*, 2007:414).

In South Africa's Vhembe District, the study found that funded food aid programmes are not prominent, and the possible explanation could be because the country functions on food self-sufficiency. According to De Cock *et al.* (2013:269), South Africa as a nation is classified as food secure and capable of providing enough food for its populations and having excess for export. However, various scholars have denounced this view claiming that most households in South Africa are food insecure and vulnerable to hunger and starvation especially in the rural areas (Abdu-Raheem & Worth, 2011:92; Altman *et al.*, 2009:346; De Cock *et al.*, 2013:270; Drimie &

Ruysenaar, 2010:317; Hendriks, 2014:2; Labadarios *et al.*, 2011:891). Though rural women reported not receiving food aid in Vhembe, they reported that they rely on the grants that are given by the government to purchase food unlike in Chivi where there are no grants provided for by the government for the poor people. Rural women in Vhembe reported that they do not have any NGOs that come with food relief programmes while in Chivi the food aid programmes are a common aspect.

Changing food consumption patterns

All households in this study reported that they changed their food consumption patterns and behaviour in order to cope with food insecurity (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). The study found that though rural women change the way their households consume food, there were differences in the actions taken. In Chivi District the changes included food rationing, cooking fewer varieties, cooking light meals, skipping meals and reserving a solid meal for supper as discussed in Chapter 4 (HJPA/CD/FGDs Field Notes Chivi, 2017). In Vhembe, changes included reducing the number of meals, reducing food portions and skipping/changing meal times as discussed in Chapter 5 (HJPA/VD/FNFGDs Vhembe, 2017). The study found that similarly, rural women reported that they skipped meals much more noticeable in Vhembe and rationed the food by cutting down on quantity protuberance in both areas. Reserving solid meals or good meals for supper was prominent in Chivi, women reported making use of light meals of *mutakura* (a boiled mixture of groundnuts, maize, roundnuts and cowpeas) and tea or sweet potatoes (*mbambaira*, *mabura*/*Ipomoea batatas*) locally grown during the day (HJPA/CD/FGDs Field Notes Chivi, 2017). Whilst in Vhembe they prefer changing meal times by eating breakfast later and supper at night or skipped one of the three basic meals.

The possible explanations for the different operations in changing consumption behaviours and patterns is because the rural women in Chivi depend on subsistence food production and donations whilst in Vhembe they rely more on food purchasing. The light meals that women reported relying on are made of food they grow on their small plots, backyard gardens, and community gardens. In Vhembe this is not common. Women in Chivi reported that sweet potato cultivation is very common and every household plants a crop. It is cheaper as it does not require any expensive inputs. Planting is done using the shoots that usually come out after the first rain from the previous harvest. They reported that shoots can be asked, free of charge, from neighbours and the sweet potatoes do not require fertilisers and any other chemicals. After harvest, they make storage areas. The crops can be consumed over a long period of time. This allows them to make use of small meals and light meals during the day reserving solid meals for supper. *Mutakura* was reportedly easy as it was a mixture of available grains that are boiled and

salted, which household members can eat during the day (HJPA/CD/FGDs Field Notes Chivi, 2017). One woman in Chivi said:

We make use of mutakura and sweet potatoes to make up day meals (morning and afternoon) because these make cheaper meals. These meals do not require any special ingredients except water and salt. We grow our own sweet potatoes and the grains are usually cowpeas that do not need any special inputs and does not require a lot of water. Even in drought season, we manage to get sweet potatoes, albeit small, and cowpeas (HJPA/CD/W8 12022017 Interview, 2017).

The fact that rural households grow these crops on their own makes it easier to make light meals of these in times of food crisis. The reason why they can be used as a coping mechanism is the fact that boiling sweet potatoes or grains for a meal does not make it a balanced diet. It is only to sustain members and keep hunger at bay but does not translate to food security. Changing consumption behaviours and patterns is an adaptive way of coping with food insecurity. However, the challenge is that it is not a long-term coping mechanism as it may have health implications. In Chivi women reported they used this in the interim period after winter going for the rainy season when most of their food reserves have been depleted or in drought cases and other disasters (HJPA/CD/FGDs Field Notes Chivi, 2017). In Vhembe, they reportedly used sweet potatoes in situations where they have a crisis, such as not having the income to purchase more food, and where income intended for food purchasing is used for other unforeseen crises such as illness or death (HJPA/VD/FNFGDs Vhembe, 2017). The management of food resources to conserve and ensure availability is resilient focused. However if the food management entails skipping meals it becomes unsustainable and cause more harm in future.

Use of Non-Timber Forest Products for Food (Wild Food Sources)

The study found that in Chivi all households (100%) rely on the use of non-timber forest products (NTFPs) whereas in Vhembe only 43.3% of households reported relying on NTFPs (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). NTFPs are natural species that people can eat to supplement or compliment their diets and use as a substitute for their normal meals. These include wild vegetables, grasses and tree leaves that can be cooked as meals or part of meals. NTFPs include the wild fruits, insects, animals and fish that people can use with their meals or can make up meals (Paumgarten & Shackleton, 2011:109). NTFPs can be different species from one area, depending on its on availability. In both Vhembe and Chivi women reported that most vegetables and insects are available during the rainy season (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). This makes the consistent use of NTFPs uncertain. Availability is influenced by seasonality and especially rainfall.

In Vhembe, the use of NTFPs has been affected by modernisation (HJPA/VD/FN Vhembe, 2017; HJPA/VD/FNFGDs Vhembe, 2017). People prefer modern types of foods and wild products have become unpopular. One woman reported that:

These wild foods are associated with poverty. Most people do not use them unless they are poor and cannot afford better food. This causes people to be shy to use them (HJPA/VD/W8 03062017 Interview, 2017).

There is a need to create more awareness for the nutritional value of foods especially wild foods to rural areas. Most people seemed not to hold wild foods in high regard in spite of them being highly nutritious and healthy. The health department may work together with other civil organisations to teach people about the value of wild and traditional foods using various media. This may promote food security, change their views towards wild foods and may lead to the preservation of environment.

The use of NTFPs has reportedly been helpful to rural households in Chivi in times of food insecurity (HJPA/CD/W4 04022017 Interview, 2017). The collection of fruits, insects, and vegetables is common during the rainy season and most of these are preserved through sun drying for later consumption. The women reported that the challenge they face is that the products are affected by the amount of rainfall received (HJPA/CD/FGD1 Women 16012017, 2017). More rain promotes the growth of vegetables and most insects come out after the rains. The study found that there are times when there are not enough vegetables to preserve and households may even struggle to have enough for one meal. The rural women reported that not having enough NTFPs is very common in times of droughts (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017).

The use of NTFPs is a profound way of supporting resilience and building the capacity of households to cope with food insecurity challenges. However, dependence on the ecosystem for these products, calls for good environmental management systems and interactions that will promote stability and sustainability of the environment to ensure it can continue to produce the products for people. The way in which people interact with the environment may alter its state and compromise its capacity to produce the NTFPs that can be used in food insecurity crises. The WEF nexus for rural households is reliant on the environment and actions people take to use one of the WEF component may have an influence on another component. The study found that most of the indigenous fruits, insects, and vegetables were becoming extinct in both Vhembe and Chivi areas. The sustainability of the environment for NTFPs in both Chivi and Vhembe districts is hindered by excessive cutting down of trees, land clearance for building and farming and the lack of adequate rains for an extended period (HJPA/CD/FN Interviews Officials, 2017; HJPA/CD/Official EMA 20170214, 2017; HJPA/VD/FN FGDs Officials, 2017; HJPA/VD/FN

Interviews Officials, 2017). Where there previously were diverse variants of zoological and botanical alternatives, most wild species are now on the verge of extinction (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017).

Off-farm livelihoods for food

Off-farm livelihoods are ways in which people diversify their activities by seeking off-farm income, food, and other provisions for basic needs. Livelihood diversification is a coping strategy for rural households who have always used farming as the source of food and income. These activities and avenues for income have helped most households in the rural areas to provide in their needs. In Chivi District, 56.7% of households reported diversifying to adopt non-farming activities as compared to the 90% in Vhembe. It seems the rate of diversification in Chivi is lower (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017).

The main reasons for diversifying are due to climatic change that has negatively affected the farming prospects in both study areas. In both Chivi and Vhembe, rural households have faced challenges related to climatic changes especially droughts and cyclones that intermittently destroy crops (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). Women in Chivi reported that their soil is now very poor and unproductive for farming, as it needs many inputs such as fertilisers and chemicals that rural households cannot afford. In Vhembe, the women reported that the challenges of droughts that have been occurring have made people devise ways of survival without farming by adapting to off-farm activities.

In Vhembe, 10% of the study population reported that they have not diversified a lot from farming and still perceive farming as the main food and livelihood source. However, some small families remain part of an irrigation scheme in the Tshiombo area. In contrast to Vhembe, the 43.3% in Chivi that reported not diversifying to other off-farm livelihoods activities, reported lack of opportunities for diversification. The women in Chivi reported that they had no access to financial capital that could aid in devising options for diversification unlike in Vhembe where most households were receiving grants and had access to loans.

Use of inferior and cheap food

The study found that in the Vhembe District all households (100%) reported that they rely on inferior and cheaper food products to cope with food insecurity challenges (HJPA/VD/FNFGDs Vhembe, 2017). It was found that participants in Vhembe District bought food from the shops and markets in the neighbouring towns. The chronic climatic change disruptions such as droughts have made farming and other livelihoods difficult to provide food for the rural households making them rely more on food purchasing. The main source of income in the rural areas of Vhembe districts are the social grants from the government (HJPA/VD/FNFGDs Vhembe, 2017). Local

women explained that they have to use the grants wisely to ensure they last them until they receive another grant. They reported that they do not purchase the best quality food items but rather choose the cheaper products and fewer varieties of food only. Whilst in Vhembe, the use of cheap and inferior food products is an option, in Chivi they did not report on using this as a coping strategy (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017).

The possible explanation for the case of Chivi is that rural women focus on having the basic food products like mealie-meal, sugar, cooking oil, salt and a few basics. The people in Chivi District mainly live off their environment and count on wild foods as supplements and compliments of meals. Most food products such as rice, pasta, and a variety of vegetables are not available locally and are treated as luxurious products (HJPA/CD/Observation Field Notes Chivi, 2017:346). Rural women in Chivi reported that they have limited funds for purchasing food (HJPA/CD/FGD3 Women 07022017, 2017). In Vhembe, most women reported being dependent on social grants that were not sufficient to cater for all their needs pushing them to opt for cheap and inferior food products.

Social security measures for food

In building resilience, the availability of social security measures for the poor people may enable them to come up with coping strategies that effectively eradicate food insecurity challenges. From the discussions held in Vhembe, the study found that the social grants that intended to aid the poor were creating a dependency syndrome (HJPA/VD/FNFGDs Vhembe, 2017). The social grants, instead of helping the poor to lift themselves out of poverty, are pushing them deeper into poverty where people look up to the government to make sure that the challenges they face are being solved (HJPA/VD/FN Vhembe, 2017). Rural women in the study continuously referred their challenges to the government not doing something to help them.

The study found that the rural women in Vhembe reported that the social grants did not increase when the prices of food and other basic services increased which made these grants inadequate. The possibility of having a government that comes in with social grants packages for the rural poor has prevented the communities from coming up with independent measures to cope with food insecurity. In contrast to Vhembe, rural women in Chivi, who did not receive such grants did not seem to have a choice of the superior and inferior products, instead rather lived on anything they can get to ensure their households survive. Rural women in Chivi showed that they have adapted to their situation and found ways of ensuring they have meals in their households without worrying about the quality of food (HJPA/CD/FGDs Field Notes Chivi, 2017).

The WEF nexus promotes the understanding of effects in each sector and actions in one sector affect the other elements. To ensure food security people have to use inferior products. This was

not reported as a coping mechanism for food only but as a way to save money for use in purchasing other things like water and energy in Vhembe. There is a need to foster resilience for rural women and households by building on the adaptation capacity of households and individuals. The people should be able to work out independent solutions and rely on the locally available resources to acquire food and other commodities for their households without looking up to government for everything they need.

Community or group savings for food

The group saving schemes for food were reported in Vhembe District. Two-thirds (66.7%) of the households practiced them (HJPA/VD/FNFGDs Vhembe, 2017). The group saving schemes for food are ways of saving money and creating food storages. Women in Vhembe explained that these schemes were done in groups of minimum four people and usually have a maximum of ten people (HJPA/VD/FGD2 Women 23052017, 2017). They contribute the same amount of money, which is then used to purchase food and other commodities. The food and commodities are then shared at the end of either six or 12 months. The households will use the commodities they buy after they have been distributed to each member. Women claimed this is a way of saving and accumulating food that is not perishable (HJPA/VD/FGD1 Women 18052017, 2017).

The advantage of group savings for food is that they ensure that basic commodities are made available to each member, which allows them to budget with the little income they have. This coping strategy was not reported in Zimbabwe. Rural people in Chivi explained they did not have a steady income avenue which guarantees that they can make savings of the same amount of money each month. The rural women in Chivi District stated that those people who benefited from the Care International groups saving schemes projects known as Fushai – meaning to preserve, did the group saving schemes. They are taught to invest a once-off amount of money and have it grow by loaning it to the outsiders or only group members with interest (HJPA/CD/Official 1 NGO 20170214, 2017). The group savings in Chivi aims to ensure that people have income for emergencies. Members only use it by borrowing and returning with interest. If they decide to share the money, it would mean the group savings will stop.

Group savings schemes are not really a way out for everyone in the rural areas. Only households with consistent and more than sufficient funds to save and invest in group saving schemes resort to using them, even in Vhembe (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). The study found that 33.3% of the households in Vhembe reported they could not join group savings for food because the income they received was too small to make investments in other things without increasing the household's vulnerability (HJPA/VD/FNFGDs Vhembe, 2017).

Group savings for food as a coping strategy allow the women to be able to make management strategies for the available food they have and conserve it to ensure they have a continued food supply channel. It is a way of coping that promotes resilience and help rural people to adapt to their situations and cope with what they have available. The group savings for food were reported as a good way of ensuring they spend money wisely and avoid living from hand to mouth with the capability of saving and channeling some funds to other basic needs such as healthcare and education. Rural women in Chivi, Zimbabwe can learn from this and form their own group saving schemes for food using the income they can work for (as a group or individually) to prepare for the future. The group saving schemes for food are an adaptive way of fostering resilience which ensure people prepare themselves for the future.

Crop diversification and use of drought-resistant crops

Crop diversification refers to the planting of different crop types and varieties depending on the soil types and the prevalence of rainfall in an area. The advantage of planting a variety of crops include promotion of soil structures and composition, reduction of pests and the need for pesticides, different crops help preserve soil fertility thereby reducing the need for chemicals and fertilisers, and it provides room for people to use drought-resistant crops in low rainfall areas. Crop diversity and use of drought-resistant crops were reported by 90% of households in Chivi District (HJPA/CD/FGDs Field Notes Chivi, 2017). They explained how they resorted to the adoption of their traditional indigenous crops that required less water and were resilient to harsh weather conditions such as high temperatures. The adoption of drought-resistant crops promotes food security. The crops are not likely to be affected by most weather conditions (HJPA/CD/FGDs Field Notes Chivi, 2017). The exposition given in Chapter 4 explains the importance of drought-resistant crops to promote food security. Rural women in Chivi and the officials in AGRITEX explained that the use of drought-resistant crops, like sorghum, ensured that these rural households had grains they could use for food (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/CD/FN Interviews Officials, 2017). The use of drought-resistant crops reduces the consequences of drought. Poor crop yields due to drought lead to an increase in food prices for commodities on the markets. Therefore, the use of drought-resistant crops is a promising avenue to increase yields and cope with drought-induced food insecurity.

Interviews with women showed that not all households have adopted the use of crop diversification and use of drought-resistant crops. In Chivi District, 10% of the households reported that they have not adopted the drought-resistant crops and still prefer to plant maize for subsistence (HJPA/CD/FGDs Field Notes Chivi, 2017). Officials in Zimbabwe applauded the use of drought-resistant crops to curb challenges of food insecurity. However, most households still view these grains as inferior to maize and prefer the use of maize (HJPA/CD/Official AGRITEX

20170222, 2017). In Vhembe District, the shift to these traditional grains was not reported. All households in Vhembe reported that they do not grow any drought-resistant crops (HJPA/VD/FNFGDs Vhembe, 2017). Officials in Vhembe District reported that local people lacked adequate knowledge and skills to grow and tend to these small grain drought-resistant crops (HJPA/VD/FN FGDs Officials, 2017).

Crop diversification promotes good environmental management. Drought resistant crops enable households to harvest better yields even in times of droughts and low rainfalls. The use of drought-resistant crops is ideal in the WEF nexus, it promotes low water usage, therefore, creating more with less, and it promotes better yields for households thereby promoting food security. According to Simba *et al.* (2012:6), people living in drought-prone areas should consider growing drought-resistant crops as an adaptive coping strategy for food insecurity. The use of small grain crops promote resilience of households and individuals to food security related challenges and eradication of poverty.

Selling off household assets

The study found that rural households sell their households assets for food. In Chivi District, 23.3% of the households' sell the available assets, compared to 6.7% of households in Vhembe District. Though the sale of assets is a coping strategy used by some households, it showed that it is not so prominent in both case study areas. Three quarters (76.7%) of the households in Chivi reported not using this coping strategy while in Vhembe District the number was higher with 93.3%. Rural women in Chivi District using this strategy reported selling livestock that they own, especially free-range chickens, to buy food. Selling off assets in Vhembe included the household's gadgets and the small tools they own in order to buy food. In Chivi, they reported that they mostly do butter trading rather than ask for money since most of the people do not have money (HJPA/CD/FGDs Field Notes Chivi, 2017). In Vhembe they reported that they do not have small livestock to sell and selling household furniture and appliances is not so viable. This is because most people also do not have money to purchase these things and people complained they would get very little compared to what the actual value of the product is (HJPA/VD/FGD1 Men 19052017, 2017; HJPA/VD/FGD2 Men 17022017, 2017). Most people do not want to buy second-hand gadgets from others and prefer to buy their own.

In rural areas, households lack assets to sell. In Vhembe's Tshiombo area the women reported that their villages made up part of irrigation schemes. They were prohibited from owning any livestock to protect the crops (HJPA/VD/FGD1 Men 19052017, 2017; HJPA/VD/FGD1 Women 18052017, 2017). In Gombani, they reported that the poor vegetation and lack of proper water resources and supply prevented households from owning any livestock. Only a few households owned goats in limited numbers which they could sell in times of need (HJPA/VD/FGD2 Men

17022017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). In Vhembe, women in an FGD said that they usually have nothing they can sell off in crisis and have to rely on other coping mechanisms.

FGDs held in Chivi District exposed that it is a norm for rural women to own free-range chickens in the area (HJPA/CD/FGDs Field Notes Chivi, 2017). Each household would have these chickens and they will be used if they need either money or food. The free-range chickens are not too difficult to keep as they look for their own food and do not demand a lot of water (HJPA/CD/FGD3 Women 07022017, 2017). This potential coping strategy can help households in times of need. Building upon livestock assets for households is important as it gives households that capability to respond to challenges. There are NGOs in Zimbabwe, as discussed in Chapter 4, that focus on asset building projects for rural people. These projects promote livestock keeping as an asset and donate goats and cows to rural people that they keep. Livestock is regarded as the capital and when they reproduce, the offspring is passed on to neighbours. This was however not very successful in Chivi because of implementation challenges and the death of livestock due to drought and other harsh climatic conditions.

Poultry projects can be used to promote livelihood security and increase household asset bases in rural areas. The free-range chickens can be used for food and be sold to get income for other needs. The advantage of free-range chickens is that they do not consume as much food or water as broiler chickens, they are viable for consideration as long-term production and require very little labour and capital. In Chivi District one woman said:

It is easy to start a free-range chicken production in the long term. These chickens lay eggs that hatch more than five chickens. One needs only one hen since they can borrow roosters from others. However, the major challenge is security for them, most of them are picked by wild dogs and vultures. We do not have money to build proper infrastructure for them which allows them to search for food as well as protect them (HJPA/CD/FGD1 Women 16012017, 2017).

This assertion calls for investment in poultry for households in the rural areas. According to Guèye (2000:135), poultry provides a valuable asset base to people in the rural areas of Africa. Poultry contributes significantly to food security and poverty alleviation, for the disadvantaged and the vulnerable groups. In another study by Mack *et al.* (2007:12), poultry was reported as an ideal strategy to promote rural livelihoods, food security and reduction of poverty. This shows that there is a need to consider household poultry keeping as a viable coping strategy for food security. It demands less water and less energy which also promotes the security of these. Poultry can also be used as a long-term solution to adapt and promote household resilience. It also promotes the creation of the household assets that can be sold in times of crisis. This stage of building assets

is termed the conservation stage in panarchy where households are in a position to conserve resources, build assets that they use when faced with challenges to adapt to and promote household resilience capacities.

Selling off household assets, though common in coping with food insecurity, is viewed by most scholars as an extreme measure, which exposes households to greater risk of absolute poverty. According to Eneyew and Abddisa (2015:533), when a household sells off its assets, especially livestock and land, it compromises food availability and production.

Migration

The study found that temporary migration is a common coping strategy in both Chivi and Vhembe districts. All households responded that they have migrated family members with the intention of coping with food challenges in the home (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). Family members were reported to migrate to urban areas and growth points in search of work and better living conditions in both countries. In Chivi District, they reported that in families where there are wealthy relatives, they usually accepted their help when they offer to take some of their children to stay with them in their homes (HJPA/CD/FGDs Field Notes Chivi, 2017). Some have children that dropped out of school to go to towns, work as housekeepers and gardeners, and send money back home. In Vhembe, they reported that they temporarily migrated to towns in search of jobs and to the nearby farms during harvesting seasons to work temporarily (HJPA/VD/FNFGDs Vhembe, 2017). Whereas in Vhembe they do rural to urban migration (HJPA/VD/FNFGDs Vhembe, 2017), for people in Chivi some migrated to neighbouring countries in search of work or means of living (HJPA/CD/FGDs Field Notes Chivi, 2017). Geographically, Chivi District is very close to the Limpopo Province in South Africa, and thus South Africa has seen an influx of Zimbabweans. Various scholars have reported the use of migration (temporary or permanent) as an extreme coping strategy used by households facing serious challenges (Chagomoka *et al.*, 2016:9; Eneyew & Abddisa, 2015:535; Ghimire, 2014:6; Shariff & Khor, 2008:28).

This analysis on food coping strategies used by women in both Chivi and Vhembe showed that these households are food insecure and the use of severe coping strategies shows the insecurity is severe (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). Causes of persistent food security challenges are erratic climatic changes, lack of sustainable livelihoods, lack of water resources for agriculture, lack of essential capitals needed for improving their lives. These varied challenges have led rural women to adopt coping strategies that aimed at minimising and cushioning the impact of challenges. The use of coping strategies varied from one household to the other, and depending on the severity of food insecurity, they use one or more of these coping strategies. Both areas received some social safety support, in Vhembe they had grants

from the government and in Chivi they had various donor-funded projects (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). However, only people that meet the criteria for benefiting can get the grants and donor aid.

The coping strategies found in this study showed that these people are facing severe and long-term food insecurity; this is shown by how they used severe strategies like borrowing, use of less preferred foods, the sale of assets, skipping meals and more. Resilience building promotes building the capacity of systems to cope with challenges and survive the varied crisis. The findings on the coping strategies in this study show the severity of challenges faced by the rural women and the opportunities that are available to them in order to survive. The way most of the coping strategies are reliant on water shows that it is necessary to look at rural food insecurity using the WEF nexus approach. The major challenges of food insecurity in both case study areas are because of a lack of water for livelihoods. Poor access to water limits the rural people's capacity to diversify to non-farming and off-farm livelihoods.

6.5.3 Coping strategies for energy

Chapters 4 and 5 gave distinct expositions of the energy security status of rural households in Chivi District, Zimbabwe and Vhembe District in South Africa. Attention was given to the availability, accessibility, security and supply of energy sources in both case study areas. A further discussion was made on the preferences of rural women and choices of energy sources. The study found that in both case study areas the rural areas are energy insecure and face various challenges in acquiring adequate energy for their needs (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). The major challenges in both districts were related to access and stability of supply. To counter these energy security challenges rural women in both case study areas came up with coping strategies to ensure they have sufficient energy for their needs. They reported that they received support from their governments on how to cope with energy insecurity for domestic uses (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). In Vhembe the government provided rural households with free basic electricity and free basic subsidies for other energy alternatives (HJPA/VD/FN Interviews Officials, 2017). Whilst in Chivi District the government sources for innovative information and solutions to promote household energy security such as the adoption of improved cooking stoves (HJPA/CD/FN Interviews Officials, 2017). There is a divergence in the coping strategies for energy in Chivi and the rural parts of Vhembe District. Homes are electrified, while in Chivi they are not (HJPA/CD/FGDs Field Notes Chivi, 2017). However, rural households in Vhembe still use firewood for cooking and electricity for other needs (HJPA/VD/FNFGDs Vhembe, 2017). The study found that these rural households did not rely on a single source of energy for their needs but rather resorted to using various types of energy sources.

The study found that in Zimbabwe they use firewood and other biomass fuels for most energy needs (HJPA/CD/FGDs Field Notes Chivi, 2017). The study found that most rural households in Chivi District had no electrical infrastructure and had no access to electrical energy for their domestic needs. Even though the government of Zimbabwe unveiled the rural electrification programme that aimed to electrify the rural areas, it did not have positive results (HJPA/CD/FGDs Field Notes Chivi, 2017). Rural women in Chivi District reported that they occasionally used kerosene, candles and other sources subject to availability and ability to purchase. The traditional sources of energy were highly preferred as they are acquired free of charge. The interviews and group discussions held in Chivi brought to light that rural households have little income and they cannot afford to purchase the better energy alternatives.

The study found that household access to energy resources in Chivi were thus limited by: low household income; distance travelled to collect firewood; the deteriorating state of the environment (as a result of increased consumption of firewood); scarcity of alternative biomass fuels; seasonality; and access to markets that supply alternative energy sources for purchase (HJPA/CD/FGD1 Women 16012017, 2017; HJPA/CD/FGD2 Women 02022017, 2017; HJPA/CD/FGD3 Women 07022017, 2017; HJPA/CD/FN Interviews Officials, 2017; HJPA/FGD1 Men 15022017, 2017; HJPA/FGD2 Men 17022017, 2017).

The researcher observed that the vegetation environment in Chivi District is deteriorating and women have to walk long distances from home to fetch firewood (HJPA/CD/FN Chivi, 2017). Women in Chivi walk long distances in search of firewood. The scarcity of firewood, which is the main source of energy in their households used for multiple purposes, has had an impact on the lives of people. Image 6.6 shows rural women returning from collecting firewood and the surrounding vegetation area showing the poor state of the environment around their villages.



Image 6.6: Rural women in Chivi District collecting firewood for domestic use.

Photograph: HJPA/CD/Observation Field Notes Chivi, (2017)

In Vhembe District, it emerged that electricity is used for lighting; firewood is used for cooking. All households tend to follow the same consumption pattern (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). In addition, the FGDs pointed out those households in the rural Vhembe areas under study, all use candles as an alternative source of energy for lighting (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017).

Few households reported that they use alternative sources like LPG, solar energy and kerosene for cooking and lighting. Low family incomes prevented households from using clean energy, like electricity or gas. Women reported that though they knew about better methods of cooking, they could not afford them (HJPA/VD/FGD1 Women 18052017, 2017; HJPA/VD/FGD2 Women 23052017, 2017). The local scarcity of firewood led to the adoption of alternative coping strategies. Table 6.9 provides a comparative view on coping strategies adopted in Chivi and Vhembe to cope with energy challenges.

Table 6.9: The percentage number of households that have adopted a certain coping strategy for energy in Chivi and Vhembe districts

Coping strategy	% No of Households in Chivi District	% No of Households in Vhembe District
Adopting improved cooking stoves for firewood	6,7%	-
Changing energy consumption patterns	100	100
Multiple energy uses and fuel switching	100	100
Fuel preservation	100	100
Forest conservation and management	-	100

Source: HJPA/CD/FGDs Field Notes Chivi (2017); HJPA/VD/FNFGDs Vhembe (2017)

Table 6.9 indicates that the rural women in these different locations have similar coping strategies for energy even if they rely on different energy types for domestic use. The table shows that they all change their energy consumption patterns, use multiple energy sources and fuel switching when the need arises, and they all have fuel preservation strategies. The dissimilarity in the coping strategies is that in Zimbabwe they have adopted the improved cooking stoves for firewood, although it is not very popular yet (HJPA/CD/FN Interviews Officials, 2017). In Vhembe, South Africa, they have forest management techniques that are not used in Chivi District (HJPA/VD/FN Interviews Officials, 2017).

Adopting improved cooking stoves for firewood

The similarity in both areas is that they all rely on firewood for cooking and heating and are facing challenges of access and availability of firewood. Rural women in both Chivi and Vhembe reported on the low-quality firewood they now use due to the extinction of indigenous trees that are regarded as the best wood for making fire (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). This has increased the number of times women go to collect firewood. Poor quality firewood increased the amount of firewood needed for cooking using an open fire (traditional way of making fire). In Zimbabwe, interviews with officials showed that the government had come up with a project of teaching rural women about improved cooking stoves (Tsootso stove, Image 4.11 in Chapter 4), which is a good and reliable way of conserving firewood (HJPA/CD/Official WA 20022017, 2017). The newly improved cooking stoves are useful for reducing the consumption of firewood in households. A study by Jagger and Jumbe (2016:410) in Malawi, as well as, Johnson and Bryden (2012b:320) in Mali, applauded the importance of improved cooking stoves in reducing deforestation, reducing the time taken and amount of firewood used for cooking.

In Chivi District, only 6.7% of the households were using the improved cooking stove at the time of the study (HJPA/CD/FGDs Field Notes Chivi, 2017). The majority (93.3%) reported either not

having the knowledge about the improved cooking stove (Tsotso stove) or not yet feeling ready to use it (HJPA/CD/FGDs Field Notes Chivi, 2017). In Vhembe District, all households still used traditional open fires for cooking and had no knowledge of the improved cooking stove (HJPA/VD/FNFGDs Vhembe, 2017). The traditional open fire used when cooking, consumes much more firewood and have been reported as hazardous to people's health in other studies (Biran *et al.*, 2004:19; Brouwer *et al.*, 1997:264; Johnson & Bryden, 2012b:319; Matsika *et al.*, 2013:723; Uhunamure *et al.*, 2017:32; Williams & Shackleton, 2002:4). Considering the scarcity of firewood due to excessive cutting down of trees, these households face challenges of acquiring enough energy for their needs especially cooking (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). This makes the need to adopt improved cooking stoves even more relevant for women in both case study areas.

The advantage of these improved cooking stoves is that they have models that can be made locally using local resources. The model shown in Chapter 4 (Image 4.11) is the best-improved cooking stove mode as it only requires the local soil used for pottery manufacture to make it, as reported by the officials (HJPA/CD/Official WA 20022017, 2017). The adoption of these improved cooking stoves in Chivi District was not as prominent at the time of the study as the government department responsible for the projects were still implementing the project (HJPA/CD/Official WA 20022017, 2017). Findings from this study, as well as available literature (Brouwer *et al.*, 1997:265; Jagger & Jumbe, 2016:417; Staton & Harding, 1998:35) highly recommend the use of this stove. It shows that it is an innovative way of ensuring households cope under firewood stress conditions and help to preserve the environment as the Tsotso stoves use little firewood as compared to open/traditional fires. The use of improved cooking stoves promotes the WEF nexus security as it conserves both the available energy and the environment by reducing the cutting down of the tree (HJPA/CD/Official WA 20022017, 2017). It promotes the resilience capacity of the environment and gives the environment a chance to regenerate. A good ecosystem promotes food security as the forests are protected and can provide other resources to people, such as fruits vegetables and insects that can be used for food. It reduces the deforestation and cuts water runoff which increases the availability of groundwater that can be used by communities. The fact that firewood consumption is reduced, promotes production. The time taken to collect firewood regularly can be used for other activities. The use of improved cooking stoves for firewood promotes the WEF nexus security for households.

Forest conservation and management

The study found that there are strategies that are used by rural people aimed at preserving their forests and other natural resources even when they need firewood. The rural women in Vhembe reported that they have government allocated areas and that each area is allocated to plant trees

that they can use for firewood (HJPA/VD/FNFGDs Vhembe, 2017). They claimed that these plantations are the responsibility of communities benefiting from them and their local traditional leaders oversee the plantations. The study found that in Vhembe, people are encouraged to fetch firewood in forests that are not so close to their homes (HJPA/VD/FGD1 Women 18052017, 2017). The researchers observed that the more distance people walked to fetch firewood the smaller the amount of firewood they can bring home (HJPA/CD/Observation Field Notes Chivi, 2017; HJPA/VD/FN Vhembe, 2017). In Vhembe District they said they are allowed to fetch firewood in the mountainous areas which are far from their villages (HJPA/VD/FGD2 Women 23052017, 2017). This contributes to firewood shortages in the home and though it preserves the forests and reduce the cutting down of trees, it increases the vulnerability of women to dangers and health problems. The idea of creating plantations they can grow trees for firewood is a good potential coping mechanism and it increases the resilience of households if implemented well. The major complaint with these plantations was that the type of trees planted, produce poor wood. Most plantations are gum (*Eucalyptus*) trees and women reported that they give poor fire quality and produce a lot of smoke. There is a need to educate people on the implications of cutting down trees especially the indigenous trees that take longer to grow.

In Zimbabwe's Chivi, though there are governmental agencies that are working for environmental protection, women in this study reported that they had no strategies to protect the environment or the indigenous trees. The official from Environmental Management Agency reported that it was difficult to enforce laws enacted on cutting down of trees. It was not reasonable to enforce stringent measure on rural households without proper alternatives to energy provision (HJPA/CD/Official EMA 20170214, 2017). The use of firewood is most prominent in Chivi District. It is difficult to ban the people from cutting down trees. Most areas in Chivi District are deforested due to the excessive cutting down of trees and still, no effective management strategies have been introduced, or enforced. The official in the ministry of women's affairs alluded that the use of an improved cooking stove may be the best and cheaper solution to promote environmental conservation (HJPA/CD/Official WA 20022017, 2017).

WEF nexus theory promotes the preservation and good management of natural resources and the whole ecosystem. Panarchy identifies the interactions of complexity in the ecosystem of which humans are part. There is a need to promote good management of natural resources including forests to promote the WEF nexus security. According to Bizikova *et al.* (2013:5), the WEF nexus framework pushes for the sustenance of the ecosystems through efficient use of natural resources. The availability of energy resources is fundamental to human wellbeing. The poor management of the environment have a negative impact over the long term on the food security and water supply, especially in the rural areas.

Changing energy consumption patterns

Energy consumption refers to the amount of energy a household uses for a certain activity. Due to challenges these rural households have come up with various strategies to reduce the amount of energy used. The findings indicate that there are similarities in how rural women change energy consumption behaviours in their households. In both areas, they have adjusted their activities to promote efficient use of energy in the home (HJPA/CD/Observation Field Notes Chivi, 2017; HJPA/VD/FN Vhembe, 2017).

In Vhembe District, it emerged that the main sources of energy were electricity and firewood. The major challenges associated with electricity in Vhembe were cost related. Rural women reported that they did not have adequate income to spend on electricity and have access to electricity through the free basic electricity grant provided by the government. This grant is however not adequate for the household energy needs and this changes the manner in which they use their electricity (HJPA/VD/FNFGDs Vhembe, 2017). The study found that they do not use electricity for all energy demanding activities such as cooking, heating, and ironing (HJPA/VD/FNFGDs Vhembe, 2017). This is different from the Zimbabwean context where rural areas do not have access to electricity.

Rural households in Vhembe mostly use firewood for cooking. In order to lessen the burden of firewood collection, households prefer to use instant, precooked and processed foods. They prefer using quick methods of cooking and fast foods (HJPA/VD/FNFGDs Vhembe, 2017). Like Vhembe, rural women in Chivi District make efforts to use as little firewood as possible to cope with challenges of firewood scarcity. Women in Chivi reported that they change their diet and avoid the food that consumes more energy in cooking (HJPA/CD/FGDs Field Notes Chivi, 2017). This coping strategy is in tandem with the coping strategies for water and food where rural households had to change their diets to adapt to the food and water challenges being faced in their respective areas. This shows the inter-linkages in the WEF nexus, the various challenges faced, and the coping strategies employed show the undeniable interlinkages in the WEF nexus. The discussion in both Chapters 4 and 5 show the trade-offs women have to make in order to maintain consistency in terms of the WEF security for their households. The changing of consumption behaviours discussed above shows how women might be trading off good diets to ensure they have enough energy in reserve to remain resilient. These trade-offs have a negative impact on the resilience capacity of the rural households.

Multiple energy use and fuel switching

The use of multiple energy sources and switching between fuels were reported as a coping strategy for energy in both Chivi and Vhembe (HJPA/CD/Observation Field Notes Chivi, 2017;

HJPA/VD/FN Vhembe, 2017). Multiple energy uses refers to the way rural households use varied energy sources to meet their energy needs. According to Masera *et al.* (2000:2085), the use of multiple fuels in the home enables households to improve on energy security and exploit advantages offered by each source. The use of multiple fuels is however influenced by factors such as cost, availability, and accessibility of fuel sources, choice and preferences of people and the needs for energy sources. Rural women in Vhembe District showed that they preferred new and modern sources of energy (HJPA/VD/FNFGDs Vhembe, 2017). The women in Vhembe reported using firewood for cooking and electricity for lighting. Alternatively, they use candles for lighting when they do not have electricity (HJPA/VD/FNFGDs Vhembe, 2017).

In contrast, the women in Chivi had a variety of fuels to either adapt or cope with energy challenges. The use of biomass, firewood, and kerosene was reported for cooking and heating (HJPA/CD/FGDs Field Notes Chivi, 2017). The use of these was subject to availability since biomass fuels used is from crop residue. The women constantly switch sources and use the energy sources simultaneously at times, depending on the availability (HJPA/CD/FGDs Field Notes Chivi, 2017). One household reported the use of kerosene for cooking. It was subject to market availability and the availability of funds to purchase it (HJPA/CD/W2 04022017 Interview, 2017). Rural women reported that the use of multiple fuels even for lighting has made it possible for their households to cope with energy shortages in their households.

Multiple uses of energy sources in rural households is a coping strategy that can be improved to increase households' capacity to face energy scarcity in the home. It shows the capacity of households to come up with innovative and resilient strategies to ensure they have sufficient energy for their needs. Building resilience is focused on coming up with coping strategies that promote the efficient use of resources available to a household to maintain its status. Due to the costs related to modern, clean and smart energy sources, rural women in both areas find it difficult to acquire them for their energy needs. The use of modern energy sources is influenced by household income and promoting sustainable livelihoods for rural women. The WEF nexus security for households is grounded on availability, improved access, utilisation and stability of supply for all WEF elements.

Fuel preservation

Rural women in Chivi and Vhembe reduce household energy by using energy preservation strategies. The study found that rural women take various actions to preserve the energy available to them (HJPA/CD/Observation Field Notes Chivi, 2017; HJPA/VD/FN Vhembe, 2017). In Chivi, the study found that strategies included: putting out the fire after use; making use of the remaining charcoal after putting out fire to warm places; using cold water for bathing; warming their water for bathing using direct sunlight; using little firewood at the same time; and reducing the number

of times they cook (HJPA/CD/FGDs Field Notes Chivi, 2017). In Vhembe District, the study found local people do not have firewood conservation strategies. Women believe firewood is a free commodity and you can use as much as you can collect. Women have devised a strategy to collect firewood in groups to reduce the risks of rape and robbery (HJPA/VD/FNFGDs Vhembe, 2017).

Energy conservation strategies were mainly implemented for saving electricity only in Vhembe District (HJPA/VD/FNFGDs Vhembe, 2017). Rural women reported that they have the means of making sure the electricity grants they receive will last until they receive the next government payment. Strategies used include not using electricity for cooking, heating, and ironing. Electricity in these households is reserved for lighting, entertainment, and other low energy consumption needs. Few households in Vhembe District, reported using electricity for cooking in an emergency. Conservation coping strategies in Vhembe included switching off unused lights in the house and using fire for warming up spaces to the extent that they prefer sitting around the fire for warmth during winter until it is time to sleep (HJPA/VD/FNFGDs Vhembe, 2017).

Differences in the needs to preserve energy is evident amongst Zimbabwean and South African rural women. The fact is that in Vhembe, though firewood may be a problem, it is not yet as bad as the situation in Chivi District. Rural women in Vhembe have the advantage of government initiatives to promote energy security such as tree plantations, free basic electricity, and subsidies for other fuels, which rural women in Chivi District do not have. Rural households in Vhembe are better positioned than those in Chivi. It was observed in this study that in Vhembe, rural women made choices of energy sources they need to use, unlike the women in Chivi who use anything available to cope with their energy needs in the home. One woman in Chivi reported that:

Due to excessive cutting down of trees, there is no supply of dry wood in the forest, forcing women to use the still damp wood for cooking. This damp wood produces a lot of smoke leading to eye diseases, chest problems, headaches and other health problems (HJPA/VD/W8 03062017 Interview, 2017).

This explains the vulnerability of women in Chivi District and the need to build on their livelihoods, which will enable them to choose smarter and clean energy sources. The WEF nexus promotes the efficient use of energy sources, energy saving, and good environmental management to reduce damage to the ecosystem. The importance of energy in the WEF nexus at the household level cannot be undermined and the way rural women deal with energy challenges influence food security for them. In this instance, women have to change their dietary patterns and avoid some type of food to preserve energy which compromise their health, nutrition and general wellbeing. An understanding of social ecological systems and the manner in which elements are interlinked is important in the achievement of WEF nexus security, especially for rural people and women in

particular. Fuel preservation is important to maintain available resources and promote sustainability.

6.6 An assessment of the WEF nexus and resilience in Chivi and Vhembe districts

Chapters 4 and 5 provided a situational description of the WEF nexus security in rural areas respectively in Chivi and Vhembe districts. The WEF nexus theory guides an understanding of the relations among the three critical resources and their security. The diversity of these frameworks created for this theory shows the complexity of the WEF nexus. The literature studied showed that frameworks formulated mainly guide policy making, and resource management at institutional levels. WEF security challenges and risks are not only affecting countries and regions, e.g. southern Africa, the security challenges are ever-present in local communities and rural households. Chapter 2 gave a comprehensive analysis of the WEF nexus theory and its applicability on households and community level. The available WEF nexus frameworks that have been formulated by various scholars and organisations fail to address the problems experienced at local community and household level (Allan *et al.*, 2015:309; Bazilian *et al.*, 2011:7900; Bizikova *et al.*, 2013:7; FAO, 2014:7). Some scholars have made modifications to the theory to enable its application to their related studies (Biggs *et al.*, 2015:392; Foran, 2015:657; Gain *et al.*, 2015:896; Gulati *et al.*, 2013:151).

This study is an exploration of rural households' WEF nexus challenges as well as the coping strategies for survival that people use. To fully understand the challenges related to WEF nexus security and coping, the study contemplatively takes note of resilience. Like the WEF nexus security, resilience is a broad-spectrum phenomenon with a number of frameworks. The components of resilience are mainly the challenges/threats faced, the responses/coping strategies and the adaptation to prevailing situations. The resilience of households to WEF nexus resources challenges in this study, is regarded in panarchy cycles which pursue an understanding of interrelations and interactions occurring in complex systems. The combination of the WEF nexus and resilience was to enable the exploration of challenges, responses and how households adapt to insecurities (see Chapter 2). Panarchy cycles in resilience promote an understanding of challenges faced and how responses can help in building resilience or increasing the vulnerability of systems.

In this chapter, the discussion provided a synthesis of the perception of rural-based people on the challenges threatening WEF nexus security in both case studies. The livelihoods of people were discussed, livelihoods are ways in which rural people access resources to provide their basic needs (Aasoglenang & Bonye, 2013:141). The research found that livelihoods influence the responses and coping strategies rural women formulate to deal with WEF nexus challenges. The

livelihoods options available in both case studies are not reliable and sustainable avenues to promote WEF nexus security in rural areas (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). There is an undeniable link between livelihoods and the WEF nexus security. Livelihoods are, for example, a source of income which can be used to purchase food, energy and pay rates, or even secure service delivery for water. Livelihoods can be direct sources of food and energy such as agriculture, where crops harvested can be used for consumption and crop residue can be used for fire. Livelihoods can promote resilient pathways to cope with challenges by providing avenues for asset building and household income savings. Livelihoods are a broad spectrum which includes having: financial capital (loans, banks, credits); natural capital (land, water bodies, and environment); social capital (safety nets, community support systems); human capital (labour); and political capital (governance, policies and leadership, public service delivery) (Aasoglenang & Bonye, 2013:141).

Looking at the availability of capitals in Chivi District, the study observed that rural communities are more vulnerable than in Vhembe District. Livelihood opportunities suggest that women in Zimbabwe rely more on farming livelihood options even when they reported suffering from prolonged droughts and cyclones that make farming difficult (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). The reliance on other types of agriculture such as small livestock keeping and gardening shows that options for diversification are limited. Women in Chivi reported they do not have access to financial capital which enable them to diversify. Furthermore, the increasing number of NGOs funding humanitarian projects for poverty alleviation and rural development, which are operating in the district signals poverty, insecurity, and vulnerability (HJPA/CD/FGDs Field Notes Chivi, 2017). In contrast to Chivi, Vhembe District rural women testified that the governmental interventions given in grants to people promote livelihood diversification. These grants have become an important source of income; women reported that it has led to large families and early pregnancies in some families (HJPA/VD/FNFGDs Vhembe, 2017).

Challenges faced by women in both Chivi and Vhembe can be alleviated by livelihoods for income generation to fund costs related to coping strategies. It shows that the wellbeing, economic growth, and development of households is reliant on accessibility of WEF nexus component resources. Food provides a source of income through provision of physical energy to work when consumed and when selling agricultural produce. Energy contributes to income generation as well as household consumption. Water forms the foundation of household consumption and livelihoods activities. Coping strategies form the base of the women's understanding of the causes/drivers of WEF nexus insecurity.

The backdrop of WEF security is promoted by access to resources. From the literature and empirical findings, it is evident that the availability of resources does not translate to household security. The most important factor to consider is the accessibility of the available resources by all people. Accessibility to resources is a broad area of concentration. Factors that promote access to resources include good governance and policies, household income, availability of resources, good climatic conditions, adequate infrastructure, capital and empowering socio-cultural norms. The study determined that in rural areas the absence of some of the above-mentioned factors are causing challenges in accessing WEF nexus resources for households in the rural areas. The differences in the coping strategies that households employed are based on these factors that influence access to resources.

Rural women in Chivi and Vhembe have poor accesses to WEF nexus resources and various factors are affecting the security of these elements within households (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). It is evident the nexus, more than often leads to states of collapse and gradual regeneration. Rural women, aware of the potential threats, therefore come up with coping strategies to resist or adapt to the challenges they face. These coping strategies are ways in which households avoid life-changing problems by relying on their ability to continue functioning and maintain their chosen way of life. The ability to remain, to stand and maintain the original structure and functions after facing life-changing challenges is resilience. Household resilience can either be a goal or an achievement after facing challenges, or it can be viewed as an intellectual capacity that enables social ecological systems to withstand severe stresses.

The concept of panarchy is a lens with which to view the interactions that occur across the scale of human and ecological interactions (Cosens & Gunderson, 2018:5). It creates an enabling environment for our understanding of how humans interact with the environment in the need for food, water, and energy. The increasing risk of WEF nexus insecurity and the need for intervention and coping measures to survive, have a negative impact on the environment which can lead to even more serious challenges in the future. The study found that in both Chivi and Vhembe, there is an excessive degree of exploitation of trees due to the rising demand for firewood both for household consumption and for sale to raise income (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). The prevalent unpredictable conditions of climate change causing frequent droughts and intermittent cyclones indirectly contribute to the clearing of land for farming. Population increase in both areas contributes to rising demand on the WEF resources in the rural areas. Women in FGDs in both Chivi and Vhembe, confirmed that in most villages the demand for land both for settlement and farming was on the rise (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017).

Panarchy includes the bottom of the pyramid, the individuals in societies and the smallest organisms in the ecological systems which promote resilience (Cosens & Gunderson, 2018:5). It allows to explore roles of women, the interactions of societies with the environment and governance systems that influence use and access of ecological resources. This study shows by use of a diagram the likely WEF security trends and causal links emanating from not having access to WEF resources. The diagram in Figure 6.1 sums up the impact of WEF insecurity on households.

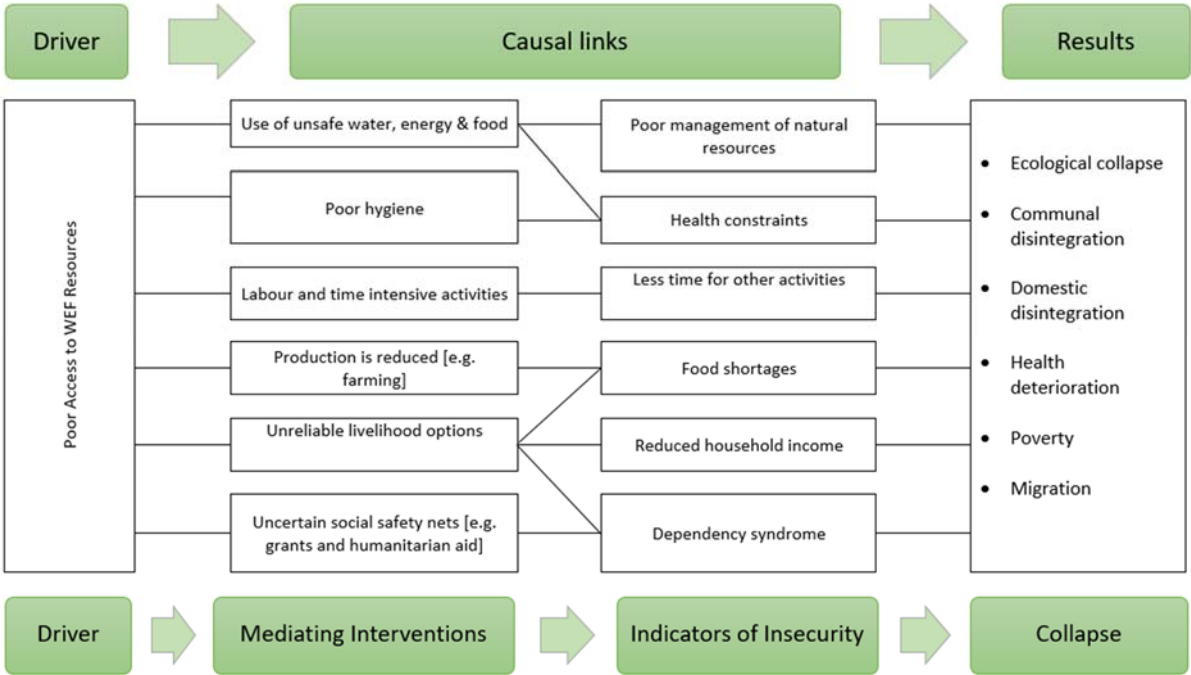


Figure 6.1: Causal pathways and effects of poor access to WEF nexus in rural communities

The diagram provides a visual representation of the probable processes that occur when rural households have poor access to WEF resources. It shows insecurity, challenges, possible actions and impacts on household and the probable results. The diagram is focused on the WEF nexus and was formulated from the impressions derived from empirical findings. The researcher, in interviews, explored WEF nexus security looking at the availability, accessibility, and the utilisation of resources, the challenges faced in rural areas and the coping strategies used to reduce or eradicate the impact. The above comparative discussions of challenges and coping strategies showed that rural households have poor access to WEF resources. The rural women are then forced to form coping strategies to adapt to or resist the impacts of WEF related challenges.

Panarchy suggests that there are two outcomes in any system that faces disruption or challenges. The system may try to resist and adapt to the challenges and survive, or the system may try to adapt and resist but collapse (Benson & Garmestani, 2011:1421; Berkes & Ross, 2016:187; Cosens & Gunderson, 2018:5). All the systems pass through phases of panarchy cycles, but the

end result differs according to the mediating interventions (coping strategies) that may be employed. The panarchy cycles have two major phases: the front loop, which represents growth and accumulation, and the back loop which represents collapse and reorganisation leading to renewal and creation of new systems, or their demise. This study found that rural households pass through phases of destruction and reorganisation in fast and shorter periods which pushes them to be innovative. The study found that each coping strategy they use is ideal until they encounter another challenge. In such scenarios, the system collapses and reorganises itself, coming up with new ways of doing things and inventing strategies that promote their survival. To explain this, women in rural areas have poor access to water resources which are needed for household and livelihood use. To cope with this challenge, they resort to skipping hygiene activities in the home and abandon water-based livelihoods. These coping strategies may alleviate water challenges for a while, but they impact negatively on livelihoods production and food and the general wellbeing of people. Therefore, people have to invent new ways of ensuring availability of water without undermining water supply for their basic needs and health.

The diagram in Figure 6.1 explains how poor access to WEF resources lead households to:

- Use unsafe sources of elements such as open sources of water, energy sources that are highly pollutant and rely on inferior products for foods.
- Indulge in poor hygiene and unhealthy actions in the home like skipping baths and household hygiene chores, skipping meals or using poor cooking methods, use of biomass fuels that produce lots of smoke and dust.
- Put more time and labour in the activities they do such as wood and water collection.
- Reducing farming plots and abandoning water and energy-intensive projects such as brickmaking.
- Survive on unreliable livelihoods such as borrowing, begging, seasonal farming (constant drought occurrences and lack of capital for inputs makes it unreliable), remuneration, reduction of WEF consumption patterns and gifts.
- Increase reliance on social security nets (grants) provided for by the governments, NGOs and other humanitarian societies. Rural women in both countries reported that these are not adequate to provide for their household needs and in Vhembe the grants were often not paid out on time, exposing households to increased insecurity.

The use of these mediating interventions to cope with WEF insecurity have various effects and impacts on both social (human) systems and their ecosystems. The arrows in the diagram in Figure 6.1 shows the impact of each mediating intervention. The impact of each mediating intervention indicates the security status of systems. These are indicators of insecurity in a system as found in both Chivi and Vhembe district households.

The indicators of insecurity, according to this study, show that communities, households, and individuals will have:

- Poor management of natural resources such as excessive cutting out of trees for firewood, poor collection of wild foods, clearing land for agriculture, deforestation leads to the river and dam siltation, infertility of soils by exposure and disruption of natural ecological cycles.
- Health constraints through exposure to poor quality and hazardous water, energy and food resources and skipping of necessary household hygienic chores.
- Less time for other activities, either for production or income generation, by spending more time and energy on firewood and water collection.
- Food shortages are encountered when production is low. Culminating in households having less income for food and having poor yields in farming.
- Reduced household income due to unreliable livelihood options exacerbates WEF insecurity.
- It creates a dependency syndrome, where people are reluctant to find their own solutions and look up to the government and NGOs for solutions.

In Vhembe social grants have created a dependency syndrome where rural people think the government must do things for them. Rural people in Vhembe blame the government either for their problems, or for not coming up with a viable solution. The reluctance of rural people to innovatively look for solutions is influenced by modernity. Rural women in Vhembe reported that they do not resort to some traditional ways of doing things to survive because they regard those actions as backward and outdated. In Vhembe the use of wild foods was interpreted as an extreme sign of poverty, while digging wells was not popular because the people lacked the know-how and it required a lot of physical energy. In Chivi, the prolonged operations of NGOs have created a dependency where some households have abandoned working and farming and rely on the donations that are provided to them. In Chivi District, NGOs tried to curb this dependency by moving from giving people donations to teaching them how to produce, even providing the necessary infrastructure in some cases. However, the interviews with officials in Chivi, exposed that these projects only functioned during the project tenure and women either use all the income capital afterwards or they just abandon the projects when forced to cater for the costs of the project such as repair of infrastructure. This shows that in both areas there is a dependency syndrome on social safety nets.

From this perspective, these indicators of insecurity lead to the collapse of the system (Ω). These results lead to:

- Ecological collapse where forests are destroyed, the environmental capacity to produce food and other organisms is altered, diminishing WEF resource base due to over-exploitation. In both case studies women reported that they used to harvest mopani worms when in a season (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FGD2 Women 23052017, 2017). However, over the years the resource base for mopani worms has been diminishing due to cutting down of mopani trees for firewood. In Chivi District, women reported that mopani trees have the best firewood, arguing that the firewood lasts longer (HJPA/CD/FGDs Field Notes Chivi, 2017). This has made mopani worms unavailable in both areas. Wild foods and vegetables can be used for food and medicine in times of crisis. Similarly, in both case studies the clearing of land and cutting down of trees has made some vegetables, insects, and fruits to be non-existent.
- Communal disintegration occurs due to WEF insecurity in an area. Families and households choose to abandon the place to go and settle in other areas. Community knowledge and ways of facing challenges may be lost when some people move away. The community togetherness in solving challenges for the WEF nexus security become a challenge. In Chivi, the women reported team working in farming activities such as weeding, ploughing, and harvesting and shelling of crops, this teamwork known as *nhimbe*. Families would come together and work in one family's field without being paid. However, over the years the use of *nhimbe* has decreased in popularity due to changing circumstances in the communities (HJPA/CD/Observation Field Notes Chivi, 2017). In Vhembe they reported that they do not have much of these community initiatives since they relied more on purchasing most of their WEF nexus resources (HJPA/VD/FNFGDs Vhembe, 2017);
- Household disintegration is a result of WEF nexus insecurity. In this study, the majority of households reported that due to WEF nexus insecurity families do not always stay together. Common in both areas the study found that men and some youths leave the villages to go and settle in nearby towns and cities (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FGD2 Women 23052017, 2017). This has altered the family units. Women become household heads in the absence of their men. In Chivi District, wealthier relatives take children to care for them to ease the burden on parents in poor households (HJPA/CD/Observation Field Notes Chivi, 2017). In Vhembe, the result is the degradation of marriage and family values. Women in Vhembe reported that values for marriage have

been destroyed since most children grow up in family units where the father may not be staying with them (HJPA/VD/FNFGDs Vhembe, 2017).

- Health deterioration is a risk when households face WEF insecurity. This may be caused by the use of inferior, unclean and unreliable sources. Use of poor unclean water sources cause water-borne diseases such as typhoid. Lack of proper sources of water lead to poor hygiene in the home and can cause cholera. The use of poor sources of energy lead to lung and eye-related diseases. Poor food sources lead to malnutrition and poor immune systems. Thus, WEF nexus security contributes to household wellbeing and survival.
- Migration, the community may experience extensive migration of able-bodied people to other areas in search of greener pastures. Migration trends may be permanent or temporary. In Chivi District, the communities experienced migration of people during the land reform era. Over the years, the district has suffered from continuous droughts and the effects were exacerbated by the poor state of the economy. Land reform in Zimbabwe created opportunities for poor households to own land in places where land was conducive for farming. Most families with younger able-bodied members migrated to farms that were up for occupation which the communities termed *KuManyengerano* (meaning that these young families were influencing each other to relocate) (HJPA/CD/FGDs Field Notes Chivi, 2017). In Vhembe the relocation of younger families to urban areas was a distinct feature in some households. The researcher observed that the communities had a high population of women and children. The women reported that most men had migrated to urban areas in search of jobs.
- The poverty status of households will increase due to WEF insecurity. Having poor access to water resources negatively affects the livelihoods of rural people. Most livelihood options for rural people are water-based and water insecurity leads to poor household income. Rural women's vulnerability is exacerbated by poor access to productive resources such as land, which hinders their capacity to produce. This study found that households in the rural areas in both Chivi and Vhembe are vulnerable to poverty due to poor livelihoods and income generating activities in their households.

Rural women in both cases, stressed that the challenges they face in terms of WEF nexus security are not static. They change constantly, from a lack of adequate rainfall, the breakdown of water infrastructure, rising costs related to food and energy resources and the lack of adequate social support services (HJPA/CD/FGDs Field Notes Chivi, 2017; HJPA/VD/FNFGDs Vhembe, 2017). These challenges change or intensify over time pushing systems to reorganise themselves and come up with other coping strategies and innovations.

If these coping strategies are good these systems recover. There is a tendency to remember past events and measures are taken to thrive again; and build on the local knowledge base and create opportunities for growth. The panarchy phase will then shift from beginnings (α alpha), to recovery (r) and ultimately, to sustainable development by conserving (K) and being responsive to the available resources in the social ecological system.

The study found that in both areas there is an opportunity for growth and development. The coping strategies for WEF-related challenges showed that women have promising coping strategies that could be upgraded and built on to make them safer, more adaptable to and may even become part of their lifestyles. In Chivi District they practice conservation farming, use drought-resistant crops to cope with water and food shortages and use Tsotso stoves to cope with energy challenges. These strategies can be fully explored and introduced in rural areas of Vhembe with appropriate technology to make them viable. In South Africa, women showed they have community-saving groups for food challenges which can be built on in a manner that rural women can practice it. Community initiatives and togetherness should be promoted such that they fight challenges as a team than individuals.

This study perceives that promoting access to resources promote WEF nexus security for households. It is imperative to promote access to WEF nexus resources if there is a need to promote the empowerment of rural women, household security, and sustainable development.

Increased access promotes various factors in households such as sustainability of livelihoods, increase household income through agriculture and other livelihoods activities, it provides pathways of creating good coping strategies that promote environmental stability and use. Figure 6.2 provides a contrast to the above diagram (Figure 6.1) showing why rural women's access to WEF nexus resources should be promoted. Increased access to WEF resources promotes improvements in water and energy infrastructures, good hygiene practices, increased production, and sustainability of livelihoods and less reliance on social safety nets. Indicators of security will include good resources management, improved overall health, more time for leisure, increased food availability, and increased household income and households and individuals become more self-reliant. Resilience, therefore, will be promoted both as an output and as an input in dealing with challenges. There will be a balanced ecology which can reproduce its resources and can supply the basic ecosystem services, the stability of communities and households will increase, there will be economic growth and development eradicating the effects of poverty, the living standards and wellbeing of people will improve and there will be sustainability for all factors. The diagram in Figure 6.2 shows WEF security trends and the causal links, emanating from increasing access to WEF nexus resources on households and communities at large.

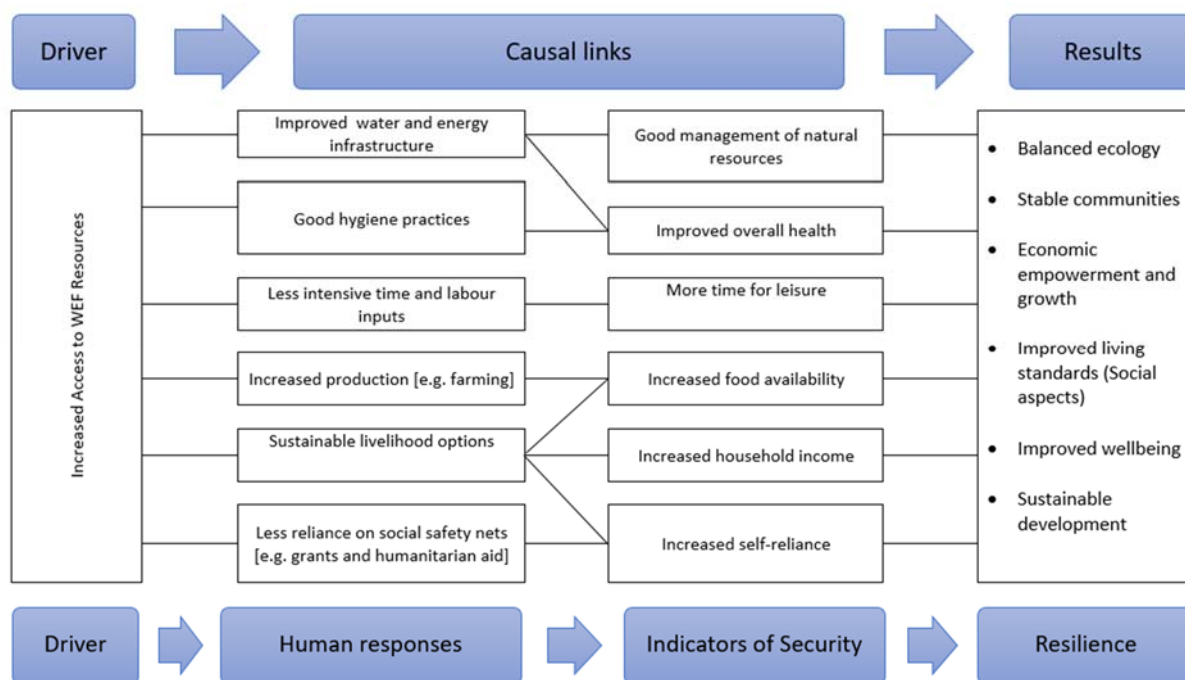


Figure 6.2: Causal pathways and effects of increased access to WEF nexus in rural communities

The diagram shows (Figure 6.2) that it is imperative that access to resources be improved. There are various ways in which access to resources can be promoted in rural areas. The study asked participants what they think should be done to improve WEF nexus security. Officials in both case studies emphasised increased funding to allow relevant service providers to execute their duties on time. Officials in Vhembe reported that service provision is affected by the lack of funding (HJPA/VD/FN Interviews Officials, 2017). In Chivi District officials reported that on top of no funding to execute projects there is a need to invest in projects that women can work on to raise income (HJPA/CD/FN Interviews Officials, 2017). Women and men in Vhembe called for an increment in the grants which have remained the same amount in the past few years despite increases in food and other commodities' prices (HJPA/VD/FNFGDs Vhembe, 2017). They called for government intervention to eradicate the challenges they were facing by increasing even the grants for energy sources. In Chivi, women and men called for a relaxation of water use rights and policies to allow them to create irrigation schemes closer to rivers, so they can continue with food production through farming (HJPA/CD/FGDs Field Notes Chivi, 2017). They called for government investments in water infrastructure such as a boreholes. Officials in the AGRITEX in Chivi called for promotion of the use of appropriate and improved technologies for WEF nexus (HJPA/CD/Official AGRITEX 20170222, 2017). In both areas, there was a recommendation for government investment to improve on water and energy infrastructure in rural areas and invest in ways that promote environmental conservation through feasible policies.

The new WEF nexus resilience framework proposed in this study to explore resource security and rural women's coping strategies can, potentially, be a successful tool (see Chapter 2). It enabled the research to explore the current WEF nexus status and coping strategies used by combining resilience and WEF nexus theory. Panarchy cycles in resilience enabled the researcher not to view WEF nexus events and occurrences in a linear format but rather as cyclical. There is constant evolution and reorganisation, remembrance of past events, coping and adapting, conservation and exploitation of resources and challenges that lead to collapse, downfalls, and threats pushing people to respond in order to survive. The study found that there is an on-going process of facing challenges and responding to them which make resilience patterns cyclical than a linear format. Panarchy helped to assess the interactions between human and ecological systems, the relationship between WEF elements and the impact of coping strategies. It emerged that the resilience of rural households in this stage occurs in smaller and faster cycles due to multiple challenges faced in the WEF nexus. Coping strategies they use can be used to recover, to reorganise themselves, as well as to conserve the available resources. In the case of these two case studies, it is difficult to categorise communities according to stages in the panarchy cycle. However, it clearly shows that communities in Chivi and Vhembe are constantly and rapidly going through the phases of panarchy. This calls for the formulation of strategies that create stability, promote good resource management and create pathways and opportunities that foster economic and social development of rural households.

6.7 Conclusion

This chapter compared the two case studies of Chivi and Vhembe districts. The chapter gave an exposition of the similarities and the differences of the case study areas, explored the roles of women in the rural areas, and found that women participated in both productive and reproductive activities. Furthermore, similarities and differences were drawn from the drivers of WEF insecurity, the study found that the majority of challenges faced were similar, except for infrastructural issues. In Vhembe, the people complained about repairs and poor maintenance of infrastructure and in Chivi they complained of not having infrastructure for water and energy. Coping mechanisms used were compared and the possible explanations of them implementing or not adopting a strategy. The study found that these women have coping strategies that can be built on to promote resilience and WEF nexus security for rural households. There is a need for officials working in public sectors to include the views of these people when making policies and devising strategies to counter WEF nexus challenges. In Vhembe the community showed that they did not work together with the public service sectors and lacked knowledge of various avenues of coping with challenges such as conservation farming, community initiatives for irrigations and water sources. This chapter explored the possible trends in the WEF nexus security based on the WEF nexus

resilience model. This model uses panarchy cycles to explain the WEF security and resilience capacities of households in this study. Panarchy fosters the need to remember past experiences and challenges and what systems do to survive. There is a need to build on local strategies in the manner that will ensure the wellbeing of people, promote WEF security in the households and build sustainable livelihoods for rural people. The WEF nexus security for households is promoted by increasing access to resources. This calls for an enabling environment to be created that will promote access to resources for all. The access of households to WEF resources is related to the viability of livelihoods which bring income, good governance and policies, increasing opportunities especially for the poor, increasing investments in the WEF nexus, team work and participation of rural women. Coping strategies of women in this study showed that they need to have a stable source of income, access to productive resources and an empowering environment for participation, which can enable them to improve on their choices of water, energy and food sources. Therefore, there is a need for more research to find innovative measures that incorporate the rural women's perceptions and coping strategies.

CHAPTER SEVEN

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

This study is essentially an exploration of WEF nexus security and coping strategies of women in rural areas in two southern African countries. The case studies were chosen from two areas with similar geographical attributes. The target group was women. However, relevant information was also collected from men and officials working in sectors related to the WEF nexus. This chapter summarises the main conclusions, findings and recommendations of the study. In Chapters three, four and five data was analysed and interpreted thematically. The conclusions are based on the findings of the empirical study.

7.2 Summary

The study is an exploration of the WEF nexus security concept that evolved in the first decade of the new millennium and subsequently gained considerable tractions in the global food, water, energy and environmental sectors. The study is essentially a comparative one dealing with the coping strategies of rural women in Zimbabwe and South Africa and how it features in a WEF nexus context. The particular focus of the study is somewhat different from general WEF nexus security investigations that tend to have a macro (either at the national, international or global context). In this study the focus is thus on the micro context of WEF nexus security. The smallest organisational unit in the study tends to be the rural household, with the housewife at the epicentre of the WEF nexus process playing out against the backdrop of the resilient coping strategies employed adapt to constantly changing social ecological circumstances. It explored the differences and the similarities of the WEF nexus security experiences of women in different geographical locations. There are similarities in the settings, but there are also social and economic dissimilarities. The perceptions of women were used as primary sources due to the role of women as managers of WEF nexus resources within the household. WEF nexus theory aims to promote the understanding of the interactions of resources across all scales. WEF nexus security is a global challenge that is affecting people even at grassroots levels, especially rural women. The study explored the challenges rural women encounter in their households in a WEF nexus security context. The study perceived that the two areas have more commonalities than differences. There are significant similarities in the challenges women experience in their engagements with WEF nexus components.

WEF nexus is an integrative theory that aims to improve our understanding of engagements with water, energy and food – three important resource-related components that are constantly subject to change in our daily lives. Advantages of WEF include: the framework guides an understanding of the relations among the three critical resources and their security; it creates an enabling environment for our understanding of how humans interact with the environment in the need for food, water, and energy; it includes the bottom of the pyramid, the individuals in societies and the smallest organisms in the ecological systems which promote resilience. The framework also allows to explore roles of women, the interactions of humans with the environment and governance systems that influence use and access of ecological resources. Furthermore, it helps in the exploration of WEF nexus security in rural households and challenges related. The framework further provides pathways of creating good coping strategies that promote resilience, environmental stability and good management of resources. It helps to assess the interactions between human and ecological systems, the relationship between WEF elements and the impact of coping strategies. The only disadvantage observed is the lack of a clearly defined model for implementation on various scales. There are a variety of frameworks and models proposed in literature that have been specifically designed for specific contexts, discourses and focuses of studies. This makes it difficult to implement any of the frameworks to specific contexts and has led to remodelling of the existing frameworks to suit the focus of studies. This has also been done in this study which combined WEF nexus and resilience to explore the WEF nexus security and coping strategies of rural women.

Chapter one contextualised WEF nexus security and coping strategies of rural women in Zimbabwe and South Africa. The chapter familiarised the reader with the WEF nexus phenomenon, the challenges that drive resources insecurity and the coping strategies of women within households. The chapter laid out the groundwork of what was likely to be found in the study. The problem statement clearly articulates the perceived challenges, gaps and the need for this study. Chapter 1 contextualises WEF security and the coping strategies of rural women using the WEF nexus theory. It is an introduction to the study as it provides background and context to household water, energy, and food security, problems related to WEF security, and what has been done in South Africa and Zimbabwe in terms of the WEF security nexus.

The chapter sets out the broad methodology adopted in the study. There is an outline of the research methods, objectives, and research questions that guided this study. It is postulated that there is a growing challenge for WEF nexus security globally, regionally as well as nationally. The manner in which a country responds to the WEF nexus has a marked impact on society, down to the level of households, especially in rural areas. The challenges for achieving WEF nexus security on macro levels are exacerbated by the increasing demands for these resources. It is

further compounded by factors, such as population growth, human mobility, economic development, international trade, urbanisation, diversifying diets, cultural and technological changes as well as climate change. These factors are the drivers of a greater demand for WEF nexus components. The effects of these trends have a trickle-down effect, which negatively disturbs the household's levels of resource security.

Faced with WEF nexus security challenges, rural people, in particular women, respond to challenges by coping with the situation caused by varied situations. The women adopt various coping strategies to survive and adapt in a resilient way to the conditions of WEF nexus resource scarcity in the confines of the household. The ability to survive these challenges shows that the typical average household in rural areas is adaptive and resilient. The coping strategies they use could be used as a take-off platform in trying to tackle the challenges of WEF nexus security for households in the rural areas.

Chapter two is an extensive review of WEF nexus theory and security. It explored the applicability of the WEF nexus theory for rural household resource security and coping strategies of women in Zimbabwe and South Africa. The chapter reviews relevant literature on major concepts and themes of this study: the WEF nexus, resources security, drivers of insecurity and coping strategies. Considerable attention was given to studies, both empirical and theoretical, by other scholars working in the field. The chapter provides an analysis of the theoretical and conceptual review of the WEF nexus theory and security in southern Africa. The focus was to examine the essence of the WEF nexus theory and see its applicability for rural household resources security. The chapter also explored the ways in which the WEF nexus theory can be used to explore the coping strategies of rural women by combining it with resilience. The focus on resilience relied on theory related to panarchy and its varied infinite cycles. Resilience is not a linear process, but rather a cyclical process, which catapults systems from one stage to another. The chapter dealt with aspects of WEF nexus theory, its approaches and dynamics, the implementation of the approach, the use of WEF nexus in Southern Africa, and how the approach has been used in various studies by other authors.

The chapter introduced a modified framework to suit this study, WEF nexus resilience, which incorporated resilience and panarchy in the WEF nexus theory to promote a better understanding of resource security, challenges and coping strategies at rural household level. The theory aims to help in the understanding of WEF nexus security at household level. An extensive review of the literature on the WEF nexus, resilience, and sustainable development in dealing with the role of rural women, at the helm of households in southern Africa, was provided. The chapter also gave a review of the literature on the global context of the WEF nexus resources, the issues of WEF security were reviewed individually for each resource. The focus was on the concepts of

each resource, challenges and potential solutions according to literature. The chapter gives a general conclusion to the discussion in the chapter.

Chapter three has examined the characteristics of the case study areas as well as the methodology. Qualitative research design using case studies was used to explore the WEF nexus security and coping strategies of rural women in Zimbabwe and South Africa. The chapter looked at the use of case studies in research. A multiple case study design was used for this study by choosing two areas for comparative purposes. Attention was given to research design and case studies before giving an extensive description of each case study area individually. The chapter described the sampling method used in the study and the characteristics of respondents involved in this study. Ethical considerations were adhered to. There followed a comparative synthesised description of the study population by distinguishing the similarities and dissimilarities in the demographical data of the respondents in Zimbabwe's Chivi and South Africa's Vhembe districts. The chapter described the data dealing with women. They are the primary and main population of the study. Data used in the study included age, marital status, education, household head and composition of the respondents. The data collection tools used included: focus group discussions, in-depth interviews, and observations made by the researcher. Data analysis was an ongoing process which was done during and after data collection. The data was analysed thematically and presented narratively. Tables, pictures and diagrams were also used to present data.

Chapter 4 explored the current WEF nexus security status of rural households in the Chivi District of the Masvingo Province, Zimbabwe. The chapter is based on both theoretical and empirical evidence found for Chivi District. The data collected were grouped into themes. The chapter gave a background exposition of water, energy and food security in Chivi District as well as the livelihoods available that provide the household with a source of income. The current WEF nexus security was given based on the perceptions of respondents (women, men, and officials) in this study. An extensive exposition was given for water, energy and food security using the themes of availability, accessibility, challenges faced, and the coping strategies used to adapt or survive unpleasant situations. The coping mechanisms were identified and reported on individually for each WEF nexus sector. This enabled the researcher to comprehensively explore how women interact with the WEF nexus resources and deal with challenges.

Chapter 5 explored current WEF security nexus status of rural households in the Vhembe District of the Limpopo Province, South Africa. The chapter provided a working model of the current WEF security nexus in rural households in South Africa. A general background was given of the WEF security situation of Vhembe District using relevant literature and empirical evidence. It examined WEF nexus security using the same themes as was the case in Chivi District. The interactions of the WEF nexus in the rural household were explained. This chapter gave a presentation of

findings on the current WEF nexus situation in Vhembe District. The challenges faced by women in this area were discussed for each individual category, similarly to what had been done in the case of the Chivi focus of the study. The coping strategies used for the security of each of the WEF nexus resource security elements were discussed. The in-depth understanding of the current WEF nexus security situation was drawn from the perceptions of rural women, men, and municipal officials.

Chapter 6 provided a comparative analysis of the coping strategies of rural women for water, energy and food security. This chapter compared the two case studies of Chivi and Vhembe districts. The comparison was based on the findings of the study in Chapters 4 and 5 on the coping strategies of rural women. The chapter compared the major causes and challenges faced by women in dealing with WEF nexus issues, looking at the similarities and differences that occur across households and nations. This chapter explored the possible trends in WEF nexus security based on the modified WEF nexus resilience model. This model uses infinite panarchy cycles in explaining the WEF security and resilience capacities of households in the study. The chapter discussed the role of women in the WEF nexus based on findings from both Chivi and Vhembe before drawing a synthesis. The challenges faced by rural households were discussed before giving a comparative analysis of coping strategies. The chapter also assesses the interactions between the WEF nexus resources and resilience capacities of rural households in Chivi and Vhembe.

7.3 Objectives revisited

This section serves to report on whether the study managed to achieve its objectives. It summarises the whole study showing the objectives and the chapters that addressed these objectives. Summaries on literature and empirical discussions are provided.

Table 7.1: Table summary of objectives, and Chapters

Objective	The chapter addressing the objective	Source of evidence and achievement status of objectives
1. Contextualizing WEF nexus security and coping strategies of rural women in Zimbabwe and South Africa	Chapter 1	Literature Outline of the empirical and theoretical field under investigation in the study. Objective achieved
2. Theorising WEF nexus and resilience in rural Southern Africa	Chapter 2	Literature review. Objective achieved
3. The WEF nexus security status of rural households in the Chivi District of Masvingo Province, Zimbabwe	Chapter 3 and 4	Empirical study, collecting relevant qualitative data. Objective achieved
4. The WEF security nexus status of rural households in the Vhembe District, Limpopo Province, South Africa	Chapter 3 and 5	Empirical study, collecting relevant qualitative data. Objective achieved
5. Comparing the coping strategies of rural women for water, energy and food security	Chapter 3 and 6	Comparative data interpretation and analysis to produce a synthesis of general cross cutting similarities and dissimilarities in the two geographical areas under investigation. Objective achieved
6. Conclusions and recommendations on using the WEF nexus approach to assess the coping strategies of rural women	Chapter 7	Empirical study. Objective achieved

7.3.1 Conclusions from the literature

Chapters 1 and 2 are based on literature reviews which, focused on clarifying the main concepts of the study. These concepts included WEF nexus, security, coping strategies, and resilience. There were also preliminary forays into limited social and geographical information on the areas under investigation in the study.

7.3.1.1 Objective one

Contextualise WEF nexus security and coping strategies of rural women in Zimbabwe and South Africa

The study found that there is a growing challenge for WEF nexus security. In a rural household setting, WEF nexus security is still a huge challenge. Women as managers of water, food, and energy at household level and should be aware of the interactions of these resources and ways to cope with insecurities. The challenges causing WEF nexus insecurity have a negative impact on the lives of people, especially people in the rural areas who do not have improved access to resources and lack access to sustainable livelihoods options. In rural areas, unlike urban areas,

there is a lack of proper channels of communication. Despite the imposing threats of WEF nexus insecurity, people in rural areas continue to survive using various coping strategies. The literature showed that the demand for water, energy, and food is predicted to double by 2030, which poses an insecurity risk globally. It has a marked influence on resilience and the ability of the rural household to adapt and change to changing conditions. Drivers of increased demand globally include increasing populations, urbanisation, climate change, diversifying diets, as well as economic and cultural changes. The increasing demand for resources and risk of insecurity impact negatively on rural households and women as a marginalised group. This calls for innovative approaches to promote good management and resource use. There is also a need to come up with innovative ways of dealing with challenges. This need led to the creation of the nexus approach that emphasises that the security of WEF resources can be achieved by understanding the interactions between the resources at any scale. The guiding theory to explore the WEF security and coping strategies of rural women was the WEF nexus. The WEF nexus is an emergent approach that gained attention because of its integrative capacity for understanding interactions, linkages, synergies, and trade-offs between resource elements. The WEF nexus approach helps stakeholders and individuals at any time seeking to promote security and sustainability of WEF resources. It suggests that stakeholders should look at the linkages and interactions so as not to trade-off security of one resource for another.

7.3.1.2 Objective two

Examine the applicability of the WEF nexus theory to rural households in Southern Africa

Review of literature showed that there is no literature which directly addresses the application of the WEF nexus theory to the household level. The literature showed that WEF nexus theory is popular for promoting resource security, good resource management at the macro level, for creating resilient social ecological systems, equitable and sustainable development, integrated solutions for resource use, and participation of all sectors, stakeholders and individuals irrespective of relative status of wealth. The review of the literature showed that there are different types of models and WEF nexus frameworks created by different organisations and scholars.

WEF nexus frameworks are fashioned depending on the special focus of scholars and organisations. They used the WEF nexus theory in a bid to find solutions and promote the security of one of the nexus resources, such as WEF nexus for energy security, WEF nexus for water security or WEF nexus for food security. This study has focused more on water. It also features a focus on the security of energy and food for rural households. The literature showed that WEF nexus theory has been used to promote natural resources use and management, especially in river basin case studies and regional studies initiatives. Therefore, there is really no consensus

to a single approach or framework for implementation, but there are defined ideas that are used to formulate frameworks implementable to any research related to water, energy and food security. The WEF nexus system can be of use in the formulation of policies and creating interventions at any scale. Some research projects combined WEF nexus theory with other existing frameworks and policies.

For the purposes of this study, the researcher proposed a combination of the WEF nexus and resilience theories to promote its applicability to household's levels. Resilience in this study was explained using panarchy as the base theory. Resilience is viewed as a cyclical process rather than a linear process. The cycles in the resilience process are explained using panarchy cycles that explain the four stages that systems pass through and possible outcomes of coping strategies that may be formulated for challenges. Therefore, during the course of study, the researcher used the three theoretical terms, *WEF nexus* in the understanding of resources availability, accessibility, supply, utilisation, and challenges faced. *Resilience* in explaining the capacity and capability of households and individuals to deal with challenges against all odds, and *panarchy* to explain the infinite responses and possible results of challenges and strategies used to alleviate the negative impact of disturbances. Panarchy is part of resilience and is used to explain the cycle stages of resilience and adaptation to challenges. In resilience, systems (human and ecological) depend on each other. The socio-ecological systems are interlinked and interrelated such that actions humans take to foster resource security lead to instability and insecurity of other ecological systems. Thus, the approach of this study can be implemented at the micro level, to understand and comprehend the views of local people in rural communities.

The *WEF nexus resilience model*, as modified for this study (Chapter 2) also explored the WEF nexus security challenges and coping strategies. This perspective helps to unravel possible pathways to promote sustainable resource use, resilience and sustainable development. The WEF nexus itself is an all-encompassing theory that integrates various concepts and frameworks, therefore, it can be used in a variety of contexts. It is a theory that upholds notions of sustainability, adaptation, and resilience that made it ideal for the purposes of this study in that it allowed for the integration of resilience for implementation at the household level.

An overview was given of the water, energy and food security situation and rural women's access to resources. The literature reviewed showed various coping strategies used by rural people to cope with the challenges of water, energy and food security. However, coping strategies are used to promote the security of one or two WEF resource components influencing negatively on the security of the other resource. Coping strategies have a varied impact on resources security. The literature on the theme suggests that there are common strategies such as behavioural changes

in resource use, changing consumption behaviours and patterns, erecting laws and policies to protect resources and changing diets.

7.3.2 Conclusions from the empirical research

Empirical research findings were reported in Chapters 3, 4, 5, and 6. The chapters indicated the qualitative, multiple cases study findings on the methodology followed, the current state of WEF nexus security and the coping strategies used in Zimbabwe and South Africa. The WEF nexus resilience framework model for this study guided the empirical study. The findings are discussed using the set objectives of this study.

7.3.2.1 Objective three

Find the WEF nexus security status of rural households in the Chivi District of Masvingo Province, Zimbabwe

The study established evidence of WEF nexus interactions in the rural households in Chivi District. There is a growing challenge of water, energy, and food for rural households in Chivi District. Water is the major resource and its availability fosters security for both food and energy. Water is important for food production in farming, manufacturing, preparation, hygiene, and sanitation. All of these improve the welfare of local communities and regional societies. Some livelihoods in rural Chivi are extremely depended on water availability such as for farming and gardening. Rural women and households rely on these livelihoods for income generation. Income is important as it gives households purchasing power important to increase access to energy and food resources for households. Water is important in the production of biomass fuels and firewood in the environment. Households in Chivi rely more on firewood for fuel needs. Energy contributes to food security, in production, gathering, conveyance, and preparation. Food is required for providing people with physical energy and wellness to conduct daily activities for WEF security such as water and firewood collection. In addition, households get their biomass energy from agricultural crops.

Water availability in the district is poor which means there is restricted household access to water. Households rely on more than one source of water. Sources include rivers, dams, wells, community boreholes and rainfall. The water infrastructure is poor and limited across the district and most households rely on a poor unsafe source of water. Challenges increasing water insecurity in the district include poor infrastructure for water supply, lack of financial capital to cover costs of maintaining, installing infrastructure, erratic seasonal climatic change. Access to water in this district is poor. The study found that infrastructure for water supply is not available and or accessible to all households. The natural sources of water are seasonal. The available

rivers and dams are far from homesteads, some women walk up to five kilometres to fetch water. This has led to water scarcity for households and livelihoods. The scarcity of water shortages and insecurity have a negative impact on food security especially on farming. Water is also a prominent input in most rural livelihoods that contribute to household income. Income enables households to have the power to buy both food and energy sources for household needs. The scarcity of water leads to reduced standards of living. Women have to settle for low quality food and energy sources.

Food security is a challenge for most households in the district. Households face food scarcity and shortages. The study found that households in Chivi mainly depend on the season, subsistence farming, gardening, food aid and food purchasing. Access to food for rural households in Chivi is limited by distance to markets, costs of transportation, poor household income and poor access to productive resources such as water, land, capital, and labour. Livelihoods provide people with the means to procure food and raise income, which can increase the access to food supplies through purchasing. However, the available options for livelihood in the district are unsustainable which reduces the stability of food supply in most households. To cope with food insecurity, rural people rely on changing their food consumption patterns, food aid, the use of wild products, saving food for the children, and borrowing, diversifying livelihoods and crops grown, selling household accumulated asset and migration of family members.

Energy is an important aspect for the everyday survival of people. Energy is expended for cooking, lighting, heating and warming up spaces in the home. It is also used in accelerating, transportation and communication, and processing of goods and services needed by people. Energy sources include both fuels and physical energy form of food for people to conduct everyday chores such as fetching firewood and water. In Chivi, households rely on firewood and biomass fuels for cooking, lighting, and heating. Some livelihood or income generating projects require energy for, pumping water in irrigation gardens and transportation of finished products and yields to markets. The demand for firewood ranks high in the district. The demand for firewood in the home has led to excessive cutting down of trees. Tree felling has a bearing on environmental stability and leads to desertification. Women are compelled to travel long distances for firewood. Alternative sources of energy such as LP gas, electricity and solar are too expensive. In order to cope, people resort to strategies such as preserving the available energy supplies, changing consumption patterns, using multiple energy sources and fuel switching depending on what is available or accessible at a particular time, exercising forest conservation and management and adopting improved firewood cooking stoves to reduce firewood consumption.

The WEF nexus security coping mechanisms found in this study for each resource element have an impact on the other. Women use changing diets and consumption patterns to promote

resource security for all WEF nexus elements. Poor access to modern energy limits rural households' access to both food and water resources. Coping strategies showed trade-offs of one resource for the other. To cope with water shortages, women opt to reduce water-based activities, for energy insecurity women choose to reduce high energy consuming activities, both have an impact on food security and the welfare of their households. Coping strategies are not sustainable to employ in periods of long-term challenges. There is a need to build on this local (indigenous) knowledge and strategies to empower, adapt and promote the resilience capacity of households.

7.3.2.2 Objective four

Find the WEF security nexus' status of rural households in the Vhembe District, Limpopo Province, South Africa

Rural households in Vhembe District are currently facing challenges of WEF nexus security. The challenges have trajectories in resources availability, accessibility, security of supply and utilisation. The processes for coping and adapting to challenges show that management and securitisation of WEF nexus components cannot be attained in isolation. The study established that the district's economy in the rural areas is depended on the availability of water supply and access. Most rural households still rely on subsistence farming regardless of the challenges causing droughts and low rainfalls. The area relies on groundwater sources for all needs. Though there are catchment management agencies mandated to provide water supply services to all people, there are still some areas that have no, or poor water supply services in the district. Other livelihood options available to these rural people are also water-based (irrigation farming, livestock keeping, and brickmaking). The scarcity of water has had a negative impact on food and energy security. Water scarcity for livelihoods has also forced households to be more reliant on the government's social grants for survival. This has created a dependency and a "government must do everything for us" syndrome, they look towards social security packages from the government for survival. This has exacerbated the vulnerability of rural households to both resource insecurity and poverty. The poor service delivery for water supply has demotivated people who otherwise are keen on working hard to provide for their families. Lack of water and poor supply systems, therefore, reduce the capacity of rural people to produce and implement strategies that promote household access to all the WEF nexus resource elements.

The availability of water in Vhembe is determined by factors such as amounts of rainfalls received, the conditions of water infrastructure, availability of energy for pumping water (most boreholes use diesel or electric pumps), stability in water supply services, availability and accessibility of natural water sources (rivers and springs). Sources of water for domestic uses include boreholes,

rivers, natural springs, water purchasing, water tankers, and irrigation canal water. Domestic needs for water include cooking, drinking, and hygiene purposes. Water stimulates food and energy security for households. Water is vital for agriculture, brickmaking, livestock keeping, gardening and other livelihoods. Household challenges for water security included poor rainfalls, climatic changes and lack of water resources, poor service delivery systems, aging infrastructure, lack of alternative water sources, and resources management challenges. To cope with challenges, households rely on multiple sources for water, community-initiated water connections, water storage to reserve water, water purchase from those individual boreholes, and the water tankers provided by the government supply water to water-stressed areas. For livelihood water-based activities, such as farming, irrigation facilities are available for some people. However, little has been done to promote farming systems in areas without irrigation schemes.

The food security situation of rural households in the parts of Vhembe under investigation in this study (Tshiombo and Gombani areas) is poor. The main sources of food for rural households included seasonal farming, irrigation farming, and food purchasing and potential altruistic sources, such as food in the form of gifts. Access to food is determined by various factors such as distance to markets and pricing of food commodities. The factor that improve access to food is the development of sustainable livelihoods, which build household resources and provide income for food purchasing. To cope with food insecurity challenges, local residents: change their food consumption behaviours and patterns; borrow food and money from neighbours and friends; use inferior food products; diversify their income generating activities; and implement saving schemes.

Like water and food, the energy security of households is based on availability, improved access and adequate supply of the resource. In Vhembe, the study established, electrical energy supply infrastructure was available for rural households. However, the use of firewood for cooking was prominent. Households rely mainly on electricity for lighting and use of other sources such as solar energy. The use of gas is not prominent. The costs of appliances for both solar and gas energy use and purchasing LPG limit their intrinsic value in rural Vhembe. The use of electricity is prompted by the free basic electricity grant provided for poor households in the rural areas. Firewood is collected from nearby forests. Other sources of energy, such as kerosene, and biomass fuels, such as crop residues, were not used because of the high rate of pollution they cause. Challenges limiting access to energy sources included the costs of energy supplies, distances from markets, cost of appliances, and poor livelihoods options. Sustainable livelihoods promote an increase in household income and expenditure on energy sources. To cope with energy challenges, rural people resort to energy saving strategies. They practice multiple energy

uses, for instance fuel switching, and try environmental management and conservation strategies, such as planting trees in designated areas, which can be used for firewood.

The WEF nexus linkages are present from the availability, access, and utilisation of resources in the rural households. Access to energy resources promotes access to water and food resources. It is used directly for pumping water, transporting food to and from markets and indirectly human energy is used to work in fields and in water collection from water sources. Food resources and productive activities contribute to wellness, health, and an increase in household income that contributes to household access to water and energy resources through improved income and livelihood.

Inter-linkages in coping strategies suggest that coping strategies for one resource influences the security of other resources or lead to potential risks. Water security coping strategies expand food security, which in turn improves energy and the household capacity to access and afford energy resources. The demand for firewood leads to deforestation effecting negatively water security by erosion and siltation of open sources of water. The continual cutting down of trees leads to poor soil structures affecting harvests, and the availability of wild and natural food resources.

7.3.2.3 Objective five

Compare the coping strategies of rural women to WEF security in Zimbabwe and South Africa

The study found that women in both case studies, Chivi and Vhembe districts, participated in the productive and reproductive roles in the household. Women are responsible for the management of WEF nexus resources in the household. They similarly employ coping strategies to promote household WEF security. In all the areas, it was established that women are responsible for caregiving and the welfare of families. The study found women in Chivi and Vhembe districts have limited access to productive resources, mainly constrained by the socio-cultural constructions that uphold patriarchy. The study showed that women in Chivi had more agricultural-based options for livelihood and income generation than women in Vhembe. This could be because rural people in Chivi have no access to social security services such as grants for the poor and pensioners, whilst the government of South Africa provides for grant payouts each month. Women in Vhembe have more avenues for livelihood diversity than in Chivi, which is fostered by stable access to financial capital through the government grants. It allows them to save and invest in small businesses.

The two areas under study showed that households were water insecure. Challenges for water security were mostly similar in Chivi and Vhembe study areas. In both case studies they reported issues related to climate changes, poor water resources, lack of water infrastructure, and distance

to water sources. Differences were noted in Vhembe. People complained about repairs and poor maintenance of infrastructure while in Chivi, they complained of not having the infrastructure for water and energy. The study found that there are water laws that restrict water use by households. In Vhembe, households are restricted from using dam water for household consumption, in contrast to Chivi, where small dams built in various places are made available for livelihoods and domestic consumption. In both areas, the use of dam water for irrigation and the extraction of water for irrigation are regulated by the government. Proper procedures should be adhered to in order to acquire relevant permission. Both case studies showed that there are no reliable water supply services for household needs. To cope with water shortages women in both case studies employ coping strategies either to alleviate short-term challenges or to adapt to the ongoing situation. In both areas, the study noted that women tend to resort to similar broad strategies but differ in implementation or actions taken. To cope with water issues, women in the rural areas often resort to water conservation through multiple uses of water; water harvesting and storage; use of unprotected sources of water such as rivers and springs and hand dug wells; changing water use behaviours and patterns by rationing and reducing water-based activities. There are also community initiatives that promote access to water including creating local based water laws; digging community wells in Chivi, and local water connections to reduce the distance to water sources in Vhembe. In both areas water is purchased from local individuals who own boreholes. In Vhembe they also have government support through the provision of water tankers, even though, these vehicles may not always be very reliable.

Food insecurity was found to be a challenge for rural households in both Chivi and Vhembe. The major drivers of food insecurity were related to climatic changes that affected amounts of rainfalls received each farming season. Droughts have also become common in both areas, causing households to produce less and less in farming. Rural households in both areas depend mainly on agriculture as their main livelihood option and source of food. The changing climatic conditions, observed by local people over the years, have affected yields, soil conditions, environmental structures and prevented households from producing food. Other alternative livelihood options for rural people are affected by external factors. These factors include lack of access to productive resources; lack of access to capital to diversify; and socially constructed norms of patriarchal societies are not so conducive to empower women. In Chivi District, there is an absence of markets and shopping centres that provide households with reliable and fresh food supplies. The prices of food are reportedly increasingly making most households vulnerable to food insecurity. Most of rural areas in Chivi are far from growth points and have unreliable transport systems. In Vhembe they have good markets and shopping centres that provide fresh produce. However, local women argued that the distance and the increasing food prices were problematic. Ultimately it reduces access to food. To cope with these challenges, rural women change food consumption

patterns, use inferior and cheap products, sell household assets, and temporarily migrate to other places. Rural households in Chivi District rely on food aid and the NGO funded income-generating projects. They practise crop diversification. A few households even do conservation farming. In Vhembe, they rely on government social grants to practise community or group saving schemes (*Chiseve-seve/stokvels*). Few households in Chivi reserve food for children, however, this is an extreme coping strategy used in severe food shortage cases, where rationing will not help to alleviate the problem. In contrast, in Vhembe they preferred using cheap food even if it may be unhealthy.

Energy insecurity is a challenge for rural households in Chivi and Vhembe districts. In Chivi District, people do not have access to electrical energy, which is a cleaner and healthier source of energy, whilst in Vhembe, people complained about the costs related to clean energy sources (electricity). In both case studies, rural households rely on firewood for cooking, heating and sometimes lighting. Whilst in Vhembe the government has made electricity available to households, in Chivi they have no access to electrical energy. In both areas, women find it difficult to purchase smart energy alternatives to electricity such as solar energy and gas (LPG or biogas). They face scarcities of firewood. The excessive cutting down of trees without replacement has depleted environmental reserves. Women now have to walk long distances and spend a lot of time fetching firewood. The increasing prices of fuels lead to reduced access to markets because of transport costs. It also reduces access to water from those boreholes using diesel pumps. The costs of appliances and infrastructure related to smart energy sources are too high, hindering access and stability of supply for most households. To cope with the challenges, rural women in both areas similarly changed their household energy consumption patterns and behaviours; have multiple energy uses and switch between fuels available to them; they also preserve the available energy to last longer. In Chivi there is a switch to more energy efficient stoves that require less firewood, whereas in Vhembe they still use open plan traditional fireplaces. In Vhembe, the government has encouraged communities to have tree plantations where they grow trees for firewood in order to conserve and manage the environment very well.

The achievement of WEF nexus security can be promoted by increasing access to resources. This will improve a balanced ecology, stable societies and communities, economic empowerment and growth, better living conditions, improved wellbeing and sustainable development. The increased access to resources especially for rural women promotes household development and family wellbeing. Women as the managers are already taking steps to eradicate the effects of WEF nexus insecurity in their households. These strategies may not be the best and are unsustainable; however, if women are granted adequate access to resources, they might be empowered to make utilitarian decisions that benefit households, communities and even the

countries at large. Coping strategies of women in this study showed that they need to have a stable source of income, access to productive resources and an empowering environment for participation, which can enable them to improve on their choices of water, energy and food sources.

The study found that these coping strategies can be promoted for resilience and WEF nexus security for rural households. The linkages between WEF nexus elements are indubitable. Challenges in one sector negatively influences the other two sectors. WEF nexus is regarded as highly important at global level. It is a prerequisite for security, development and economic growth globally as well as at household level.

7.3.2.4 Objective six

Draw conclusions and make recommendations on using the WEF nexus approach to assess the WEF nexus security and coping strategies of rural women in Zimbabwe and South Africa

The researcher discusses this objective in the subheadings below.

7.3.2.4.1 Overall conclusion

Globally the emergence of the WEF nexus theory was propelled by the rapid growth in populations, changing consumption behaviours, climatic changes, and urbanisation which led to increasing demand for WEF resources. These changes pushed for the need to come with strategies that edify resources management. The WEF nexus theory was designed to respond to this need by integrating the water, energy and food sectors together. The WEF nexus is an inclusive approach that aims at managing the linkages between the water, energy and food resources and achieving multiple goals. The nexus allows for analysis of resources needs, security and opportunities for sustainable resource use and security both at macro and micro levels. The approach is not exclusively water centered like integrated water resource management (IWRM), even though it has gained considerable popularity in the water field. It is an inclusive theory promoting transparency, efficiency, cooperation, participation and equity of all stakeholders in the decision-making processes. The WEF nexus pushes for utilisation and maximisation of synergies while reducing trading off the security of one resource for another. The WEF nexus approach contributes to our understanding of security issues, their availability, accessibility, utilisation and supply. The WEF nexus further informs us on the complexity and challenges that people in rural households encounter at various levels. The approach allows for exploring actions, and innovations to promote security and offer justification for decisions made

at various governance levels and in various social ecological systems. This study was conducted at a micro level, with a special focus on rural communities in Zimbabwe and South Africa.

The study established that water is needed for domestic purposes (drinking, cooking and washing). It is needed for livelihood purposes as most activities are water-based for example agriculture, brickmaking, and gardening. Water availability is constrained by low rainfall, depleting water tables, persistent droughts, and climate change. Access to water is affected by poor service delivery in the rural areas, lack of or poor water infrastructures, costs of purchasing water, vandalism, and theft of water property, poor communications with relevant offices e.g. and red tape measures that hinder efficient service delivery. As a result of water scarcity and poor infrastructure for good water service delivery, people resort to using inferior, unprotected, unsafe and traditional sources of water such as rivers and springs. People in rural areas often lack adequate water for both domestic and livelihood purposes, which increase their vulnerability. Lack of water impacts negatively on energy and food security as it is a major input resource for the achievement of WEF security in rural areas.

Energy is important for domestic uses such as cooking, lighting, and heating, and also for livelihood purposes as pumping water in irrigations, manual jobs, transportation and communication. Rural people use a variety of energy sources for livelihood activities. In agriculture, fuel is used for pumping, processing, and transportation of water and products, firewood for sale and fuel in brickmaking. The availability of energy for rural household consumption in Chivi is mired by a lack of clean energy infrastructure such as for thermal electricity and even solar power. It is also constrained by depleting forests increasing scarcity of firewood. Access to clean energy sources retarded by high costs. People cannot afford to pay. In Vhembe, the government has taken measures to promote access to clean sources of energy by providing energy grants for poor households. These grants are limited, and once depleted, households have to purchase the extra electricity themselves. Households in rural areas showed reliance on firewood. They switch between types of fuel, depending on the availability of energy resources. In Chivi, the use of poor and unclean energy sources is higher than in Vhembe District. The uses for energy are many in rural households and energy shortages have an impact on water and food security.

Food security is dependent on the availability of water and energy for food production and processing. Food is a source of physical energy, which enables rural people to conduct various activities such as fetching firewood and water and jobs such as farming and gardening for survival. Availability of food in rural households is hampered by lack of adequate water for agriculture. The rural areas have been experiencing droughts over the years that have negatively affected agricultural yields. Diversification to other livelihood options was mired by lack of capital,

especially for women. The alternative strategies for farming, e.g. conservation farming, failed to gain popularity in Chivi due to the intensive labour required and lack of proper machinery for implementation whilst in Vhembe the rural communities lacked knowledge of such innovations in agriculture. The poor state of food security in rural areas has led to reliance on humanitarian aid given by NGOs and social welfare department in Zimbabwe, whilst in South Africa, the people demonstrated increased reliance on social grants offered by the government. Access to food is also through food purchasing on the available markets. However, most households have low incomes. They do not have much to spend on food. All these factors increase the vulnerability of rural households to food scarcity.

The major drive of this study was to explore how rural households using the knowledge of women as the managers of resources in the home tackle these challenges. The coping mechanisms of women have so far promoted household resilience to challenges that are faced in the WEF nexus. However, most of these strategies are not sustainable and have negative effects in the end. The coping strategies used lacked continuity in the face of persistent WEF nexus security challenges. The promising strategies like community initiatives to stimulate water and food security need to be promoted and their advantages should be well communicated to all people. The use of a Tsotso stove for energy saving and conservation farming for reduced water use and food security promotes WEF security if rural people are educated and made aware of their advantages. There is a need to build on these coping mechanisms to ensure that they benefit the women as well as to foster development and sustainable resource use. The coping strategies reported included changing consumption patterns, saving, falling back on household assets, relying on social services support and other community inventiveness. The imprints of the stated coping strategies were found in all WEF nexus resources.

WEF security is still a huge challenge for rural households in Chivi and Vhembe District. Coping mechanisms used by households in South Africa exhibited influences of modernisation. Sources of water and energy were chosen based on quality, cleanliness and some traditional sources e.g. hand dug wells and rivers were unpopular and considered either outdated or of poor quality. In contrast, the study found that women in Chivi used whatever sources were available to them without consideration of hygiene or quality. They rely mainly on aid that they accept in whatever form. WEF nexus security challenges in rural areas under study are persistent. Coping strategies used do not always mitigate insecurity. Coping strategies ensure adaptation and enable people to contain challenges related to the WEF nexus security. Resilience provides avenues for WEF security, economic growth, sustainable development and the potential sustainable use of available resources. Resilience also pushes for stability and sustainability of systems for the

future. However, people have to be educated to actively seek resilient alternatives within their existing skill sets of coping with resource scarcity.

This study concludes that the WEF nexus theory is an ideal tool for exploring resources security, challenges and even promoting resilience for households and individuals. The use of resilience and panarchy to complement the guiding WEF nexus theory made it possible to explore coping strategies and views of rural women on the impacts of such strategies. Their ability to adapt and cope inevitably improves over the short and long term. The findings showed that there is an increased demand for resources. WEF nexus resources are stressed due to apparent challenges that have been identified globally. WEF nexus resources are increasingly becoming unavailable for many rural households. Both service providers (government) and consumers should work together to manage available resources for future security and sustainable development. The coping strategies used to eradicate the effects of WEF nexus insecurities are management strategies to promote security, stability, and development for all sectors.

7.3.2.4.2 Recommendations for WEF nexus security

The WEF nexus combines the most important resources for the survival of humans and the ecosystem. WEF nexus security is still a challenge in some rural areas of Zimbabwe and South Africa. The persistent challenges of climate change, population growth, migration and urbanisation have increased the need for understanding of the workings of WEF nexus resources. Attempts to achieve security for water, energy, and food in sectors have failed to yield positive results especially in the case of rural households. The emergence of the WEF nexus framework has provided an avenue for promoting resources security for all sectors across a spectrum of systems. This framework can be implemented at the household level to promote resource use and for achieving WEF security even in the rural areas. This project exploring the WEF nexus security of rural communities and the coping strategies used by women to curb insecurity challenges revealed valuable information of which the recommendations are based.

Promote the use of the WEF nexus approach

The use of the nexus approach for the achievement of WEF security should be promoted across all sectors and systems. The interlinkages and interactions between the resources cannot be ignored or denied. There is a need to understand how actions in one resource affect the security of other resources at all levels. A nexus approach is an all-inclusive approach that speaks to all resource management levels (governments, policymakers, service providers and consumers). The promotion of using WEF nexus theory for resource security should be accompanied by educating both stakeholders and consumers and service providers on the linkages, probable

synergies and trade-offs associated with promoting a better understanding. It may: contribute to better planning; the formulation of good and innovative strategies for resource management; and give rise to sustainable use of resources.

Build on local knowledge in dealing with WEF insecurity challenges

There is a need to build on local strategies in the manner that will ensure the wellbeing of people and promote resilience. The need to learn and remember experiences, challenges, and insecurities and how coping strategies were adopted should be held high. There is a need to collect and build upon local knowledge and resources available for resilience against possible social ecological threats. Rural people have long-standing coping strategies they have used in past times to cope, adapt and overcome negative threats in the face of typical WEF insecurity. These strategies should be value-added to nurture resource security and resilience. There is evidence of existing local (indigenous) knowledge that can be used to good effect in overcoming what appear to be serious obstacles to human livelihoods.

Empower women

Rural women are valuable managers of WEF nexus resources in the home. They need to be empowered. Women should be included in decision-making processes. They should have access to more capacity building to participate in initiatives aimed at promoting resource security, sustainable use, and effective management. There is a need to create an enabling environment in promoting women's access to productive resources. They should also be educated to understand the WEF nexus, synergies, and trade-offs in order for them to make effective and positive decisions when managing resources in the home. They should be made more aware of effectively using and further strengthening their resilient strategies to thrive under circumstances of considerable discomfort e.g. scarcities, shocks and other stresses emanating from WEF nexus insecurity.

Build resilience capacities of systems

There is a need to build on resilience and adaptive capacity of systems in particular rural households and the environment. People should be empowered to be creative and innovative and survive most challenges in their own capacity. The growing of plantations for firewood as revealed in Vhembe should be promoted to reduce deforestation. People should be provided with adequate information in a properly structured manner on the benefits of emerging technologies and strategies such as the improved cooking stoves to reduce wood usage; conservation farming to maximise water use and promote food security; and the use of renewable energy sources for

domestic use. These strategies and technologies may promote resource security and improve resource use in local households.

Increase participation and stakeholder dialogue

There is a need to include all stakeholders when making policies, laws and devising strategies to counter WEF nexus challenges. Interactions between stakeholders, officials, and communities should be improved. Increased communication promotes dialogue and allows people to report their concerns to authorities as well as to work together with officials to promote good management of and resource use. In Vhembe, the community showed that they did not work together with the public service sectors. They lacked knowledge of various avenues of coping with challenges such as conservation farming, community initiatives for irrigations and water sources. This may result in shifting blame for resource insecurity and mismanagement. In Chivi, it showed there was improved stakeholder dialogue and participation of both officials and local people in development initiatives. Working together is important in fostering good management and sustainable use of resources in the face of severe obstacles and challenges. However, the issue of participation still needs to be advocated for and investments should be made to create awareness and disseminating information that may be useful in ensuring WEF security. Educational awareness campaigns should be upheld to equip people with knowledge of actions that increase resource scarcity. Policies and laws should be enforced and adhered to create an environment for development and resource security for the future. Red tape measures that reduce efficiency in service deliveries should be relaxed. All WEF nexus security sector stakeholders should work together to maximise synergies and reduce trade-offs.

Improve and invest in low-cost projects for income generation and consumption

There is a need to promote WEF security in the household by improving and increasing investments in building sustainable livelihoods for rural people. There are projects that are cheap to implement, such as poultry farming. Investors can increase awareness of such projects and help promote resilience by building household capacity to respond to challenges through income generation, asset building, and food production. Projects include those that save both water and energy while producing for income and consumption promote WEF nexus security. Projects where people are required to work may also reduce the dependency on aid and grants and encourage self-reliance for people in the rural areas. Investments to promote WEF nexus security should desist from creating a dependency syndrome in people but should be used to lift communities out of poverty.

Promote community initiatives for WEF security

Community initiatives for water, energy and food security should be encouraged to increase self-reliance and resilience. People, especially in the rural areas, should be empowered to come together and work towards a common goal. Communities should be innovative and creative to devise solutions appropriate for their special cases and challenges. Investments should be channeled towards such community initiatives to act as an incentive for such projects and teamwork. Team building strategies have to be promoted to ensure that people would be able to work together towards the achievement of WEF security, sustainable resources use, and development.

Increase equity in access to resources

The WEF nexus security for households is promoted by increasing access to resources. This calls for an enabling environment to be created that will promote access to resources for all. The access of households to WEF resources is related to the viability of livelihoods, which bring income, good governance and policies, increasing opportunities especially for the poor, increasing investments in the WEF nexus, teamwork, and participation of rural women.

7.4 Suggestions for further research

The broad scope of WEF nexus security and resilience provides for further research areas. WEF nexus security impacts nations broadly on a global level. Various strategies used to cope with nexus related scarcities, challenges and threats have not produced the desired results. Thus, the WEF nexus approach can lead to a better understanding of the resources and the processes of which they are part and parcel of in the context of the WEF nexus. The approach intends to achieve the broad security and sustainable use of resources at all levels. However, studies conducted thus far have targeted WEF nexus security at the macro level – primarily global, regional and national. The WEF nexus is also multi-faceted and lacks a comprehensive framework for implementation at all levels. This has led to its modification to suit various studies and objectives. The researcher recommends the following areas for further research.

There is a need for more research to:

- Structure a comprehensive WEF nexus approach for practical implementation at all levels and systems targeting WEF nexus security.
- Find ways of building integrative WEF nexus local coping strategies for resource security and resilience.

- Explore the WEF nexus trade-offs that occur within rural communities and households which have a negative impact on future resource security.
- Find effective ways of locally managing WEF resources to curb insecurities, challenges, and threats.
- Investigate the role of stakeholders and officials (governments and NGOs) in promoting WEF nexus security for rural communities
- Find innovative measures that incorporate the rural women's perceptions and coping strategies for WEF nexus security.

BIBLIOGRAPHY

Primary Sources A: Interviews, Focus Group Discussions and Field notes.

HJPA/CD/FGD1 Women 16012017. 2017. Focus group discussion with women in Chivi district 16/01/2017. Chivi. (Field Research).

HJPA/CD/FGD2 Women 02022017. 2017. Focus group discussion with women in Chivi district 02/02/2017 . Chivi. (Field research).

HJPA/CD/FGD3 Women 07022017. 2017. Focus group discussion with women in Chivi district 07/02/2017 . Chivi. (Field research).

HJPA/CD/FGDs Field Notes Chivi. 2017. Field notes taken during Focus Group Discussions in Chivi district. Chivi. (Field research).

HJPA/CD/FN Chivi. 2017. Field notes in Chivi district collected during observation January to March 2017. Chivi. (Field research).

HJPA/CD/FN Interviews Officials. 2017. Interview notes and handouts taken during interviews with officials in Chivi district, January to February 2017. Chivi. (Field research).

HJPA/CD/Observation Field Notes Chivi. 2017. Field notes in chivi district collected during observation. Chivi. (Field research).

HJPA/CD/Official 1 NGO 20170214. 2017. Individual interviews with key stakeholders in the WEF nexus Chivi district, Non Governmental Organisation. Chivi. (Field research).

HJPA/CD/Official 2 NGO 20170215. 2017. Individual interviews with key stakeholders in the WEF nexus Chivi district, Non Governmental Organisation. Chivi. (Field research).

HJPA/CD/Official AGRITEX 20170222. 2017. Individual interviews with key stakeholders in the WEF nexus Chivi district, AGRITEX. Chivi. (Field research).

HJPA/CD/Official EMA 20170214. 2017. Individual interviews with key stakeholders in the WEF nexus Chivi district, Environmental Management Agency. Chivi. (Field research).

HJPA/CD/Official Mechanisation 1 20170222. 2017. Individual interviews with key stakeholders in the WEF nexus Chivi district, Department of Mechanisation. Chivi. (Field research).

HJPA/CD/Official RSC 20170222. 2017. Individual interviews with key stakeholders in the WEF nexus Chivi district, Runde Sub-Catchment Office. Chivi. (Field research).

HJPA/CD/Official SW 20022017. 2017. Individual interviews with key stakeholders in the WEF nexus Chivi district, Ministry of Social Welfare. Chivi. (Field research).

HJPA/CD/Official WA 20022017. 2017. Individual interviews with key stakeholder in the WEF nexus Chivi district, Ministry of women's Affairs. Chivi. (Field research).

HJPA/CD/Official ZINWA 20170214. 2017. Individual interviews with key stakeholders in the WEF nexus Chivi district, Zimbabwe National Water Authority. Chivi. (Field research).

HJPA/CD/W1 04022017 Interview. 2017. Indepth individual interviews with women in Chivi district 04 February 2017. Chivi. (Field research).

HJPA/CD/W2 04022017 Interview. 2017. Indepth individual interview with women in Chivi District 04 February 2017. Chivi. (Field research).

HJPA/CD/W3 04022017 Interview. 2017. Indepth individual interview with women in Chivi District 04 February 2017. Chivi. (Field research).

HJPA/CD/W4 04022017 Interview. 2017. Indepth individual interview with women in Chivi District 04 February 2017. Chivi (Field research).

HJPA/CD/W5 04022017 Interview. 2017. Indepth individual interview with women in Chivi District 04 February 2017. Chivi. (Field research).

HJPA/CD/W7 12022017 Interview. 2017. Indepth individual interview with women in Chivi district. Chivi. (Field research).

HJPA/CD/W8 12022017 Interview. 2017. Indepth individual interview with women in Chivi district. Chivi. (Field research).

HJPA/CD/W9 12022017 Interview. 2017. Indepth individual interview with women in Chivi district. Chivi. (Field research).

HJPA/CD/W10 12022017 Interview. 2017. Indepth individual interview with women in Chivi district. Chivi. (Field research).

HJPA/FGD1 Men 15022017. 2017. Focus group discussion with men in chivi district, 15022017 (pp. 1-5). Chivi. (Field Research).

HJPA/FGD2 Men 17022017. 2017. Focus group discussion with men in chivi district . Chivi. (Field Research).

HJPA/Official RDC 25022017. 2017. Individual interviews with key stakeholders in the WEF nexus Chivi district, Rural District Council. Chivi. (Field research).

HJPA/VD/FGD1 Men 19052017. 2017. Focus group discussion with men in Vhembe district, Tshiombo area. Vhembe district. (Field Research).

HJPA/VD/FGD1 Women 18052017. 2017. Focus group discussion with women in Vhembe district, Tshiombo area. Vhembe district. (Field research).

HJPA/VD/FGD2 Men 17022017. 2017. Focus group discussion with men in Vhembe district May 2017,Gombani area. Vhembe district. (Field research).

HJPA/VD/FGD2 Women 23052017. 2017. Focus group discussion with women in Vhembe district, Gombani area. Vhembe district. (Field research).

HJPA/VD/FGD ARD officials 30052017. 2017. Focus group discussion with officials in Vhembe district, Department of Agriculture and Rural Development. Vhembe district. (Field Research).

HJPA/VD/FGD Water officials 29052017. 2017. Focus group discussion with officials in Vhembe district, Department of Water services. Vhembe district. (Field Research).

HJPA/VD/FN FGDs Officials. 2017. Interview notes and handouts taken during FGDs with officials in Vhembe district. (Field research).

HJPA/VD/FN Interviews Officials. 2017. Interview notes and handouts taken during interviews with officials in Vhembe district, May to June 2017. Vhembe district. (Field research).

HJPA/VD/FN Vhembe. 2017. Field notes in Vhembe district collected during observation May-June 2017. Vhembe district. (Field research).

HJPA/VD/FNFGDs Vhembe. 2017. Field notes taken during focus group discussions in Vhembe district. Vhembe district. (Field research).

HJPA/VD/Official EA 25052017. 2017. Individual interviews with key stakeholders in the WEF nexus Vhembe district Municipality Environmental affairs. Vhembe district. (Field research).

HJPA/VD/Official Energy 01062017. 2017. Individual interviews with key stakeholders in the WEF nexus Vhembe district Municipality, Department of energy. Vhembe district. (Field research).

HJPA/VD/Official water 25052017. 2017. Individual interviews with key stakeholders in the WEF nexus Vhembe district Municipality, Water Services. Vhembe district. (Field research).

HJPA/VD/Tribal leader 06062017. 2017. Individual interviews with key stakeholders in the WEF nexus Vhembe district , Local Village Head. Vhembe district. (Field research).

HJPA/VD/Tribal leader 24052017. 2017. Individual interviews with key stakeholders in the WEF nexus Vhembe district , Local Village Head. Vhembe district. (Field research).

HJPA/VD/W1 24052017 Interview. 2017. Indepth individual interviews with women in Vhembe district May-June 2017. Vhembe district. (Field research).

HJPA/VD/W2 25052017 Interview. 2017. Indepth individual interviews with women in Vhembe district May-June 2017. Vhembe district. (Field research).

HJPA/VD/W3 25052017 Interview. 2017. Indepth individual interviews with women in Vhembe district May-June 2017. Vhembe district. (Field research).

HJPA/VD/W4 26052017 Interview. 2017. Indepth individual interviews with women in Vhembe district May-June 2017. Vhembe district. (Field research).

HJPA/VD/W5 26052017 Interview. 2017. Indepth individual interviews with women in Vhembe district May-June 2017. Vhembe district. (Field research).

HJPA/VD/W6 03062017 Interview. 2017. Indepth individual interviews with women in Vhembe district May-June 2017. Vhembe district. (Field research).

HJPA/VD/W7 03062017 Interview. 2017. Indepth individual interviews with women in Vhembe district May-June 2017. Vhembe district. (Field research).

HJPA/VD/W8 03062017 Interview. 2017. Indepth individual interviews with women in Vhembe district May-June 2017. Vhembe district. (Field research).

HJPA/VD/W9 04062017 Interview. 2017. Indepth individual interviews with women in Vhembe district May-June 2017. Vhembe district. (Field research).

HJPA/VD/W10 04062017 Interview. 2017. Indepth individual interviews with women in Vhembe district May-June 2017. Vhembe district. (Field research).

HJPA/W6 12022017 Interview. 2017. Indepth individual interview with women in Chivi district. Chivi. (Field Research).

Primary Sources B: Illustrations

HJPA/ FPW February2017. 2017. Pictures showing funded projects for women in Chivi district taken in February 2017. Chivi. (Field research).

HJPA/ ICSP 22022017. 2017. Picture of an improved cooking stove (tsotso stove) introduced in chivi for conserving energy. Chivi. (Field research).

HJPA/CBP22022017. 2017. Picture of a community borehole in Chivi disrict taken during Field Observation. Chivi. (Field research).

HJPA/CD/CSWAP 08022017b. 2017. A well dug on the side of the dam as a water source for domestic use. Chivi. (Field research).

HJPA/CD/FCSP 29012017. 2017. A food coping strategy picture of a woman collecting termites(shwarara) that come out only after the rain. Chivi. (Field research).

HJPA/CD/Water Harvesting 02022017. 2017. Rooftop water-harvesting technique used in Chivi district. Chivi. (Field research).

HJPA/CDP 12022017. 2017. Picture of a community Dam in Chivi district taken during observation, February 2017. Chivi. (Field research).

HJPA/CSWAP 08022017a. 2017. Water infrastructure leakage serving as water security coping mechanism for the community in Chivi district. (Field research).

HJPA/RSWP 16012017. 2017. Riverbed shallow well dry season picture taken during observation of water sources in Chivi district, January 2017. Chivi. (Field research).

HJPA/RWSP 15022017. 2017. Picture of a river water source for communities in Chivi district taken during observation. Chivi. (Field research).

HJPA/VD/ Natural springs 30052017. 2017. Picture showing water flowing from natural springs and pipe connections that used to draw water close to homesteads, taken during field observation. Vhembe district. (Field research).

HJPA/VD/CTP30052017. 2017. Picture of a community tap in Vhembe district taken during field observation. Vhembe district. (Field research).

HJPA/VD/Jojo Tank 30052017. 2017. Jojo tanks used to store water for the Brickmaking project in Vhembe. Vhembe district. (Field research).

HJPA/VD/River source 27052017. Picture showing a man collecting water for domestic use from the river, taken during field observation. Vhembe district. (Field research).

HJPA/VD/Water containers 02062017. 2017. Picture of water containers lined up by the roadside awaiting water tankers in Vhembe district taken during field observation. Vhembe district. (Field research).

HJPA/VD/Water harvest 25052017. 2017. Picture of Jojo tanks used for water harvesting and storage in Vhembe district taken during field observation. Vhembe district. (Field research).

Secondary Sources

Aasoglenang, A.T. & Bonye, S.Z. 2013. Rural Livelihoods Diversity: Coping Strategies in Wa West District in Northern Ghana. *European Scientific Journal, ESJ*, 9(35):139-156.

Abdulla, F.A. & Al-Shareef, A.W. 2009. Roof rainwater harvesting systems for household water supply in Jordan. *Desalination*, 243(1):195-207.

Abdu-Raheem, K.A. & Worth, S.H. 2011. Household food security in South Africa: evaluating extension's paradigms relative to the current food security and development goals. *South African Journal of Agricultural Extension*, (39):91-103.

ADB. 2013a. Asian Water Development Outlook 2013. <http://www.adb.org/sites/default/files/publication/30190/asian-water-development-outlook-2013.pdf> Date of access: 23 June 2015.

ADB. 2013b. Thinking about water differently: Managing the water–food–energy nexus: Bank, A.D. <http://www.adb.org/publications/thinking-about-water-differently-managing-water-food-energy-nexus> Date of access: 13 Aug. 2015.

Adelekan, I.O. & Jerome, A.T. 2006. Dynamics of household energy consumption in a traditional African city, Ibadan. *The Environmentalist*, 26(2):99-110.

- Adger, W.N. 2000. Social and ecological resilience: are they related? *Progress in Human Geography*, 24(3):347-364.
- Adger, W.N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D.R., Naess, L.O., Wolf, J. & Wreford, A. 2008. Are there social limits to adaptation to climate change? *Climatic Change*, 93(3-4):335-354.
- Adkins, E., Eapen, S., Kaluwile, F., Nair, G. & Modi, V. 2010. Off-grid energy services for the poor: Introducing LED lighting in the Millennium Villages Project in Malawi. *Energy Policy*, 38(2):1087-1097.
- Adkins, E., Ooppelstrup, K. & Modi, V. 2012. Rural household energy consumption in the millennium villages in Sub-Saharan Africa. *Energy for Sustainable Development*, 16(3):249-259.
- Africa-EUEIP. 2008. The Energy Challenge: Access and Security for Africa and for Europe. Germany: European Union Energy Initiative - Partnership Dialogue Facility (Euei-Pdf). http://www.aEEP-forum.org/documents/aEEP_communication_paper.pdf Date of access: 22 June 2017.
- Aggarwal, R., Netanyahu, S. & Romano, C. 2001. Access to natural resources and the fertility decision of women: the case of South Africa. *Environment and Development Economics*, 6(2):209-236.
- Ajadi, A.A., Oladele, O.I., Ikegami, K. & Tsuruta, T. 2015. Rural women's farmers access to productive resources: the moderating effect of culture among Nupe and Yoruba in Nigeria. *Agriculture & Food Security*, 4(1):26.
- Akella, A.K., Sharma, M.P. & Saini, R.P. 2007. Optimum utilization of renewable energy sources in a remote area. *Renewable and Sustainable Energy Reviews*, 11(5):894-908.
- Alauddin, M. & Sarker, M.A.R. 2014. Climate change and farm-level adaptation decisions and strategies in drought-prone and groundwater-depleted areas of Bangladesh: an empirical investigation. *Ecological Economics*, (106):204-213.
- Algozzine, B. & Hancock, D. 2006. Doing case study research: a practical guide for beginning researchers. New York: Teachers College Press.
- Aliber, M. & Hart, T.G.B. 2009. Should subsistence agriculture be supported as a strategy to address rural food insecurity? *Agrekon*, 48(4):434-458.

- Allan, T., Keulertz, M. & Woertz, E. 2015. The water–food–energy nexus: an introduction to nexus concepts and some conceptual and operational problems. *International Journal of Water Resources Development*, 31(3):301-311.
- Allen, C.R., Angeler, D.G., Garmestani, A.S., Gunderson, L.H. & Holling, C.S. 2014. Panarchy: Theory and Application. *Ecosystems*, 17(4):578-589.
- Allison, H. E. and R. J. Hobbs. 2004. Resilience, adaptive capacity, and the “Lock-in Trap” of the Western Australian agricultural region. *Ecology and Society* 9(1):1-25.
- Allouche, J. 2011. The sustainability and resilience of global water and food systems: Political analysis of the interplay between security, resource scarcity, political systems and global trade. *Food Policy*, (36):S3-S8.
- Allouche, J., Middleton, C. & Gyawali, D. 2014. Nexus nirvana or nexus nullity? A dynamic approach to security and sustainability in the water-energy-food nexus. <http://steps-centre.org/wp-content/uploads/Water-and-the-Nexus.pdf> Date of access: 18 Nov. 2015.
- Al-Saidi, M. & Elagib, N.A. 2017. Towards understanding the integrative approach of the water, energy and food nexus. *Science of The Total Environment*, (574):1131-1139.
- Altman, M., Hart, T. & Jacobs, P. 2009. Household food security status in South Africa. *Agrekon*, 48(4):345-361.
- Andersson, J.A. & D'Souza, S. 2014. From adoption claims to understanding farmers and contexts: A literature review of Conservation Agriculture (CA) adoption among smallholder farmers in southern Africa. *Agriculture, Ecosystems & Environment*, (187):116-132.
- Animesh, K.G., Carlo, G. & Yoshihide, W. 2016. Measuring global water security towards sustainable development goals. *Environmental Research Letters*, 11(12):124015.
- Ansell, N. 2002. Secondary Education Reform in Lesotho and Zimbabwe and the Needs of Rural Girls: Pronouncements, policy and practice. *Comparative Education*, 38(1):91-112.
- Arendse, L. 2011. The obligation to provide free basic education in South Africa: an international law perspective. *PER: Potchefstroomse Elektroniese Regsblad*, (14):96-127.

- Arthur, M.d.F.S.R., Bond, C.A. & Willson, B. 2012. Estimation of elasticities for domestic energy demand in Mozambique. *Energy Economics*, 34(2):398-409.
- Ashley, C. & Maxwell, S. 2001. Rethinking Rural Development. *Development Policy Review*, 19(4):395-425.
- Asif, M. & Muneer, T. 2007. Energy supply, its demand and security issues for developed and emerging economies. *Renewable and Sustainable Energy Reviews*, 11(7):1388-1413.
- Backeberg, G.R. & Sanewe, A.J. 2010. Towards productive water use and household food security in South Africa. Paper presented at the 6th Asian Regional Conference of ICID, Indonesia, 10-16 October 2010. http://www.rid.go.th/thaicid/_6_activity/Technical-Session/SubTheme2/2.08-Gerhard_RB-Andrew_JS.pdf Date of access: 22 May 2016.
- Baiphethi, M.N. & Jacobs, P.T. 2009. The contribution of subsistence farming to food security in South Africa. *Agrekon*, 48(4):459-482.
- Baldwin, D.A. 2011. Security Studies and the end of the Cold War. *World Politics*, 48(1):117-141.
- Bernard, H. R. 2000. Social research methods. Thousand Oaks, CA: Sage Publications.
- Banks, M. 2008. Using visual data in qualitative research. Los Angeles, CA: Sage Publications.
- Barnes, D.F. & Floor, W.M. 2003. Rural Energy in Developing countries: A Challenge for Economic Development¹. *Annual Review of Energy and the Environment*, 21(1):497.
- Barrett, C.B. 2010. Measuring Food Insecurity. *Science*, 327(5967):825-828.
- Basu, M., Hoshino, S. & Hashimoto, S. 2015. Many issues, limited responses: Coping with water insecurity in rural India. *Water Resources and Rural Development*, (5):47-63.
- Batterbury, S. 2008. Sustainable Livelihoods Framework: ten years of researching the poor. *African Environments Programme, 24th January 2008, 2-6pm*. Oxford University Centre for the Environment (OUCE). Pp.1-16.
- Baxter, P. & Jack, S. 2008. Qualitative case study methodology: Study design and implementation for novice researchers. *The qualitative report*, 13(4):544-559.

- Bazilian, M., Nussbaumer, P., Rogner, H.-H., Brew-Hammond, A., Foster, V., Pachauri, S., Williams, E., Howells, M., Niyongabo, P., Musaba, L., Gallachóir, B.Ó., Radka, M. & Kammen, D.M. 2012. Energy access scenarios to 2030 for the power sector in sub-Saharan Africa. *Utilities Policy*, 20(1):1-16.
- Bazilian, M., Rogner, H., Howells, M., Hermann, S., Arent, D., Gielen, D., Steduto, P., Mueller, A., Komor, P., Tol, R.S.J. & Yumkella, K.K. 2011. Considering the energy, water and food nexus: Towards an integrated modelling approach. *Energy Policy*, 39(12):7896-7906.
- Beck, M.B. & Walker, R.V. 2013. On water security, sustainability, and the water-food-energy-climate nexus. *Frontiers of Environmental Science & Engineering*, 7(5):626-639.
- Benson, D., Gain, A.K. & Rouillard, J.J. 2015. Water Governance in a Comparative Perspective: From IWRM to a 'Nexus' Approach? *Water Alternatives*, 8(1):756-773.
- Benson, M.H. & Garmestani, A.S. 2011. Embracing panarchy, building resilience and integrating adaptive management through a rebirth of the National Environmental Policy Act. *Journal of Environmental Management*, 92(5):1420-1427.
- Bentley, K. 2004. Women's human rights & the feminisation of poverty in South Africa. *Review of African Political Economy*, 31(100):247-261.
- Berkes, F. & Ross, H. 2016. Panarchy and community resilience: Sustainability science and policy implications. *Environmental Science & Policy*, (61):185-193.
- Beverly, S.G., McBride, A.M. & Schreiner, M. 2003. A Framework of Asset-Accumulation Stages and Strategies. *Journal of Family and Economic Issues*, 24(2):143-156.
- Bhaduri, A., Ringler, C., Dombrowski, I., Mohtar, R. & Scheumann, W. 2015. Sustainability in the water–energy–food nexus. *Water International*, 40(5-6):723-732.
- Biggs, E.M., Boruff, B., Bruce, E., Duncan, J.M.A., Duce, S., Haworth, B.J., Horsley, J., Curnow, J., Neef, A., McNeill, K., Pauli, N., Van Ogtrop, F. & Imanari, Y. 2014. Environmental Livelihood Security in South-East Asia and Oceania: A nexus livelihoods approach for spatially assessing change. Colombo, Sri Lanka: International Water Management Institute. <http://www.iwmi.cgiar.org/publications/other-publication-types/environmental-livelihood-security-south-east-asia-oceania/> Date of access: 12 April 2015.

- Biggs, E.M., Bruce, E., Boruff, B., Duncan, J.M.A., Horsley, J., Pauli, N., McNeill, K., Neef, A., Van Ogtrop, F., Curnow, J., Haworth, B., Duce, S. & Imanari, Y. 2015. Sustainable development and the water–energy–food nexus: A perspective on livelihoods. *Environmental Science & Policy*, (54):389-397.
- Biran, A., Abbot, J. & Mace, R. 2004. Families and Firewood: A Comparative Analysis of the Costs and Benefits of Children in Firewood Collection and Use in Two Rural Communities in Sub-Saharan Africa. *Human Ecology*, 32(1):1-25.
- Bird, K. & Shepherd, A. 2003. Livelihoods and Chronic Poverty in Semi-Arid Zimbabwe. *World Development*, 31(3):591-610.
- Bizikova, L., Roy, D., Swanson, D., Venema, H.D. & McCandless, M. 2013. The water-energy-food security nexus: Towards a practical planning and decision-support framework for landscape investment and risk management. Canada: International Institute for Sustainable Development.
- Bogardi, J.J., Dudgeon, D., Lawford, R., Flinkerbusch, E., Meyn, A., Pahl-Wostl, C., Vielhauer, K. & Vörösmarty, C. 2012. Water security for a planet under pressure: interconnected challenges of a changing world call for sustainable solutions. *Current Opinion in Environmental Sustainability*, 4(1):35-43.
- Boyce, C. & Neale, P. 2006. Conducting in-depth interviews: A Guide for Designing and Conducting In-Depth Interviews for Evaluation Input. *Massachusetts: Pathfinder international tool series*, Monitoring and evaluation 2.
- Bricki, N. & Green, J. 2007. A Guide to Using Qualitative Research Methodology. *Medecins sans frontiers*.
<http://fieldresearch.msf.org/msf/bitstream/10144/84230/1/Qualitative+research+methodology.pdf> Date of access: 20 May 2016.
- Brouwer, I.D., Hoorweg, J.C. & van Liere, M.J. 1997. When households run out of fuel: Responses of rural households to decreasing fuelwood availability, Ntcheu District, Malawi. *World Development*, 25(2):255-266.
- Brown, C. & Lall, U. 2006. Water and economic development: The role of variability and a framework for resilience. *Natural Resources Forum*, 30(4):306-317.
- Brunner, K.-M., Spitzer, M. & Christanell, A. 2012. Experiencing fuel poverty. Coping strategies of low-income households in Vienna/Austria. *Energy Policy*, (49):53-59.

- Brush, S.B., Institute, I.P.G.R. & Centre, I.D.R. 2000. Genes in the Field: On-farm Conservation of Crop Diversity. Canada: International Plant Genetic Resources Institute, International Development Research Centre.
- Bvenura, C. & Afolayan, A.J. 2015. The role of wild vegetables in household food security in South Africa: A review. *Food Research International*, (76):1001-1011.
- Bwerinofa, C. & Chiweshe, M.K. 2016. Responses to Disasters and Climate Change: Understanding Vulnerability and Fostering Resilience. (In. Companion, M. (Ed.), Chaiken, M. (Ed.). (2017). Responses to Disasters and Climate Change. Boca Raton: CRC Press. p. 183-209).
- Byrne, M. 2001. Sampling for qualitative research. *AORN Journal*, 73(2):494-498.
- Calow, R.C., MacDonald, A.M., Nicol, A.L. & Robins, N.S. 2010. Ground Water Security and Drought in Africa: Linking Availability, Access, and Demand. *Groundwater*, 48(2):246-256.
- Campbell, B.M., Doré, D., Luckert, M., Mukamuri, B. & Gambiza, J. 2000. Special section: Land use options in dry tropical woodland ecosystems in zimbabwe: Economic comparisons of livestock production in communal grazing lands in Zimbabwe. *Ecological Economics*, 33(3):413-438.
- Campbell, B.M., Jeffrey, S., Kozanayi, W., Luckert, M., Mutamba, M. & Zindi, C. 2002. Household livelihoods in semi-arid regions: options and constraints. Jakarta: Indonesia: CIFOR.
- Carpenter, S.R. & Gunderson, L.H. 2001. Coping with collapse: ecological and social dynamics in ecosystem management. *BioScience*, (51):451-457.
- Carpenter, S.R., Walker, B.H., Anderies, J.M. & Abel, N. 2001. From metaphor to measurement: resilience of what to what? . *Ecosystems*, (4):765–781.
- Carr, E.R. 2013. Livelihoods as Intimate Government: Reframing the logic of livelihoods for development. *Third World Quarterly*, 34(1):77-108.
- Chagomoka, T., Unger, S., Drescher, A., Glaser, R., Marschner, B. & Schlesinger, J. 2016. Food coping strategies in northern Ghana. A socio-spatial analysis along the urban–rural continuum. *Agriculture & Food Security*, 5(1):4.

- Chaminuka, P., Udo, H.M.J., Eilers, K.C.H.A.M. & van der Zijpp, A. 2014. Livelihood roles of cattle and prospects for alternative land uses at the wildlife/livestock interface in South Africa. *Land Use Policy*, (38):80-90.
- Charles, P. 2006. Resilience and sustainable development. *Environment and Development Economics*, 11(4):417-427.
- Charman, A. 2008. Empowering women through livelihoods orientated agricultural service provision: a consideration of evidence from Southern Africa: Research Paper. UNU-WIDER: United Nations University (UNU).
- Chaves, M. & Oliveira, M. 2004. Mechanisms underlying plant resilience to water deficits: prospects for water-saving agriculture. *Journal of experimental botany*, 55(407):2365-2384.
- Chazovachii, B. & Chuma, M. 2013. Rural highway service centres and rural livelihoods diversity: a case of Ngundu halt in Zimbabwe. *Russian Journal of Agricultural and Socio-Economic Sciences*, 17(5):13-19.
- Cherni, J.A., Dyer, I., Henao, F., Jaramillo, P., Smith, R. & Font, R.O. 2007. Energy supply for sustainable rural livelihoods. A multi-criteria decision-support system. *Energy Policy*, 35(3):1493-1504.
- Cherp, A. & Jewell, J. 2014. The concept of energy security: Beyond the four As. *Energy Policy*, (75):415-421.
- Chester, L. 2010. Conceptualising energy security and making explicit its polysemic nature. *Energy Policy*, 38(2):887-895.
- Chikava, W. & Annegarn, H.J. 2013. Human and physical energy cycles in a subsistence village in South Africa. *Journal of Energy in Southern Africa*, 24(2): 67.
- Chirisa, I. & Bandaiko, E. 2015. African Cities and the Water-Food-Climate-Energy Nexus: an Agenda for Sustainability and Resilience at a Local Level. *Urban Forum*, (26): 391-404
- Chitja, J., Mthiyane, C., Mariga, I., Shimelis, H., Murugani, V., Morojele, P., Naidoo, K. & Aphane, O. 2016. Empowerment of women through water use security, land use security and knowledge generation for improved household food security and sustainable rural livelihoods in selected areas in Limpopo. WRC: South Africa. .

- Chopra, M., Lawn, J.E., Sanders, D., Barron, P., Karim, S.S.A., Bradshaw, D., Jewkes, R., Karim, Q.A., Flisher, A.J., Mayosi, B.M., Tollman, S.M., Churchyard, G.J. & Coovadia, H. 2009. Achieving the health Millennium Development Goals for South Africa: challenges and priorities. *The Lancet*, 374(9694):1023-1031.
- Clark, W.A. & Finley, J.C. 2007. Determinants of Water Conservation Intention in Blagoevgrad, Bulgaria. *Society & Natural Resources*, 20(7):613-627.
- Cleaver, F. & Elson, D. 1995. Women and water resources: continued marginalisation and new policies. London: International Institute for Environment and Development.
<http://www.mekonginfo.org/assets/midocs/0003073-environment-women-and-water-resources-continued-marginalisation-and-new-policies.pdf> Date of access: 22 Aug 2015.
- Cobuild, C. 2006. Collins COBUILD advanced learner's English dictionary. New York: HarperCollins publishers.
- Conway, D., van Garderen, E.A., Deryng, D., Dorling, S., Krueger, T., Landman, W., Lankford, B., Lebek, K., Osborn, T., Ringler, C., Thurlow, J., Zhu, T. & Dalin, C. 2015. Climate and southern Africa's water-energy-food nexus. *Nature Climate Change*, 5(9):837-846.
- Cook, C. & Bakker, K. 2012. Water security: Debating an emerging paradigm. *Global Environmental Change*, 22(1):94-102.
- Cosens, B. & Gunderson, L. 2018. Practical Panarchy for Adaptive Water Governance: Linking Law to Social-Ecological Resilience. Switzerland: Springer International Publishing AG.
- Cote, M. & Nightingale, A.J. 2012. Resilience thinking meets social theory: Situating social change in socio-ecological systems (SES) research. *Progress in Human Geography*, 36(4):475-489.
- Creswell, J.W. 1998. Qualitative inquiry and research design: Choosing among five traditions. Thousand Oaks, CA: Sage Publications.
- Cresswell, J.W. & Maietta, R. 2002. (In Miller, D.C. & Salkind, N., eds. Handbook of social research. California: Sage Publications. p. 185-196).
- Creswell, J.W. 2009. Research design: Qualitative, quantitative, and mixed methods approaches, 3rd ed. Thousand Oaks, CA, US: Sage Publications, Inc.

- Cucek, L., Klemes, J.J., Varbanov, P.S. & Kravanja, Z. 2015. Significance of environmental footprints for evaluating sustainability and security of development. *Clean Technologies and Environmental Policy*, 17(8):2125-2141.
- Davidson, O., Halsnæs, K., Huq, S., Kok, M., Metz, B., Sokona, Y. & Verhagen, J. 2003. The development and climate nexus: the case of sub-Saharan Africa. *Climate Policy*, (3):97-113.
- Davies, S. 1993. Are coping strategies a cop out? *IDS bulletin*, 24(4):60-72.
- Davis, M. 1998. Rural household energy consumption: The effects of access to electricity—evidence from South Africa. *Energy Policy*, 26(3):207-217.
- Davoudi, S., Shaw, K., Haider, L.J., Quinlan, A.E., Peterson, G.D., Wilkinson, C., Fünfgeld, H., McEvoy, D., Porter, L. & Davoudi, S. 2012. Resilience: A Bridging Concept or a Dead End? “Reframing” Resilience: Challenges for Planning Theory and Practice Interacting Traps: Resilience Assessment of a Pasture Management System in Northern Afghanistan Urban Resilience: What Does it Mean in Planning Practice? Resilience as a Useful Concept for Climate Change Adaptation? The Politics of Resilience for Planning: A Cautionary Note. *Planning Theory & Practice*, 13(2):299-333.
- De Cock, N., D’Haese, M., Vink, N., van Rooyen, C.J., Staelens, L., Schönfeldt, H.C. & D’Haese, L. 2013. Food security in rural areas of Limpopo Province, South Africa. *Food Security*, 5(2):269-282.
- De Haan, L. 2017. Livelihoods in development. *Canadian Journal of Development Studies*, 38(1):22-38.
- De Vos, A.S. 2002. Research at grass roots: For the social sciences and human services professions. Pretoria: Van Schaik publishers.
- De Vos, A.S., Fouche, C.B., Strydom, H. & Delpont, C. 2005. Research at grass roots: for the social sciences and human service professions. 5th ed. Pretoria: Van Schaik Publishers.
- Del Ninno, C., Dorosh, P.A. & Subbarao, K. 2007. Food aid, domestic policy and food security: Contrasting experiences from South Asia and sub-Saharan Africa. *Food Policy*, 32(4):413-435.
- Department of Energy. 2012. A survey of energy related behaviour and perceptions in South Africa: the residential sector. South Africa.

- Derman, B. & Hellum, A. 2007. Livelihood rights perspective on water reform: Reflections on rural Zimbabwe. *Land Use Policy*, 24(4):664-673.
- Desalu, O.O., Ojo, O.O., Ariyibi, E.K., Kolawole, T.F. & Ogunleye, A.I. 2012. A community survey of the pattern and determinants of household sources of energy for cooking in rural and urban south western, Nigeria. *The Pan African Medical Journal*, 12(2): 1-12.
- Devereux, S. 2001. Livelihood Insecurity and Social Protection: A Re-emerging Issue in Rural Development. *Development Policy Review*, 19(4):507-519.
- Devereux, S. 2006. Distinguishing between chronic and transitory food insecurity in emergency needs assessments. Rome, Italy: WFP. <http://www.livestock-emergency.net/userfiles/file/assessment-review/Institue-Development-Studies-2006.pdf>
Date of access: 12 Sep 2015.
- Devereux, S. 2007. The impact of droughts and floods on food security and policy options to alleviate negative effects. *Agricultural Economics*, 37(s1):47-58.
- Dinkelman, T. 2011. The Effects of Rural Electrification on Employment: New Evidence from South Africa. *The American Economic Review*, 101(7):3078-3108.
- Drimie, S. & Ruysenaar, S. 2010. The Integrated Food Security Strategy of South Africa : an institutional analysis. *Agrekon*, 49(3):316-337.
- Du Toit, D.C. 2011. Food Security. South Africa:DAFF.
- Dube, D. & Swatuk, L.A. 2002. Stakeholder participation in the new water management approach: a case study of the Save catchment, Zimbabwe. *Physics and Chemistry of the Earth, Parts A/B/C*, 27(11):867-874.
- Duflo, E., Greenstone, M. & Hanna, R. 2008. Indoor air pollution, health and economic well-being. *SAPIENS, Surveys and Perspectives Integrating Environment and Society*, 1(1): 6-16.
- Dupar, M. & Oates, N. 2012. Getting to grips with the water-energy-food 'nexus'. *Climate and Development Knowledge Network (London)*. <http://cdkn.org/2012/04/getting-to-grips-withthe-water-energy-food-nexus> Date of access: 12 July 2015.
- DWAF. 2008. Water allocation reform strategy. Pretoria, South Africa: Department of Water Affairs and Forestry.

- DWAF. 2009. Water for growth and development. Pretoria, South Africa: Department of Water Affairs and Forestry.
- DWS. 2017. National Norms and Standards for Domestic Water and Sanitation Services, Version 3- Final. Pretoria, South Africa: Department of Water and Sanitation.
- Ejigu, M. 2008. Toward energy and livelihoods security in Africa: Smallholder production and processing of bioenergy as a strategy. *Natural Resources Forum*, 32(2):152-162.
- Ellis, F. 1998. Household strategies and rural livelihood diversification. *Journal of Development Studies*, 35(1):1-38.
- Ellis, F. 2000. The Determinants of Rural Livelihood Diversification in Developing Countries. *Journal of Agricultural Economics*, 51(2):289-302.
- Endo, A., Burnett, K., Orencio, M.P., Kumazawa, T., Wada, A.C., Ishii, A., Tsurita, I. & Taniguchi, M. 2015. Methods of the Water-Energy-Food Nexus. *Water*, 7(10):5806-5830.
- Eneyew, A. & Abddisa, F. 2015. Vulnerability to food insecurity and households' coping strategies. 34(4):529-542.
- ENSURE. 2014. Gender Analysis Report, 07 November 2014. Zimbabwe: Worldvision_Led Ensure.
- Everson, C., Everson, T., Modi, A., Csiwila, D., Fanadzo, M., Naiken, V., Auerbach, R., Moodley, M., Mtshali, S. & Dladla, R. 2011. Sustainable techniques and practices for water harvesting and conservation and their effective application in resource-poor agricultural production through participatory adaptive research. Pretoria, South Africa: Water Research Commission. (1465/1/11).
<http://www.wrc.org.za/Knowledge%20Hub%20Documents/Research%20Reports/1465-1-11.pdf> Date of access: 25 April 2015.
- Faber, M., Oelofse, A., Van Jaarsveld, P.J., Wenhold, F.A.M. & Jansen van Rensburg, W.S. 2010. African leafy vegetables consumed by households in the Limpopo and KwaZulu-Natal provinces in South Africa : original research. *South African Journal of Clinical Nutrition*, 23(1):30-38.

- Faber, M., Schwabe, C. & Drimie, S. 2009. Dietary diversity in relation to other household food security indicators. *International Journal of Food Safety, Nutrition and Public Health*, 2(1):1-15.
- Falkenmark, M. 2010. The Greatest Water Problem: The Inability to Link Environmental Security, Water Security and Food Security. *International Journal of Water Resources Development*, 17(4):539-554.
- FAO, IFAD & ILO. 2010. Gender dimensions of agricultural and rural employment: differentiated pathways out of poverty. Rome. Geneva: Food and Agricultural Organization, International Fund for Agricultural Development & International Labour Office. <http://www.fao.org/docrep/013/i1638e/i1638e.pdf> Date of access: 12 June 2015.
- FAO. 1996. Rome Declaration on World Food Security and World Food Summit Plan of Action. Rome. Rome: Food and Agriculture Organization of the United Nations. <http://www.fao.org/docrep/003/w3613e/w3613e00.htm> Date of access: 12 April 2015..
- FAO. 2003. Focus on Food Insecurity and Vulnerability – A review of the UN System Common Country Assessments and World Bank Poverty Reduction Strategy Papers. Rome, Italy: Fivims Secretariat and Wageningen University and Research Centre.
- FAO. 2007. Coping with water scarcity :Challenge of the twenty-first century. Rome, Italy: Food and Agricultural Organisation.
- FAO. 2008a. An introduction to the basic concepts of food security. Rome: Ec - Fao Food Security Programme. <http://www.fao.org/docrep/013/al936e/al936e00.pdf> Date of access: 21 May 2015.
- FAO. 2008b. Water for the rural poor: Interventions for improving livelihoods in sub-Saharan Africa. Rome, Italy: Food and Agricultural Organisation.
- FAO. 2010. The State of Food Insecurity in the World Addressing food insecurity in protracted crises. Rome, Italy: Food and Agriculture Organization <http://www.fao.org/docrep/013/i1683e/i1683e.pdf> Date of access: 30 May 2016.
- FAO. 2011. The state of food and agriculture. Women in agriculture, closing the gender gap for development. Rome: Food and Agriculture Organisation. <http://www.fao.org/docrep/013/i2050e/i2050e.pdf> Date of access: 20 May 2015.

- FAO. 2012. Coping with water scarcity: An action framework for agriculture and food security. Rome: Italy: Food and Agriculture Organisation.
- FAO. 2014. The water-energy-food nexus: a new approach in support of food security and sustainable agriculture. Rome: Food and Agriculture Organisation of the United Nations http://www.fao.org/nr/water/docs/FAO_nexus_concept.pdf Date of access: 30 April 2015.
- FAO. Nutrition, F.A. 1997. Agriculture, food and nutrition for Africa. Rome: Food and Agriculture Organization of the United Nations. www.fao.org/docrep/003/w3613e/w3613e00.htm Date of access: 12 April 2015.
- Farrell, A.E., Zerriffi, H. & Dowlatabadi, H. 2004. Energy Infrastructure and Security. *Annual Review of Environment and Resources*, 29(1):421-469.
- Fell, M.J. 2017. Energy services: A conceptual review. *Energy Research & Social Science*, 27:129-140.
- FEWSNET. 2016. Zimbabwe Food Security Outlook. Harare: Zimbabwe. http://www.fews.net/sites/default/files/documents/reports/ZW_FSO_2015_10.pdf Date of access: 22 September 2017.
- FEWSNET. 2017. Projected Food Assistance needs for April 2018. *Food Assistance Outlook Brief*, 1(10):1-4.
- Finley, J.W. & Seiber, J.N. 2014. The Nexus of Food, Energy, and Water. *Journal of Agricultural and Food Chemistry*, 62(27):6255-6262.
- Fischer, C. 2008. Feedback on household electricity consumption: a tool for saving energy? *Energy Efficiency*, 1(1):79-104.
- Flammini, A., Puri, M., Pluschke, L. & Dubois, O. 2014. Walking the Nexus Talk: Assessing the Water-Energy-Food Nexus in the Context of the Sustainable Energy for All Initiative. Rome Italy: Nations. <http://www.fao.org/3/a-i3959e.pdf> Date of access: 10 July 2016.
- Flick, U. 2013. The SAGE Handbook of Qualitative Data Analysis. London: SAGE.
- Folke, C. 2006. Resilience: the emergence of a perspective for social–ecological systems analyses. *Global Environmental Change*, 16:253–267.

- Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C.S. & Walker, B. 2002. Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations. *AMBIO: A Journal of the Human Environment*, 31(5):437-440.
- Foran, T. 2015. Node and regime: Interdisciplinary analysis of water-energy-food nexus in the Mekong region. *Water Alternatives*, 8(1)655-674.
- Frankenberger, T., Langworthy, M., Spangler, T., Nelson, S., Campbell, J. & Njoka, J. 2012. Enhancing resilience to food security shocks. *White Paper (Draft)*. Tucson: TANGO International Inc.
http://erepository.uonbi.ac.ke/bitstream/handle/11295/81864/Njoka_Enhancing%20Resilience....pdf?sequence=1 Date of access 12 Mar 2016 .
- Frost, P., Campbell, B., Luckert, M., Mutamba, M., Mandondo, A. & Kozanayi, W. 2007. In Search of Improved Rural Livelihoods in Semi-Arid Regions through Local Management of Natural Resources: Lessons from Case Studies in Zimbabwe. *World Development*, 35(11):1961-1974.
- Furst, C., Luque, S. & Geneletti, D. 2017. Nexus thinking – how ecosystem services can contribute to enhancing the cross-scale and cross-sectoral coherence between land use, spatial planning and policy-making. *International Journal of Biodiversity Science, Ecosystem Services & Management*, 13(1), 412-421.
- Gaidzanwa, R. 1995. Land and the economic empowerment of women: A gendered analysis. *Southern African Feminist Review*, 1(1):1-12.
- Gaidzanwa, R. 2004. Gender, Women and Electoral Politics in Zimbabwe. Johannesburg, South Africa.
- Gain, A.K., Giupponi, C. & Benson, D. 2015. The water–energy–food (WEF) security nexus: the policy perspective of Bangladesh. *Water International*, 40(5-6):895-910.
- Gandure, S. & Drimie, S. 2011. Role of Humanitarian food and nutrition security responses to HIV and AIDS. Harare: Centre for Applied Social Sciences, University of Zimbabwe
- Gandure, S., Drimie, S. & Faber, M. 2010. Food Security Indicators after Humanitarian Interventions Including Food Aid in Zimbabwe. *Food and Nutrition Bulletin*, 31(4):513-523.

- Gerbens-Leenes, W. & Nonhebel, S. 2005. Food and land use. The influence of consumption patterns on the use of agricultural resources. *Appetite*, 45(1):24-31.
- Gerhardt, K. & Nemarundwe, N. 2006. Participatory Planting and Management of Indigenous Trees: Lessons from Chivi District, Zimbabwe. *Agriculture and Human Values*, 23(2):231-243.
- Gheewala, S.H., Berndes, G. & Jewitt, G. 2011. The bioenergy and water nexus. *Biofuels, Bioproducts and Biorefining*, 5(4):353-360.
- Ghimire, D.R. 2014. Household food security and coping strategies: Vulnerabilities and capacities in rural communities. *International Journal of Scientific and Research Publications*, 4(9):1-8.
- Giller, K.E., Corbeels, M., Nyamangara, J., Triomphe, B., Affholder, F., Scopel, E. & Tiftonell, P. 2011. A research agenda to explore the role of conservation agriculture in African smallholder farming systems. *Field Crops Research*, 124(3):468-472.
- Giller, K.E., Witter, E., Corbeels, M. & Tiftonell, P. 2009. Conservation agriculture and smallholder farming in Africa: The heretics' view. *Field Crops Research*, 114(1):23-34.
- Gillespie, S. & Gillespie, S.R. 2006. AIDS, Poverty, and Hunger: Challenges and Responses. Washington DC: International Food Policy Research Institute.
<http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/125247/filename/125248.pdf>
 Date of Access 22 Aug 2015.
- GIZ. 2016. The Water – Energy – Food Security Nexus, German Technical Cooperation: Analysis of the Project Portfolio and Assessment of Opportunities for Nexus Mainstreaming. (In: HOFF, H. & KASPAREK, M. (eds.) the Water Energy-Food Security Nexus. Federal Ministry for Economic Cooperation and Development).
https://www.water-energy-food.org/fileadmin/user_upload/files/2016/documents/Germany__Federal_Government/nexus-portfolio-analysis-bmz-giz.pdf Date of Access 22 Jul 2017.
- Gladwin, C.H., Thomson, A.M., Peterson, J.S. & Anderson, A.S. 2001. Addressing food security in Africa via multiple livelihood strategies of women farmers. *Food Policy*, 26(2):177-207.
- Gleick, P.H. 1994. Water and energy. *Annual Review of Energy and the environment*, 19(1):267-299.

- Gotts, N.M. 2007. Resilience, panarchy, and world-systems analysis. *Ecology and Society*, 12(1):1-24.
- Government of Zimbabwe. Management, M.O.W.R.D.A. 2012. Zimbabwe National Water policy August 2010. Harare: Zimbabwe.
- Graham. J, Mitsuaki. H & Seung-Sup. k. 2016. An Analysis of Water Collection Labor among Women and Children in 24 Sub-Saharan African Countries. *PLoS One*, 11(6):1-14.
- Granit, J., Carlsen, H., Carson, M., Hallding, K., Johnson, O., Rosner, K., Nina, W., Eriksson, M., Andersson, C., Liljedahl, B., Mobjörk, M., Tulldahl, M. & Waleij, A. 2015. Integrating sustainable development and security: An analytical approach with examples from the Middle East and North Africa, the Arctic and Central Asia. Stockholm Environment Institute:Sweden. <https://www.sei-international.org/mediamanager/documents/Publications/SEI-FOI-WP-2015-14-Security-sustainable-development.pdf> Date of access: 05 February 2017.
- Granit, J., Jagerskog, A., Lindstrom, A., Bjorklund, G., Bullock, A., Lofgren, R., de Gooijer, G. & Pettigrew, S. 2012. Regional Options for Addressing the Water, Energy and Food Nexus in Central Asia and the Aral Sea Basin. *International Journal of Water Resources Development*, 28(3):419-432.
- Grey, D. & Sadoff, C.W. 2007. Sink or Swim? Water security for growth and development. *Water Policy*, 9(6):545.
- Grey, D., Garrick, D., Blackmore, D., Kelman, J., Muller, M. & Sadoff, C. 2013. Water security in one blue planet: twenty-first century policy challenges for science. *Phil. Trans. R. Soc. A*, 371(2002):20120406.
- Griggs, D., Stafford-Smith, M., Gaffney, O., Rockström, J., Öhman, M.C., Shyamsundar, P., Steffen, W., Glaser, G., Kanie, N. & Noble, I. 2013. Policy: Sustainable development goals for people and planet. *Nature*, 495(7441):305-307.
- Gudhlanga, E., Chirimuuta, C. & Bhukuvhani, C. 2012. Towards a gender inclusive curriculum in Zimbabwe's education system : opportunities and challenges. *Gender and Behaviour*, 10(1):4533-4545.
- Guest. G, Bunce. A, Johnson. L, 2006. How Many Interviews Are Enough? An Experiment with Data Saturation and Variability, *Field Methods*, 18,(1),59-82.

- Guèye, E.F. 2000. The Role of Family Poultry in Poverty Alleviation, Food Security and the Promotion of Gender Equality in Rural Africa. *Outlook on Agriculture*, 29(2):129-136.
- Gulati, M., Jacobs, I., Jooste, A., Naidoo, D. & Fakir, S. 2013. The Water–energy–food Security Nexus: Challenges and Opportunities for Food Security in South Africa. *Aquatic Procedia*, 1(2013):150-164.
- Gumede, N.B. 2013. Investigating water access constraints and land based livelihoods for empowerment of rural farming women and implication for household food security: the case study of three irrigation schemes in limpopo. Pietermaritzburg: University of KwaZulu-Natal.
- Gunderson, L.H. & Holling, C.S. 2002. Panarchy: Understanding Transformations in Human and Natural Systems. Washington DC: Island Press.
- Guo, B. 2011. Household Assets and Food Security: Evidence from the Survey of Program Dynamics. *Journal of Family and Economic Issues*, 32(1):98-110.
- Gupta, A.D. 2017. Water-Energy-Food (WEF) Nexus and Sustainable Development. (In Water-Energy-Food Nexus Principles and Practices, Eds Salam, P. A, Shrestha, S, Pandey, V.P and Anal, A. K, 229:223-242).
- Gwimbi, P. 2009. Linking rural community livelihoods to resilience building in flood risk reduction in Zimbabwe. *Jamba : Journal of Disaster Risk Studies*, 2(1):71-79.
- GWP. 2000. Towards Water Security: a Framework for action. GWP, Stockholm. <http://www.gwp.org/globalassets/global/toolbox/references/towards-water-security.-a-framework-for-action.-mobilising-political-will-to-act-gwp-2000.pdf> Date of access: 20 February 2015..
- Haile, M. 2005. Weather patterns, food security and humanitarian response in sub-Saharan Africa. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 360(1463):2169-2182.
- Hak, T., Janouskova, S. & Moldan, B. 2016. Sustainable Development Goals: A need for relevant indicators. *Ecological Indicators*, 60(2016):565-573.
- Hall, R.P., Van Koppen, B. & Van Houweling, E. 2014. The Human Right to Water: The Importance of Domestic and Productive Water Rights. *Science and Engineering Ethics*, 20(4):849-868.

- Hamdy, A., Driouech, N. & Hmid, A. 2014. The water-energy-food security nexus in the mediterranean: challenges and opportunities. (In. 5th International scientific agricultural symposium, agrosym organised by. p. 23-26).
- Hanjra, M.A., Ferede, T. & Gutta, D.G. 2009. Reducing poverty in sub-Saharan Africa through investments in water and other priorities. *Agricultural Water Management*, 96(7):1062-1070.
- Hardy, L., Garrido, A. & Juana, L. 2012. Evaluation of Spain's Water-Energy Nexus. *International Journal of Water Resources Development*, 28(1):151-170.
- Harris, F.M. & Mohammed, S. 2003. Relying on nature: wild foods in northern Nigeria. *AMBIO: A Journal of the Human Environment*, 32(1):24-29.
- Helmreich, B. & Horn, H. 2009. Opportunities in rainwater harvesting. *Desalination*, 248(1):118-124.
- Heltberg, R. 2004. Fuel switching: evidence from eight developing countries. *Energy Economics*, 26(5):869-887.
- Hendriks, S. 2014. Food security in South Africa: Status quo and policy imperatives. *Agrekon*, 53(2):1-24.
- Hendriks, S.L. 2005. The challenges facing empirical estimation of household food (in)security in South Africa. *Development Southern Africa*, 22(1):103-123.
- Hermann, S., Welsch, M., Segerstrom, R.E., Howells, M.I., Young, C., Alfstad, T., Rogner, H.-H. & Steduto, P. 2012. Climate, land, energy and water (CLEW) interlinkages in Burkina Faso: An analysis of agricultural intensification and bioenergy production. *Natural Resources Forum*, 36(4):245-262.
- Hernández, D. 2016. Understanding 'energy insecurity' and why it matters to health. *Social science & medicine (1982)*, 167:1-10.
- Hiemstra-van der Horst, G. & Hovorka, A.J. 2009. Fuelwood: The "other" renewable energy source for Africa? *Biomass and Bioenergy*, 33(11):1605-1616.
- Hildyard, N., Lohmann, L. & Sexton, S. 2012. Energy security: For whom? For what. Sturminster, Newton: The Corner House.: House, T.C.
<http://www.thecornerhouse.org.uk/sites/thecornerhouse.org.uk/files/Energy%20Security%20For%20Whom%20For%20What.pdf> Date of access: 12 April 2015..

- Hoff, H. 2011. Understanding the nexus: Background paper for the Bonn2011 Nexus Conference. Stockholm: Stockholm Environment Institute. <http://www.sei-international.org/publications?pid=1977> Date of access: 07 April 2015..
- Hoffman, D. & Nkadimeng, L. 2016. Investigating water supply challenges in the elias Motsoaledi municipality of Limpopo Province, south africa: a case of motetema settlement. South Africa: University of Pretoria.
- Holden, E., Linnerud, K. & Banister, D. 2014. Sustainable development: Our Common Future revisited. *Global Environmental Change*, 26(2014):130-139.
- Holling, C.S. 1973. Resilience and stability of ecological systems. *Annual review of ecology and systematics*, 4(1):1-23.
- Hope, R.A. 2006. Evaluating water policy scenarios against the priorities of the rural poor. *World Development*, 34(1):167-179.
- Hosier, R.H. & Dowd, J. 1987. Household fuel choice in Zimbabwe: An empirical test of the energy ladder hypothesis. *Resources and Energy*, 9(4):347-361.
- Howells, M., Hermann, S., Welsch, M., Bazilian, M., Segerström, R., Alfstad, T., Gielen, D., Rogner, H., Fischer, G., van Velthuisen, H., Wiberg, D., Young, C., Roehrl, R.A., Mueller, A., Steduto, P. & Ramma, I. 2013. Integrated analysis of climate change, land-use, energy and water strategies. *Nature Climate Change*, 3(7):621-626.
- Howells, M.I., Alfstad, T., Victor, D.G., Goldstein, G. & Remme, U. 2005. A model of household energy services in a low-income rural African village. *Energy Policy*, 33(14):1833-1851.
- HSRC. 2004. Fact Sheet: Poverty in South Africa. http://www.sarprn.org/documents/d0000990/P1096-Fact_Sheet_No_1_Poverty.pdf Date of access: 04 March 2015.
- HSRC. 2008. South African social attitude survey. Pretoria: HSRC.
- Hunt, L.C. & Ryan, D.L. 2015. Economic modelling of energy services: Rectifying misspecified energy demand functions. *Energy Economics*, 50(2015):273-285.
- Hunter, L.M., Twine, W. & Patterson, L. 2007. "Locusts are now our beef": Adult mortality and household dietary use of local environmental resources in rural South Africa1. *Scandinavian Journal of Public Health*, 35(69):165-174.

- Hussey, K. & Pittock, J. 2012. The Energy–Water Nexus: Managing the Links between Energy and Water for a Sustainable Future. *Ecology and Society*, 17(1).
- ICIMOD. 2012. Contribution of Himalayan ecosystems to water, energy, and food security in South Asia: A nexus approach. Kathmandu, Nepal: International Centre for Integrated Mountain Development (ICIMOD)
- Indu, B.A., Janice, M.D. & Magda, B. 1998. Social Support and Coping Behaviors of Low-Income Families Experiencing Food Insufficiency in North Carolina. *Health Education & Behavior*, 25(5):599-612.
- International Energy Agency. 2014. Africa Energy Outlook: A Focus on Energy Prospects in Sub-Saharan Africa, World Energy Outlook Special Report. France: International Energy Agency.
https://www.iea.org/media/news/2014/press/141013_WEO_Africa_Energy_OutlookFactsheet1.pdf Date of access: 06 June 2015.
- IPCC. 2018. Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C approved by governments. Geneva: World Meteorological Organization, United Nations Environment Programme, (Intergovernmental Panel on Climate Change press release).
https://www.ipcc.ch/pdf/session48/pr_181008_P48_spm_en.pdf Date of access 01 November 2018.
- Jabeen, H., Johnson, C. & Allen, A. 2010. Built-in resilience: learning from grassroots coping strategies for climate variability. *Environment and Urbanization*, 22(2):415-431.
- Jagger, P. & Jumbe, C. 2016. Stoves or sugar? Willingness to adopt improved cookstoves in Malawi. *Energy Policy*, 92(2016):409-419.
- Jeswani, H.K., Burkinshaw, R. & Azapagic, A. 2015. Environmental sustainability issues in the food–energy–water nexus: Breakfast cereals and snacks. *Sustainable Production and Consumption*, 2(2015):17-28.
- Jobbins, G., Kalpakian, J., Chriyaa, A., Legrouri, A. & El Mzouri, E.H. 2015. To what end? Drip irrigation and the water–energy–food nexus in Morocco. *International Journal of Water Resources Development*, 31(3):393-406.
- Johnson, N.G. & Bryden, K.M. 2012a. Energy supply and use in a rural West African village. *Energy*, 43(1):283-292.

- Johnson, N.G. & Bryden, K.M. 2012b. Factors affecting fuelwood consumption in household cookstoves in an isolated rural West African village. *Energy*, 46(1):310-321.
- Kahinda, J.-m.M., Rockström, J., Taigbenu, A.E. & Dimes, J. 2007a. Rainwater harvesting to enhance water productivity of rainfed agriculture in the semi-arid Zimbabwe. *Physics and Chemistry of the Earth, Parts A/B/C*, 32(15):1068-1073.
- Kahinda, J.-m.M., Taigbenu, A.E. & Boroto, J.R. 2007b. Domestic rainwater harvesting to improve water supply in rural South Africa. *Physics and Chemistry of the Earth, Parts A/B/C*, 32(15):1050-1057.
- Kanda, A., Murongazvombo, M. & Ncube, F. 2017. Adapting household water use in rural Zimbabwe. *International Journal of Environmental Studies*, 74(3):471-485.
- Kanyongo, G.Y. 2005. Zimbabwe's Public Education System Reforms: Successes and Challenges. *International Education Journal*, 6(1):65-74.
- Karabulut, A., Egoh, B.N., Lanzaova, D., Grizzetti, B., Bidoglio, G., Pagliero, L., Bouraoui, F., Aloe, A., Reynaud, A., Maes, J., Vandecasteele, I. & Mubareka, S. 2016. Mapping water provisioning services to support the ecosystem–water–food–energy nexus in the Danube river basin. *Ecosystem Services*, 17(2016):278-292.
- Karabulut, A.A., Crenna, E., Sala, S. & Udias, A. 2018. A proposal for integration of the ecosystem-water-food-land-energy (EWFLE) nexus concept into life cycle assessment: A synthesis matrix system for food security. *Journal of Cleaner Production*, 172(2018):3874-3889.
- Karekezi, S. & Majoro, L. 2002. Improving modern energy services for Africa's urban poor. *Energy Policy*, 30(11):1015-1028.
- Katsi, L., Siwadi, J., Guzha, E., Makoni, F.S. & Smits, S. 2007. Assessment of factors which affect multiple uses of water sources at household level in rural Zimbabwe – A case study of Marondera, Murehwa and Uzumba Maramba Pfungwe districts. *Physics and Chemistry of the Earth, Parts A/B/C*, 32(15):1157-1166.
- Kaygusuz, K. 2011. Energy services and energy poverty for sustainable rural development. *Renewable and Sustainable Energy Reviews*, 15(2):936-947.
- Kepe, T. & Tessaro, D. 2014. Trading-off: Rural food security and land rights in South Africa. *Land Use Policy*, 36(2014):267-274.

- Keskinen, M., Guillaume, J., Kattelus, M., Porkka, M., Räsänen, T. & Varis, O. 2016. The Water-Energy-Food Nexus and the Transboundary Context: Insights from Large Asian Rivers. *Water*, 8(5):193-218.
- Keskinen, M., Someth, P., Salmivaara, A. & Kummu, M. 2015. Water-Energy-Food Nexus in a Transboundary River Basin: The Case of Tonle Sap Lake, Mekong River Basin. *Water*, 7(10):5416-5436.
- Khagram, S., Clark, W. & Firas Raad, D. 2003. From the Environment and Human Security to Sustainable Security and Development. *Journal of Human Development*, 4(2):289-313.
- Khan, S. & Hanjra, M.A. 2009. Footprints of water and energy inputs in food production – Global perspectives. *Food Policy*, 34(2):130-140.
- Kibaroglu, A. & Gürsoy, S.I. 2015. Water–energy–food nexus in a transboundary context: the Euphrates–Tigris river basin as a case study. *Water International*, 40(5-6):824-838.
- Kinsey, B., Burger, K. & Gunning, J.W. 1998. Coping with drought in Zimbabwe: Survey evidence on responses of rural households to risk. *World Development*, 26(1):89-110.
- Kituyi, E., Marufu, L., Huber, B., O. Wandiga, S., O. Jumba, I., O. Andrae, M. & Helas, G. 2001. Biofuel consumption rates and patterns in Kenya. *Biomass and Bioenergy*, 20(2):83-99.
- Klein, R.J.T., Nicholls, R.J. & Thomalla, F. 2003. Resilience to natural hazards: How useful is this concept? *Environmental Hazards*, 5(1):35-45.
- Konkagul, E. 2009. *Water in a Changing World*. United Nations Educational, Scientific and Cultural Organisation (UNESCO), London United Kingdom.
<http://unesdoc.unesco.org/images/0018/001819/181993e.pdf> Date of access: 10 March 2015.
- Kowsari, R. & Zerriffi, H. 2011. Three dimensional energy profile:: A conceptual framework for assessing household energy use. *Energy Policy*, 39(12):7505-7517.
- Kristjanson, P., Waters-Bayer, A., Johnson, N., Tipilda, A., Njuki, J., Baltenweck, I., Grace, D. & MacMillan, S. 2014. (In Quisumbing, A.R., Meinzen-Dick, R., Raney, T.L., Croppenstedt, A., Behrman, J.A. & Peterman, A., eds. *Gender in Agriculture: Closing the Knowledge Gap*. Dordrecht: Springer Netherlands. p. 209-233).

- Kruyt, B., van Vuuren, D.P., de Vries, H.J.M. & Groenenberg, H. 2009. Indicators for energy security. *Energy Policy*, 37(6):2166-2181.
- Kujinga, K., Vanderpost, C., Mmopelwa, G. & Wolski, P. 2014. An analysis of factors contributing to household water security problems and threats in different settlement categories of Ngamiland, Botswana. *Physics and Chemistry of the Earth, Parts A/B/C*, 67:187-201.
- Kurian, M. 2017. The water-energy-food nexus. *Environmental Science & Policy*, 68:97-106.
- Labadarios, D., Mchiza, Z.J.-R., Steyn, N.P., Gericke, G., Maunder, E.M.W., Davids, Y.D. & Parker, W.-a. 2011. Food security in South Africa: a review of national surveys. *Bulletin of the World Health Organization*, 89:891-899.
- Latham, C.J.K. 2002. Manyame Catchment Council: a review of the reform of the water sector in Zimbabwe. *Physics and Chemistry of the Earth, Parts A/B/C*, 27(11):907-917.
- Lawford, R., Bogardi, J., Marx, S., Jain, S., Wostl, C.P., Knüppe, K., Ringler, C., Lansigan, F. & Meza, F. 2013. Basin perspectives on the Water–Energy–Food Security Nexus. *Current Opinion in Environmental Sustainability*, 5(6):607-616.
- Leck, H., Conway, D., Bradshaw, M. & Rees, J. 2015. Tracing the Water–Energy–Food Nexus: Description, Theory and Practice. *Geography Compass*, 9(8):445-460.
- Leedy, P. & Ormrod, J. 2005. Practical research: Planning and design. New Jersey: Pearson Merrill Prentice hall.
- Leedy, P.D. & Ormrod, J.E. 2014. Practical research: planning and design. 10th. Essex, England Pearson Education Limited.: Pearson Education Limited.
- Leese, M. & Meisch, S. 2015. Securitising Sustainability? Questioning the 'Water, Energy and Food-Security Nexus'. *Water Alternatives*, 8(1):695-709.
- LEESE, M. & MEISCH, S. 2015. Securitising sustainability? Questioning the 'water, energy and foodsecurity nexus'. *Water Alternatives*, 8.
- Legwaila, G., Mojeremane, W., Madisa, M., Mmolotsi, R. & Rampart, M. 2011. Potential of traditional food plants in rural household food security in Botswana. *Journal of Horticulture and Forestry*, 3(6):171-177.

- Lin, B.B. 2011. Resilience in Agriculture through Crop Diversification: Adaptive Management for Environmental Change. *BioScience*, 61(3):183-193.
- Lincoln, Y.S. & Guba, E.G. 1985. *Naturalistic inquiry*. Newbury Park, CA: Sage.
- Lobell, D.B., Burke, M.B., Tebaldi, C., Mastrandrea, M.D., Falcon, W.P. & Naylor, R.L. 2008. Prioritizing climate change adaptation needs for food security in 2030. *Science*, 319(5863):607-610.
- Mabhaudhi T, Simpson G, Badenhorst J, Mohammed M, Motongera T, Senzanje A & Jewitt A. 2018. Assessing the State of the Water-Energy-Food (WEF) Nexus in South Africa. South Africa: Water Research Commission & University of KwaZulu-Natal. (WRC Report No KV 365/18) Date of access: 01 October 2018. URL: <http://www.wrc.org.za/Knowledge%20Hub%20Documents/Research%20Reports/KV%20365-18.pdf>.
- Mabhaudhi, T., Jewitt, G., Senzanje, A., Madhlopa, A., Stuart-Hill, S., Mpandeli, S. & Simpson, G. 2017. Linking the water-energy-food nexus to the sustainable development goals: a southern African perspective. 18th WaterNet/GWP-SA Symposium. Swakopmund, Namibia.
- Mabhaudhi, T., Mpandeli, S., Madhlopa, A., Modi, A. T., Backeberg, G. & Nhamo, L. 2016. Southern Africa's Water-Energy Nexus: Towards Regional Integration and Development. *Water*, 8.
- Mabuza, M.L., Ortmann, G.F., Wale, E. & Mutenje, M.J. 2016. The effect of major income sources on rural household food (in)security: Evidence from Swaziland and implications for policy. *Ecology of Food and Nutrition*, 55(2):209-230.
- Machethe, C., Mollel, N., Ayisi, K., Mashatola, M., Anim, F. & Vanasche, F. 2004. Smallholder irrigation and agricultural development in the Olifants River Basin of Limpopo Province: management, transfer, productivity, profitability and food security Issues. *Report to the Water Research Commission on the Project "Sustainable Local Management of Smallholder Irrigation in the Olifants River Basin of Limpopo Province," Pretoria, South Africa*.
- Machiwana, V.R. 2010. The impact of rural water supply and sanitation programmes in Chivi District, Zimbabwe. Harare: University of Zimbabwe.

- Mack, S., Hoffmann, D. & Otte, J. 2007. The contribution of poultry to rural development. *World's Poultry Science Journal*, 61(1):7-14.
- Madubansi, M. & Shackleton, C.M. 2006. Changing energy profiles and consumption patterns following electrification in five rural villages, South Africa. *Energy Policy*, 34(18):4081-4092.
- Magadza, C.H.D. 2000. Climate Change Impacts and Human Settlements in Africa: Prospects for Adaptation. *Environmental Monitoring & Assessment*, 61(1):193-205.
- Majuru, B., Jagals, P. & Hunter, P.R. 2012. Assessing rural small community water supply in Limpopo, South Africa: Water service benchmarks and reliability. *Science of The Total Environment*, 435-436:479-486.
- Majuru, B., Suhrcke, M. & Hunter, P.R. 2016. How Do Households Respond to Unreliable Water Supplies? A Systematic Review. *International Journal of Environmental Research and Public Health*, 13(12):1222.
- Makiwane, M. 2010. The Child Support Grant and teenage childbearing in South Africa. *Development Southern Africa*, 27(2):193-204.
- Makoni, F.S., Manase, G. & Ndamba, J. 2004. Patterns of domestic water use in rural areas of Zimbabwe, gender roles and realities. *Physics and Chemistry of the Earth, Parts A/B/C*, 29(15):1291-1294.
- Maleksaeidi, H. & Karami, E. 2013. Social-Ecological Resilience and Sustainable Agriculture Under Water Scarcity. *Agroecology and Sustainable Food Systems*, 37(3):262-290.
- Mansson, A., Johansson, B. & Nilsson, L.J. 2014. Assessing energy security: An overview of commonly used methodologies. *Energy*, 73(2014):1-14.
- Manzungu, E. 2002. More than a headcount: towards strategic stakeholder representation in catchment management in South Africa and Zimbabwe. *Physics and Chemistry of the Earth, Parts A/B/C*, 27(11):927-933.
- Manzungu, E. 2004. Water for all: improving water resource governance in Southern Africa. The Gatekeeper Series no 113. International Institute for Environment and Development: SIDA.

- Mapako, M. & Prasad, G. 2005. The free basic electricity policy and rural grid-connected households, solar home system users and unelectrified households. (*In. Proceedings of the International Conference on Domestic use of Energy organised by.* p. 29-31).
- Maree, K. 2007. First steps in research. Pretoria: Van Schaik Publishers.
- Maroyi, A. 2011. The Gathering and Consumption of Wild Edible Plants in Nhema Communal Area, Midlands Province, Zimbabwe. *Ecology of Food and Nutrition*, 50(6):506-525.
- Maroyi, A. 2013. Use of weeds as traditional vegetables in Shurugwi District, Zimbabwe. *Journal of Ethnobiology and Ethnomedicine*, 9(1):60.
- Marshall, M.N. 1996. Sampling for qualitative research. *Family Practice*, 13(6):522-526.
- Martineau, R. 1997. Women and Education in South Africa: Factors Influencing Women's Educational Progress and Their Entry into Traditionally Male-Dominated Fields. *The Journal of Negro Education*, 66(4):383-395.
- Martinez-Hernandez, E., Leach, M. & Yang, A. 2017. Understanding water-energy-food and ecosystem interactions using the nexus simulation tool NexSym. *Applied Energy*, 206(2017):1009-1021.
- Marufu, L., Ludwig, J., Andreae, M.O., Meixner, F.X. & Helas, G. 1997. Domestic biomass burning in rural and urban Zimbabwe—Part A. *Biomass and Bioenergy*, 12(1):53-68.
- Masera, O.R., Saatkamp, B.D. & Kammen, D.M. 2000. From Linear Fuel Switching to Multiple Cooking Strategies: A Critique and Alternative to the Energy Ladder Model. *World Development*, 28(12):2083-2103.
- Mason, N. & Calow, R. 2012. Water security: from abstract concept to meaningful metrics. London, UK. <https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/7866.pdf> Date of access: 04 June 2015.
- Matshe, I. 2004. Off-farm labour allocation decisions in small-scale rural households in Zimbabwe. *Agricultural Economics*, 30(3):175-186.
- Matsika, R., Erasmus, B.F.N. & Twine, W.C. 2013. Double jeopardy: The dichotomy of fuelwood use in rural South Africa. *Energy Policy*, 52:716-725.

- Mavengahama, S., McLachlan, M. & de Clercq, W. 2013. The role of wild vegetable species in household food security in maize based subsistence cropping systems. *Food Security*, 5(2):227-233.
- Mavhura, E., Manyena, S.B., Collins, A.E. & Manatsa, D. 2013. Indigenous knowledge, coping strategies and resilience to floods in Muzarabani, Zimbabwe. *International Journal of Disaster Risk Reduction*, 5(2013):38-48.
- Maxwell, D. & Caldwell, R. 2008. The coping strategies index: field methods manual. Atlanta, GA: CARE.http://home.wfp.org/stellent/groups/public/documents/manual_guide_proced/wfp211058. Pdf Date of access: 02 May 2015.
- Maxwell, D., Watkins, B., Wheeler, R. & Collins, G. 2003. The coping strategies index: A tool for rapidly measuring food security and the impact of food aid programs in emergencies. Nairobi: CARE Eastern and Central Africa Regional Management Unit and the World Food Programme Vulnerability Assessment and Mapping Unit.
- Maxwell, S. & Smith, M. 1992. Household food security: a conceptual review. Rome and New York.
- May, T. 2001. Social research: issues, methods and process. 3rd ed. Berkshire, UK: Open Press University.
- Mayor, B., López-Gunn, E., Villarroya, F.I. & Montero, E. 2015. Application of a water–energy–food nexus framework for the Duero river basin in Spain. *Water International*, 40(5-6):791-808.
- McCusker, B. 2004. Land Use and Cover Change as an Indicator of Transformation on Recently Redistributed Farms in Limpopo Province, South Africa. *Human Ecology*, 32(1):49-75.
- McMillan, J.H. & Schumacher, S. 2014. Research in education: Evidence-based inquiry. New Jersey: Pearson Higher Ed.
- Mehretu, A. & Mutambirwa, C. 1992. Gender differences in time and energy costs of distance for regular domestic chores in rural Zimbabwe: A case study in the Chiduku communal area. *World Development*, 20(11):1675-1683.

- Meissner, R. 2018. Water Security at Local Government Level: Towards a Individual Water Security Perspective. (Presented to the South African Water History Archival Repository (SAWHAR), North-West University, Vanderbijlpark Campus, 17 March 2018).
- Menendez, A. & Curt, M.D. 2013. Energy and socio-economic profile of a small rural community in the highlands of central Tanzania: A case study. *Energy for Sustainable Development*, 17(3):201-209.
- Mertens, D.M. 2010. Research and evaluation in education and psychology. 3rd ed. London: Sage Publications.
- MHCW. 2008. Chivi District Annual Report for 2008. Chivi, Masvingo.
- Miah, M.D., Kabir, R.R.M.S., Koike, M., Akther, S. & Yong Shin, M. 2010. Rural household energy consumption pattern in the disregarded villages of Bangladesh. *Energy Policy*, 38(2):997-1003.
- Middleton, C., Allouche, J., Gyawali, D. & Allen, S. 2015. The Rise and Implications of the Water-Energy-Food Nexus in Southeast Asia through an Environmental Justice Lens. *Water Alternatives*, 8(1):627-654.
- Mintz, E., Bartram, J., Lochery, P. & Wegelin, M. 2001. Not Just a Drop in the Bucket: Expanding Access to Point-of-Use Water Treatment Systems. *American Journal of Public Health*, 91(10):1565-1570.
- Misselhorn, A.A. 2005. What drives food insecurity in southern Africa? a meta-analysis of household economy studies. *Global Environmental Change*, 15(1):33-43.
- Mohtar, R.H. & Daher, B. 2012. Water, energy, and food: The ultimate nexus. (In Encyclopedia of agricultural, food, and biological engineering, Eds, Heldman, D, Moraru, C.I, 2nd ed. CRC Press, 2012).
- Moner-Girona, M., Ghanadan, R., Jacobson, A. & Kammen, D.M. 2006. Decreasing PV costs in Africa. *Refocus*, 7(1):40-45.
- Morrow, B.H. 1999. Identifying and Mapping Community Vulnerability. *Disasters*, 23(1):1-18.
- Mouton, J. 2009. Understanding social research. 6th ed. Pretoria: Van Schaik publishers.

- Mpandeli, S. 2014. Evaluation of Crop Production Practices by Farmers in Tshakhuma, Tshiombo and Rabali Areas in Limpopo Province of South Africa. *Journal of Agricultural Science*, 6(8):10-19.
- Mpandeli, S. 2017. Driving the Water-Energy-Food nexus in the context of sustainable development. *Water Wheel*, 16(5):34-35.
- Mpandeli, S. & Maponya, P. 2013. Coping with climate variability in Limpopo Province, South Africa. *Peak Journal of Agricultural Sciences*, 1(4):54-64.
- Mpandeli, S., Naidoo, D., Mabhaudhi, T., Nhemachena, C., Nhamo, L., Liphadzi, S., Hlahla, S. & Modi, A. 2018. Climate Change Adaptation through the Water-Energy-Food Nexus in Southern Africa. *International Journal of Environmental Research and Public Health*, 15(10):2306.
- Mpandeli, S., Nesamvuni, E. & Maponya, P. 2015. Adapting to the Impacts of Drought by Smallholder Farmers in Sekhukhune District in Limpopo Province, South Africa. *Journal of Agricultural Science*, 7(2):115-125.
- Mtisi, S. & Nicol, A. 2003. Water Points and Water Policies: Decentralisation and Community Management in Sangwe Communal Area. *Sustainable Livelihoods in Southern Africa Research Paper 15*. Brighton: Institute of Development Studies, University of Sussex.
- Muchadeyi, F.C., Sibanda S, Kusina N T, Kusina J & S, M. 2004. The village chicken production system in Rushinga District of Zimbabwe. *Livestock Research for Rural Development*, 16(40)1-10.
- Mudimu, G. 2002. Zimbabwe's food security policy and strategy: country position paper for the FAO World Food Summit <https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/5613.pdf> Date of access: 15 Feb 2016.
- Mudombi, S. & Muchie, M. 2013. Perceptions of water access in the context of climate change by rural households in the Seke and Murewa districts, Zimbabwe. *Jamba: Journal of Disaster Risk Studies*, 5(1): 1-8.
- Mudzonga, E. 2012. Farmers' Adaptation to Climate Change in Chivi District of Zimbabwe. Belgravia, Harare: Trade and Development Studies Centre.

- Mukherji, A. 2007. The energy-irrigation nexus and its impact on groundwater markets in eastern Indo-Gangetic basin: Evidence from West Bengal, India. *Energy Policy*, 35(12):6413-6430.
- Muller, H. Affairs, W. 2011. The Right to Water and Sanitation- the South African experience: A presentation at the Consultation with State Actors- Good Practices in Water, Sanitation and Human Rights. Republic of South Africa.
- Muller, M., Schreiner, B., Smith, L., Van Koppen, B., Sally, H., Aliber, M., Cousins, B., Tapela, B., Van der Merwe-Botha, M., Karar, E. & Pietersen, K. 2009. Water security in South Africa. Midrand: DBSA.
- Muller-Kraenner, S. 2015. Energy Security. New York:Routledge, Taylor & Francis.
- Murphree, M.W. 1991. Communities as institutions for resource management. London: Sage publications.
- Mushtaq, S., Maraseni, T.N., Maroulis, J. & Hafeez, M. 2009. Energy and water tradeoffs in enhancing food security: A selective international assessment. *Energy Policy*, 37(9):3635-3644.
- Mutopo, P. 2011. Women's struggles to access and control land and livelihoods after fast track land reform in Mwenezi District, Zimbabwe. *The Journal of Peasant Studies*, 38(5):1021-1046.
- Mwabu, G. & Thorbecke, E. 2004. Rural Development, Growth and Poverty in Africa. *Journal of African Economies*, 13(1):16-65.
- Namara, R.E., Hanjra, M.A., Castillo, G.E., Ravnborg, H.M., Smith, L. & Van Koppen, B. 2010. Agricultural water management and poverty linkages. *Agricultural Water Management*, 97(4):520-527.
- Nawrotzki, R.J., Robson, K., Gutilla, M.J., Hunter, L.M., Twine, W. & Norlund, P. 2014. Exploring the impact of the 2008 global food crisis on food security among vulnerable households in rural South Africa. *Food Security*, 6(2):283-297.
- Ncube, A. 2012. Impact of livelihood diversification on household food security: the case of Hurungwe District, Zimbabwe (Dissertation). South Africa: UNISA
- Nelson, V. & Stathers, T. 2009. Resilience, power, culture, and climate: a case study from semi-arid Tanzania, and new research directions. *Gender & Development*, 17(1):81-94.

- Nemarundwe, N. 2003. Negotiating resource access: institutional arrangements for woodlands and water use in Southern Zimbabwe. Uppsala: Swedish University of Agricultural Sciences.
- Nemarundwe, N. & Kozanayi, W. 2003. Institutional arrangements for water resource use: A case study from southern Zimbabwe. *Journal of Southern African Studies*, 29(1):193-206.
- Nembambula, A.A. 2013. An investigation into the challenges and the management of firewood scarcity on rural livelihood in Limpopo Province, Vhembe District: a case study of Nweli Village.south africa (MA Thesis). University of Venda
- Nesamvuni, C., Steyn, N.P. & Potgieter, M.J. 2001. Nutritional value of wild, leafy plants consumed by the Vhavenda : research letter. *South African Journal of Science*, 97(1-2):51-54.
- Netshipale, L.L. 2016. Water Services Delivery In Mukondeni Village In Limpopo Province, South Africa (MA Thesis). University of Limpopo.
- Neubert, S., Komm, M. & Krumsiek, A. 2011. Agricultural development in a changing climate in Zambia: Increasing resilience to climate change and economic shocks in crop production. Humburg: German Development Institute
- Ngoran, S.D., Dogah, K.E. & Xue, X. 2015. Assessing the impacts of climate change on water resources: The Sub-Saharan Africa perspective. *Journal of Economics and Sustainable Development*, 6(1):185-193.
- Nieuwenhuis, J. 2010. (In Maree, K., ed. First steps in research. 5th ed. Pretoria: Van Schaik Publishers).
- Nthenge, A.K. 2016. Water access challenges and coping strategies in selected sites of Makueni county,Kenya. Nairobi: South Eastern Kenya University.
- Nyong, A.O. & Kanaroglou, P.S. 1999. Domestic Water Use in Rural Semiarid Africa: A Case Study of Katarko Village in Northeastern Nigeria. *Human Ecology*, 27(4):537-555.
- Nyong, A.O. & Kanaroglou, P.S. 2001. A survey of household domestic water-use patterns in rural semi-arid Nigeria. *Journal of Arid Environments*, 49(2):387-400.
- Oberhauser, A.M. & Pratt, A. 2004. Women's collective economic strategies and political transformation in rural South Africa. *Gender, Place & Culture*, 11(2):209-228.

- Oberhauser, A.M., Mandel, J.L. & Hapke, H.M. 2004. Gendered livelihoods in diverse global contexts: an introduction. *Gender, Place & Culture*, 11(2):205-208.
- Ofoegbu, C., Chirwa, P.W., Francis, J. & Babalola, F.D. 2016. Assessing forest-based rural communities' adaptive capacity and coping strategies for climate variability and change: The case of Vhembe district in south Africa. *Environmental Development*, 18(2016):36-51.
- Ogunlela, Y.I. & Mukhtar, A.A. 2009. Gender issues in agriculture and rural development in Nigeria: The role of women. *Humanity & social sciences Journal*, 4(1):19-30.
- O'Laughlin, B. 1998. Missing men? The debate over rural poverty and women-headed households in Southern Africa. *The Journal of Peasant Studies*, 25(2):1-48.
- Oldewage-Theron, W.H., Dicks, E.G. & Napier, C.E. 2006. Poverty, household food insecurity and nutrition: Coping strategies in an informal settlement in the Vaal Triangle, South Africa. *Public Health*, 120(9):795-804.
- Oli, B., Anne, H. & Robert, M. 2007. Climate Change as the 'New' Security Threat: Implications for Africa. *International Affairs (Royal Institute of International Affairs 1944-)*, 83(6):1141-1154.
- Olonisakin, F. 2003. Security and Sustainable Development: An African Perspective. United Nations Organisation:Geneva. <https://www.un.org/ruleoflaw/files/Olonisakin.pdf> Date of access: 22 July 2015.
- Onditi, F.O. 2010. Rural-based water security coping strategies: a case of Muhuru-bay Migori District, Western Kenya. Nairobi: University of Nairobi.
- Oni .S, Maliwichi. L, L., O. & Olusegun A. 2010. Socio-economic factors affecting smallholder farming and household food security: A case of Thulamela local municipality in Vhembe District of Limpopo Province, South Africa. *African Journal of Agricultural Research* 5(17), pp. 2289-2296.
- Oni, S.A., Maliwichi, L.L. & Obadire, O. 2011. Assessing the contribution of smallholder irrigation to household food security, in comparison to dryland farming in Vhembe district of Limpopo Province, South Africa. *African Journal of Agricultural Research* 6(10), pp. 2188-2197.

- Pachauri, S. 2004. An analysis of cross-sectional variations in total household energy requirements in India using micro survey data. *Energy Policy*, 32(15):1723-1735.
- Pachauri, S. 2010. (In Sovacool, B.K., ed. The Routledge handbook of energy security. New York: Routledge).
- Parliament of Zimbabwe. 2011. Parliament of Zimbabwe, Tuesday, 20th September, 2011. Harare: Zimbabwe.
- Patton, M.Q. & Cochran, M. 2002. A guide to using qualitative research methodology. UK: Medicins Sans Frontiers.
- Paumgarten, F. & Shackleton, C.M. 2011. The role of non-timber forest products in household coping strategies in South Africa: the influence of household wealth and gender. *Population and Environment*, 33(1):108-131.
- Pereira, L.S., Cordery, I. & Iacovides, I. 2009. Coping with water scarcity: Addressing the challenges. *International Hydrological Programme*. Unesco: Springer Science & Business Media.
- Pereira, L.S., Cuneo, C. & Twine, W.C. 2014. Food and cash: understanding the role of the retail sector in rural food security in South Africa. *Food Security*, 6(3):339-357.
- Perrings, C. 2006. Resilience and sustainable development. *Environment and Development Economics*, 11(4):417-427.
- Perrone, D., Murphy, J. & Hornberger, G.M. 2011. Gaining Perspective on the Water–Energy Nexus at the Community Scale. *Environmental Science & Technology*, 45(10):4228-4234.
- Petrosillo, I., Zaccarelli, N. & Zurlini, G. 2010. Multi-scale vulnerability of natural capital in a panarchy of social–ecological landscapes. *Ecological Complexity*, 7(3):359-367.
- Pickering, A.J., Davis, J., Walters, S.P., Horak, H.M., Keymer, D.P., Mushi, D., Strickfaden, R., Chynoweth, J.S., Liu, J., Blum, A., Rogers, K. & Boehm, A.B. 2010. Hands, Water, and Health: Fecal Contamination in Tanzanian Communities with Improved, Non-Networked Water Supplies. *Environmental Science & Technology*, 44(9):3267-3272.
- Pimentel, D., Houser, J., Preiss, E., White, O., Fang, H., Mesnick, L., Barsky, T., Tariche, S., Schreck, J. & Alpert, S. 1997. Water resources: agriculture, the environment, and society. *BioScience*, 47(2):97-106.

- Pingali, P., Alinovi, L. & Sutton, J. 2005. Food Security in Complex Emergencies: Enhancing Food System Resilience. *Disasters*, 29(S1):S5-S24.
- Pinstrup-Andersen, P. 2009. Food security: definition and measurement. *Food Security*, 1(1):5-7.
- Pisano, U. 2012a. Resilience and Sustainable Development: Theory of resilience, systems thinking. *European Sustainable Development Network (ESDN) Quarterly report*, 26:1-50.
- Pisano, U. 2012b. Resilience and Sustainable Development: Theory of resilience, systems thinking and adaptive governance. Vienna, Austria: ESDN.
<https://pdfs.semanticscholar.org/8f2e/b4dfe08f00faa0567c88b5ef1019c08714e3.pdf>
 Date of access: 03 June 2018.
- Pittock, J., Orr, S., Stevens, L., Aheeyar, M. & Smith, M. 2015. Tackling Trade-offs in the Nexus of Water, Energy and Food. *Aquatic Procedia*, 5(2015):58-68.
- Plummer, R. & Armitage, D. 2007. A resilience-based framework for evaluating adaptive co-management: Linking ecology, economics and society in a complex world. *Ecological Economics*, 61(1):62-74.
- Posel, D. & Rogan, M. 2009. Women, income and poverty: Gendered access to resources in Post-Apartheid South Africa. *Agenda*, 23(81):25-34.
- Postel, S.L. 1998. Water for food production: Will there be enough in 2025? *BioScience*, 48(8):629-637.
- Quaye, W. 2008. Food security situation in northern Ghana, coping strategies and related constraints. *African Journal of Agricultural Research*, 3(5):334-342.
- Quinn, C.H., Ziervogel, G., Taylor, A., Takama, T. & Thomalla, F. 2011. Coping with Multiple Stresses in Rural South Africa. *Ecology & Society*, 16(3):1-20.
- Rahut, D.B., Behera, B. & Ali, A. 2015. Household access to water and choice of treatment methods: Empirical evidence from Bhutan. *Water Resources and Rural Development*, 5(2015):1-16.
- Raidimi, E.N. 2014. The roles and activities of women in the six selected agricultural projects in Thulamela Local Municipality of Vhembe District Municipality in the Limpopo Province. *South African Journal of Agricultural Extension*, 42(2):10-23.

- Rasul, G. 2014. Food, water, and energy security in South Asia: A nexus perspective from the Hindu Kush Himalayan region☆. *Environmental Science & Policy*, 39(2014):35-48.
- Rasul, G. 2016. Managing the food, water, and energy nexus for achieving the Sustainable Development Goals in South Asia. *Environmental Development*, 18(2016):14-25.
- Rasul, G. & Sharma, B. 2015. The nexus approach to water–energy–food security: an option for adaptation to climate change. *Climate Policy*, 16(6):682-702.
- Reddy, B.V.S., Ramesh, S., Ashok Kumar, A., Wani, S.P., Ortiz, R., Ceballos, H. & Sreedevi, T.K. 2008. Bio-Fuel Crops Research for Energy Security and Rural Development in Developing Countries. *BioEnergy Research*, 1(3-4):248-258.
- Republic of South Africa. 1997. Water Services Act, Act No. 108. 1997. Capetown: South Africa.
- Republic of South Africa. 1998. National Water Act, Act no 36 of 1998. Pretoria: South Africa.
- Ribar, D.C. & Hamrick, K.S. 2003. Dynamics of poverty and food sufficiency: US Department of Agriculture, Economic Research Service Washington, DC.
- Rijsberman, F.R. 2006. Water scarcity: Fact or fiction? *Agricultural Water Management*, 80(1-3):5-22.
- Ringler, C., Bhaduri, A. & Lawford, R. 2013. The nexus across water, energy, land and food (WELF): potential for improved resource use efficiency? *Current Opinion in Environmental Sustainability*, 5(6):617-624.
- Ritchie, J., Lewis, J., Nicholls, C.M. & Ormston, R. 2013. Qualitative research practice: A guide for social science students and researchers. London: Sage publications.
- Robertson, J. & Lawes, M.J. 2005. User perceptions of conservation and participatory management of iGxalingenwa forest, South Africa. *Environmental Conservation*, 32(1):64-75.
- Rockström, J. 2003. Resilience building and water demand management for drought mitigation. *Physics and Chemistry of the Earth, Parts A/B/C*, 28(20):869-877.
- Rosegrant, M.W. & Cline, S.A. 2003. Global Food Security: Challenges and Policies. *Science*, 302(5652):1917-1919.

- Rosegrant, M.W., Cai, X. & Cline, S.A. 2002. World water and food to 2025: dealing with scarcity. Washington D.C:International Food Policy Research Institute, International Water Management Institute.
- Rubin, H.J. & Rubin, I.S. 1995. Qualitative Interviewing: The Art of Hearing Data. London: Sage Publications.
- Ruel, M.T., Garrett, J.L., Hawkes, C. & Cohen, M.J. 2010. The food, fuel, and financial crises affect the urban and rural poor disproportionately: a review of the evidence. *Journal of Nutrition*, 140(1):170S-176S.
- Rukuni, M., Tawonezvi, P., Eicher, C., Munyuki-Hungwe, M. & Matondi, P. 2006. Zimbabwe's agricultural revolution revisited. Harare: University of Zimbabwe Publications.
- Sachs, I. & Silk, D. 1990. Food and energy: strategies for sustainable development. Washington DC: United Nations University Press.
- Sachs, J.D. 2012. From Millennium Development Goals to Sustainable Development Goals. *The Lancet*, 379(9832):2206-2211.
- Schreiner, B. & Van Koppen, B. 2002. Catchment Management Agencies for poverty eradication in South Africa. *Physics and Chemistry of the Earth, Parts A/B/C*, 27(11):969-976.
- Scoones, I. 1995. Investigating Difference: Applications of Wealth Ranking and Household Survey Approaches among Farming Households in Southern Zimbabwe. *Development and Change*, 26(1):67-88.
- Scoones, I. 2009. Livelihoods perspectives and rural development. *The Journal of Peasant Studies*, 36(1):171-196.
- Scoones, I. & et al. 1996. Hazards and opportunities: farming livelihoods in dryland Africa. Lessons from Zimbabwe. London: Zed Books.
- Scott, C.A., Kurian, M. & Wescoat, J.L. 2015. (In Kurian, M. & Ardakanian, R., eds. Governing the Nexus: Water, Soil and Waste Resources Considering Global Change. Cham: Springer International Publishing. p. 15-38).
- Sebitosi, A.B. 2008. Energy efficiency, security of supply and the environment in South Africa: Moving beyond the strategy documents. *Energy*, 33(11):1591-1596.

- Sen, A.K. 1999. *Development as Freedom*. Oxford: Oxford University Press.
- Sershen, Rodda, N., Stenström, T., Schmidt, S., Dent, M., Bux, F., Hanke, N., Buckley, C. & Fennemore, C. 2016. Water security in South Africa: Perceptions on public expectations and municipal obligations, governance and water re-use. *Water SA*, 42(3):456-465.
- Shabaya, J. & Konadu-Agyemang, K. 2010. Unequal access, unequal participation: some spatial and socio-economic dimensions of the gender gap in education in Africa with special reference to Ghana, Zimbabwe and Kenya. *Compare: A Journal of Comparative and International Education*, 34(4):395-424.
- Shackleton, C. & Shackleton, S. 2004. The importance of non-timber forest products in rural livelihood security and as safety nets: a review of evidence from South Africa. *South African Journal of Science*, 100(11/12):658-654.
- Shariff, Z.M. & Khor, G.L. 2008. Household food insecurity and coping strategies in a poor rural community in Malaysia. *Nutrition Research and Practice*, 2(1):26-34.
- Shepherd, G. 2012. The non-cash values of forests, and their CPF OLI September 19-21st, 2012 Rome Italy importance [PowerPoint]. Paper presented at the CPF OLI September 19-21st, 2012, Rome Italy.
<https://pdfs.semanticscholar.org/presentation/1d3d/0ac544b4542d58190ac9d508e54b4edf2a7c.pdf> Date of access: 22 March 2018..
- Sibhatu, K.T. & Qaim, M. 2017. Rural food security, subsistence agriculture, and seasonality. *PLOS ONE*, 12(10):e0186406.
- Siddiqi, A. & Anadon, L.D. 2011. The water–energy nexus in Middle East and North Africa. *Energy Policy*, 39(8):4529-4540.
- Sigenu, K. 2006. *The role of rural women in mitigating water scarcity*. Bloemfontein: University of the Free State.
- Simba, F., Chikodzi, D. & Murwendo, T. 2012. Climate change scenarios, perceptions and crop production: a case study of Semi-arid Masvingo Province in Zimbabwe. *Journal of Earth Science and Climate Change*, 3(124):2.

- Sinyolo, S., Mudhara, M. & Wale, E. 2014. Water security and rural household food security: empirical evidence from the Mzinyathi district in South Africa. *Food Security*, 6(4):483-499.
- Slifko, T.R., Smith, H.V. & Rose, J.B. 2000. Emerging parasite zoonoses associated with water and food. *International Journal for Parasitology*, 30(12):1379-1393.
- Snel, E. & Staring, R. 2001. Poverty, migration, and coping strategies: an introduction. *Focaal European Journal of Anthropology*, 38(2001):7-22.
- Sovacool, B.K. 2012. The political economy of energy poverty: A review of key challenges. *Energy for Sustainable Development*, 16(3):272-282.
- Staton, D.M. & Harding, M.H. 1998. Health and environmental effects of cooking stove use in developing countries. The Renewable Energy Policy Project and the Center for Renewable Energy and Sustainable Technology.
<http://lists.bioenergylists.org/stovesdoc/Environment/staton.pdf> Date of access: 27 February 2013.
- StatsSA. 2011, S.S.A. 2011b. Census 2011 Statistical Release. Pretoria: Statistics South Africa.
- StatsSA. 2014. Poverty Trends in South Africa: An examination of absolute poverty between 2006 and 2011. Pretoria: Statistics South Africa.
- StatsSA. 2015. General household survey 2014. Pretoria: Statistics South Africa.
- StatsSA. 2017a. Living Conditions of Households in South Africa: An analysis of household expenditure and income data using the LCS 2014/2015, Statistical release. Pretoria: South Africa.
- StatsSA. 2017b. Poverty Trends in South Africa: An examination of absolute poverty between 2006 and 2015. Pretoria: South Africa.
- StatsSA. 2017c. Statistical release P0318: General household survey 2016 Pretoria: South Africa.
- StatsSA. Department of Water and Sanitation. 2011a. 2011 Census: South African demarcation board, municipal boundaries. Pretoria: South Africa.

- Stevens, L. & Gallagher, M. 2015. *The Energy–Water–Food Nexus at Decentralized Scales: Synergies, Trade-offs and How to Manage Them*. Rugby: Practical Action Publishing.
- Stevenson, J.R., Serraj, R. & Cassman, K.G. 2014. Evaluating conservation agriculture for small-scale farmers in Sub-Saharan Africa and South Asia. *Agriculture, Ecosystems & Environment*, 187(2014):1-10.
- Stewart, F. 2004. Development and security. *Conflict, Security & Development*, 4(3):261-288.
- Steyn, N.P., Olivier, J., Winter, P., Burger, S. & Nesamvuni, C. 2001. A survey of wild, green, leafy vegetables and their potential in combating micronutrient deficiencies in rural populations : research in action. *South African Journal of Science*, 97(7-8):276-278.
- Streb, C.K. 2010. *Encyclopedia of Case Study Research*. Thousand Oaks: California: SAGE Publications, Inc. <http://sk.sagepub.com/reference/casestudy> Date of access: 23 Sep 2015.
- Sturm, M., Zimmermann, M., Schütz, K., Urban, W. & Hartung, H. 2009. Rainwater harvesting as an alternative water resource in rural sites in central northern Namibia. *Physics and Chemistry of the Earth, Parts A/B/C*, 34(13):776-785.
- Suberu, M.Y., Mustafa, M.W., Bashir, N., Muhamad, N.A. & Mokhtar, A.S. 2013. Power sector renewable energy integration for expanding access to electricity in sub-Saharan Africa. *Renewable and Sustainable Energy Reviews*, 25(2013):630-642.
- Suri, H. 2011. Purposeful Sampling in Qualitative Research Synthesis. *Qualitative Research Journal (RMIT Training Pty Ltd trading as RMIT Publishing)*, 11(2):63-75.
- Taniguchi, M., Allen, D. & Gurdak, J. 2013. Optimizing the Water-Energy-Food Nexus in the Asia-Pacific Ring of Fire. *Eos, Transactions American Geophysical Union*, 94(47):435-435.
- Taylor, S.J., Bogdan, R. & DeVault, M. 2015. *Introduction to qualitative research methods: A guidebook and resource*. New Jersey: John Wiley & Sons.
- Termote, C., Van Damme, P. & Dhed'a Djailo, B. 2010. Eating from the Wild: Turumbu Indigenous Knowledge on Noncultivated Edible Plants, Tshopo District, DR Congo. *Ecology of Food and Nutrition*, 49(3):173-207.

- Thamaga-Chitja, J.M., Kolanisi, U. & Murugani, V.G. 2010. Is the South African land reform programme gender sensitive to women's food security and livelihood efforts? *Agenda*, 24(86):121-134.
- Thom, C. 2000. Use of grid electricity by rural households in South Africa. *Energy for Sustainable Development*, 4(4):36-43.
- Thomas, D.S.G., Twyman, C., Osbahr, H. & Hewitson, B. 2007. Adaptation to climate change and variability: farmer responses to intra-seasonal precipitation trends in South Africa. *Climatic Change*, 83(3):301-322.
- Thompson, H.E., Berrang-Ford, L. & Ford, J.D. 2010. Climate Change and Food Security in Sub-Saharan Africa: A Systematic Literature Review. *Sustainability*, 2(8):2719-2733.
- Tranter, R.B., Swinbank, A., Wooldridge, M., Costa, L., Knapp, T., Little, G.J. & Sottomayor, M.L. 2007. Implications for food production, land use and rural development of the European Union's Single Farm Payment: Indications from a survey of farmers' intentions in Germany, Portugal and the UK. *Food Policy*, 32(5):656-671.
- Triegaardt, J.D. 2005. The Child Support Grant in South Africa: a social policy for poverty alleviation? *International Journal of Social Welfare*, 14(4):249-255.
- Tucker, J., Moti, Z. & Eshetu Lemma, S. 2013. Water for livelihood resilience, food security, and poverty reduction. Rugby, UK: Practical Action Publishing.
- Turrall, H., Burke, J.J. & Faurès, J.-M. 2011. Climate change, water and food security. Rome, Italy. <http://www.fao.org/docrep/014/i2096e/i2096e.pdf> Date of access: 22 March 2017.
- Tussupova, K., Hjorth, P. & Berndtsson, R. 2016. Access to Drinking Water and Sanitation in Rural Kazakhstan. *International Journal of Environmental Research and Public Health*, 13(11):1115-1128.
- Tyler, S., Keller, M., Swanson, D., Bizikova, L., Hammill, A., Zamudio, A., Moench, M., Dixit, A., Guevara Flores, R., Heer, C., Gonzalez, D., Sosa, A.R., Gough, A.M., Solorzano, J.L., Wilson, C., Hernandez, X. & Bushey, S. 2013. Climate Resilience and Food Security: A framework for planning and monitoring (pp. 29). Winnipeg Canada: International Institute for Sustainable Development.
https://assets.publishing.service.gov.uk/media/57a08a2eed915d3cfd000620/adaptation_CREFSCA.pdf Date of access: 22 March 2016.

- Uhunamure, S.E., Nethengwe, N.S. & Musyoki, A. 2017. Driving forces for fuelwood use in households in the Thulamela municipality, South Africa. *Journal of Energy in Southern Africa*, 28(1):25-34.
- UN General Assembly. 1979. Convention on the elimination of all forms of discrimination against women. Washington DC: USA.
- UN General Assembly. 2000. Resolution adopted by the General Assembly, 55/2 United Nations Millennium Declaration. Washington DC: USA.
- UN. 2016. Agriculture development, food security and nutrition, Report of the Secretary General, Item 25. 71st Session of the UN General Assembly New York.
http://unctad.org/meetings/en/SessionalDocuments/a71d283_en.pdf Date of access: 22 September 2017.
- UNU. 2013. Water Security and the Global Water Agenda: UN-water Analytical Brief. Date of access: 02 September 2015 URL: <https://collections.unu.edu/eserv/UNU:2651/Water-Security-and-the-Global-Water-Agenda.pdf> Date of access: 23 June 2015.
- UN-Water. 2006. Water, A Shared Responsibility. The United Nations World Water Development Report 2. Paris, France: UNESCO.
- UN-Water. 2014. A Post-2015 Global Goal for Water: Synthesis of Key Findings and Recommendations from UN-water.
http://www.un.org/waterforlifedecade/pdf/27_01_2014_un-water_paper_on_a_post2015_global_goal_for_water.pdf Date of access: 22 March 2016.
- UNWFP. 2009. Distinguishing between chronic and transitory food insecurity in emergency food security assessments (EFSA). Rome, Italy: UNWFP.
http://documents.wfp.org/stellent/groups/public/documents/manual_guide_proced/wfp203246.pdf Date of access: 02 June 2016.
- Urama, K.C. & Ozor, N. 2010. Impacts of climate change on water resources in Africa: the role of adaptation. *African Technology Policy Studies Network*, 29:1-29.
- Van Koppen, B., Moriarty, P. & Boelee, E. 2006. Multiple-use water services to advance the millennium development goals. Research Report 98. Colombo, Sri Lanka: International Water Management

- Institute http://www.worldagroforestry.org/treesandmarkets/hvc07_meet/other_materials/WMI%20Multiple%20Use%20Water.pdf Date of access: 05 August 2017.
- Van Koppen, B., Parthasarathy, R. & Safiliou, C. 2002. Poverty dimensions of irrigation management transfer in large-scale canal irrigation in Andhra Pradesh and Gujarat, India. Vol. Research Report 61. Colombo: International Water Management Institute.
- Van Koppen, B., Smits, S. & Mikhail, M. 2009. Homestead- and community-scale multiple-use water services: unlocking new investment opportunities to achieve the Millennium development Goals. *Irrigation and Drainage*, 58(S1):S73-S86.
- van Vuuren, D.P., Nakicenovic, N., Riahi, K., Brew-Hammond, A., Kammen, D., Modi, V., Nilsson, M. & Smith, K.R. 2012. An energy vision: the transformation towards sustainability—interconnected challenges and solutions. *Current Opinion in Environmental Sustainability*, 4(1):18-34.
- Vanham, D. 2016. Does the water footprint concept provide relevant information to address the water–food–energy–ecosystem nexus? *Ecosystem Services*, 17(2016):298-307.
- Vannoni, M. 2014. What Are Case Studies Good for? Nesting Comparative Case Study Research Into the Lakatosian Research Program. *Cross-Cultural Research*, 49(4):331-357.
- Verhoef, G. 2001. Informal Financial Service Institutions for Survival: African Women and Stokvels in Urban South Africa. *Enterprise & Society*, 2(2):259-296.
- Vhembe District Municipality. 2011a. Vhembe district 2011/12 IDP review. Thohoyandou: Vhembe District Municipality.
- Vhembe District Municipality. 2011b. Vhembe District Municipality, 2011-12 IDP review, 26 03 2011. South Africa.
- Vhembe District Municipality. 2016. 2016/17 IDP review final Draft. Thohoyandou: South Africa.
- Vhembe District Municipality. Cooperative Governance and Traditional Affairs. 2012. Vhembe District Municipality Profile. Republic of South Africa.
- Vivoda, V. 2010. Evaluating energy security in the Asia-Pacific region: A novel methodological approach. *Energy Policy*, 38(9):5258-5263.

- Von Hippel, D., Suzuki, T., Williams, J.H., Savage, T. & Hayes, P. 2011. Energy security and sustainability in Northeast Asia. *Energy Policy*, 39(11):6719-6730.
- Vonck, I. & Notteboom, T. 2016. Panarchy within a port setting. *Journal of Transport Geography*, 51(2016):308-315.
- Vorosmarty, C.J., McIntyre, P.B., Gessner, M.O., Dudgeon, D., Prusevich, A., Green, P., Glidden, S., Bunn, S.E., Sullivan, C.A., Liermann, C.R. & Davies, P.M. 2010. Global threats to human water security and river biodiversity. *Nature*, 467(7315):555-561.
- Walker, B., Holling, C.S., S.R. C. & Kinzig, A. 2004. Resilience, adaptability and transformability in social-ecological systems. *Ecology and Society*, 9(2):1-10.
- Walsh, C.M. & van Rooyen, F.C. 2015. Household food security and hunger in rural and urban communities in the Free State Province, South Africa. *Ecology of Food and Nutrition*, 54(2):118-137.
- WaterAid. 2012. Water security framework. London: Wateraid. www.wateraid.org/publications
Date of access: 15 March 2016.
- WCED. 1987. Our Common Future. United Nations: New York. https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/152/WCED_v17_doc149.pdf?sequence=1
Date of access: 16 February. 2017.
- WEC. 2007. Deciding the future: energy scenarios to 2050. London: WEC.
https://www.worldenergy.org/wp-content/uploads/2012/10/scenarios_study_es_online.pdf Date of access: 25 March 2015.
- WEF. 2011a. Global risks 2011. Geneva.
http://www3.weforum.org/docs/WEF_GlobalRisks_ExecutiveSummary_2011_EN.pdf
Date of access: 25 March 2015.
- WEF. 2011b. Water security: The water-food-energy-climate nexus. Washington: Island Press.
http://www3.weforum.org/docs/WEF_WI_WaterSecurity_WaterFoodEnergyClimateNexus_2011.pdf Date of access: 25 March 2015.

- Weitz, N., Nilsson, M. & Davis, M. 2014. A nexus approach to the post-2015 agenda: Formulating integrated water, energy, and food SDGs. *SAIS Review of International Affairs*, 34(2):37-50.
- Wicaksono, A., Jeong, G. & Kang, D. 2017. Water, energy, and food nexus: review of global implementation and simulation model development. *Water Policy*, 19(2017): 440-462
- Wichelns, D. 2017. The water-energy-food nexus: Is the increasing attention warranted, from either a research or policy perspective? *Environmental Science & Policy*, 69(2017):113-123.
- Williams, A. & Shackleton, C.M. 2002. Fuel wood use in South Africa: Where to in the 21st Century? *Southern African Forestry Journal*, 196(1):1-7.
- World Bank. 2018. GDP per capita (current US\$)Zimbabwe. <https://data.worldbank.org/indicator/NY.GDP.PCAP.CD> Date of access: 22 May 2018.
- WWF. 2017. The Food-Energy-Nexus as a lens for delivering the UN's Sustainable Development Goals in Southern Africa. Cape Town, South Africa: World Wide Fund for Nature.
- Xu, J., Grumbine R, E., Shrestha, A., Eriksson, M., Yang, X., Wang, Y.U.N. & Wilkes, A. 2009. The Melting Himalayas: Cascading Effects of Climate Change on Water, Biodiversity, and Livelihoods. *Conservation Biology*, 23(3):520-530.
- Yergin, D. 2006. Ensuring Energy Security. *Foreign Affairs*, 85(2):69-82.
- Yin, R.K. 2003a. Applications of Case Study Research. Thousand Oaks: Sage Publications.
- Yin, R.K. 2003b. Case study research: Design and methods. Thousand Oaks: CA: Sage Publications.
- Yin, R.K. 2009. Case Study Research: Design and Methods.Thousand Oaks: CA: Sage Publications.
- Zainal, Z. 2007. Case study as a research method. *Journal Kemanusiaan bil 9(2007):1-6.*
- Zhang, X. & Vesselinov, V.V. 2017. Integrated modeling approach for optimal management of water, energy and food security nexus. *Advances in Water Resources*, 101(2017):1-10.

- Ziervogel, G. & Drimie, S. 2008. The integration of support for HIV and AIDS and livelihood security: district level institutional analysis in southern Africa. *Population and Environment*, 29(3-5):204-218.
- Ziervogel, G., Bharwani, S. & Downing, T.E. 2006a. Adapting to climate variability: Pumpkins, people and policy. *Natural Resources Forum*, 30(4):294-305.
- Ziervogel, G., Nyong, A., Osman, B., Conde, C., Cortés, S. & Downing, T. 2006b. Climate variability and change: implications for household food security. AIACC Working Paper No. 20. Washington, DC, USA: Assessment of Impacts and Adaptations to Climate Change (AIACC).
- ZIMSTAT. 2013. Poverty Income Consumption and Expenditure Survey 2011/12 Report Harare.
- ZIMSTAT. Zimbabwe National Statistics Agency. 2012. Census 2012 provincial report Masvingo. Causeway, Harare.
- ZimVAC. 2017. Zimbabwe Vulnerability Assessment Committee 2017 rural livelihoods assessment report. Harare.

ANNEXURES

Annexure A: Ethics Approval Certificate



NORTH-WEST UNIVERSITY
YUNIBESITHI YA BOKONE-BOPHIRIMA
NOORDWES-UNIVERSITEIT

Private Bag X6001, Potchefstroom,
South Africa, 2520

Tel: (018) 299-4900
Faks: (018) 299-4910
Web: <http://www.nwu.ac.za>

Institutional Research Ethics Regulatory Committee
Tel: +27 18 299 4849
Email : Ethics@nwu.ac.za

ETHICS APPROVAL CERTIFICATE OF STUDY

Based on approval by the Basic and Social Sciences Research Ethics Committee (BaSSREC) on 04/11/2016 after being reviewed at the meeting held on 03/11/2016, the North-West University Institutional Research Ethics Regulatory Committee (NWU-IRERC) hereby approves your study as indicated below. This implies that the NWU-IRERC grants its permission that, provided the special conditions specified below are met and pending any other authorisation that may be necessary, the study may be initiated, using the ethics number below.

Project title: An exploration of WEF-Nexus coping strategies of rural women in Masvingo Province, Zimbabwe and Limpopo Province, South Africa.																														
Project Leader/Supervisor: Prof JWN Tempelhoff																														
Student: Ms Hilda Jaka																														
Ethics number: <table border="1"><tr><td>N</td><td>W</td><td>U</td><td>-</td><td>HS</td><td>-</td><td>2</td><td>0</td><td>1</td><td>6</td><td>-</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td colspan="4">Institution</td><td colspan="4">Year</td><td colspan="7">Project Number</td></tr></table>	N	W	U	-	HS	-	2	0	1	6	-	0	1	2	3	Institution				Year				Project Number						
N	W	U	-	HS	-	2	0	1	6	-	0	1	2	3																
Institution				Year				Project Number																						
Application Type: Original project																														
Commencement date: 2016-11-04																														
Expiry date: 2019-02-04																														
Risk: <input type="text" value="Low"/>																														

Special conditions of the approval (if applicable):

- Translation of the informed consent document to the languages applicable to the study participants should be submitted to the BaSSREC (if applicable).
- Any research at governmental or private institutions, permission must still be obtained from relevant authorities and provided to the BaSSREC. Ethics approval is required BEFORE approval can be obtained from these authorities.

General conditions:

While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, please note the following:

- The project leader (principle investigator) must report in the prescribed format to the NWU-IRERC via BaSSREC:
 - annually (or as otherwise requested) on the progress of the study, and upon completion of the project
 - without any delay in case of any adverse event (or any matter that interrupts sound ethical principles) during the course of the project.
 - Annually a number of projects may be randomly selected for an external audit.
- The approval applies strictly to the proposal as stipulated in the application form. Would any changes to the proposal be deemed necessary during the course of the study, the study leader must apply for approval of these changes at the BaSSREC. Would there be deviation from the study proposal without the necessary approval of such changes, the ethics approval is immediately and automatically forfeited.
- The date of approval indicates the first date that the project may be started. Would the project have to continue after the expiry date, a new application must be made to the NWU-IRERC via BaSSREC and new approval received before or on the expiry date.
- In the interest of ethical responsibility the NWU-IRERC and BaSSREC retains the right to:
 - request access to any information or data at any time during the course or after completion of the study;
 - to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process.
 - withdraw or postpone approval if:
 - any unethical principles or practices of the project are revealed or suspected,
 - it becomes apparent that any relevant information was withheld from the BaSSREC or that information has been false or misrepresented,
 - the required annual report and reporting of adverse events was not done timely and accurately,
 - new institutional rules, national legislation or international conventions deem it necessary.
- BaSSREC can be contacted for further information or any report templates via Chamaine.Lekonyane@nwu.ac.za or 018 210 3483.

The IRERC would like to remain at your service as scientist and researcher, and wishes you well with your project. Please do not hesitate to contact the IRERC or BaSSREC for any further enquiries or requests for assistance.

Yours sincerely

Prof LA Du Plessis
Digitally signed by Prof LA Du Plessis
Date: 2017.03.07 08:48:08 +02'00'

Prof Linda du Plessis
Chair NWU Institutional Research Ethics Regulatory Committee (IRERC)

Annexure B: Gatekeepers' Letter

English letter

School of Basic Sciences

North-West University

P.O Box 1174,

Vanderbijlpark, South Africa,

1900

Date: _____

Dear Sir/Madam

My name is Hilda Jaka and I'm currently beginning a research project for my PhD in Development and Management, Water Studies at North West University, Vaal triangle Campus, South Africa.

Subject to approval by North West University, Research Ethics committee, this study will be using interviews, observations and focus group discussions to assess the coping strategies of rural women to the challenges of water-energy-food security nexus. The study will look at the current security status of water, energy and food in rural households. It will focus on the availability, supply, access to, uses of and affordability of water, energy sources and food in rural areas, furthermore it will seek to find out what rural women are doing in response to situations arising from these.

I am writing to ask your permission to be allowed access to your community to have face to face interviews, group discussions and also participate in some of the activities done by rural women. This should not take a large amount of time and can be conducted at a convenient time and date to be arranged. All I will need is to arrange a suitable time with you to come and interview the respondents chosen, and also carry out the field visits for the observations. I will also be asking you to kindly help with selection of respondents these should be, above the age of 18, living permanently in the rural areas. Respondents are also required from people who are working for organisations or institutions with water-energy-food governance roles in your rural communities e.g. councils, non-governmental and governmental organisations. The researcher will pick the respondents randomly from those you suggest.

All answers and results from the interviews and group discussions are kept strictly confidential and the results will be reported in a research paper available to all participants on completion.

If this is possible please could you E-mail me at hjaka2@gmail.com or sign this letter to confirm that you are willing to allow access to the communities and its members providing they agree to take part.

Yours sincerely

Hilda Jaka

Fill in the consent part as applicable.

I _____ have read the contents of this letter and agree to act as a gatekeeper for this intended research study. My position as a _____ allows me to act as such, to give permission of entry/ help in the selection of participants for this study. I have been permanently residing in _____ rural district for _____ years and have reliable knowledge to help in the selection of respondents.

Signed _____

Date _____

Shona letter

School of Basic Sciences

North-West University
P.O Box 1174,
Vanderbijlpark, South Africa,
1900

Zuva: _____

Anodiwa Changamire

Donzvo: Tsamba yekukumbira mvumo yekuita tsvakurudzo uye kuti muve mumiriri

Zita rangu ndinoitwa Hilda Jaka, ndirikuitawo tsvakurudzo yekuona nzira dzirikushandiswa nemadzimai anogara mumaruwa kutapudza kana kupedza matambudziko anouya nekushomeka/kushaikwa kwechikafu, mvura kana masimba/moto/magetsi anodiwa pakushandisa mudzimba. Tsvakurudzo iyi inodiwa kuti ndiwane PhD yeDevelopment neManagement, Water studies, paNorth West University muSouth Africa.

Tsvakurudzo iyi ichaitwa kubudirikidza nehurukuro dzemumapoka, hurukuro neumwe wevatambi, uye ongororo yezvirikuitika munharaunda. Ndichatarisa nzvimbo dzinowanikwa mvura, masimba/moto/magetsi nechikafu munharaunda nemudzimba. Ndichatarisawo zvinoenderana nemashandisirwo ezvunhu izvi uyewo matambudziko akakomberedza mawanirwo azvo. Ndinodawo kuitawo tsvakurudzo yekuona zvirikuitwa nemadzimai munharaunda kutapudza matambudziko aya.

Ndirikunyorera kukumbira mvumo yekushandira munharaunda menyu kuti tiite tsvakurudzo iyoyi. Ndinokumbirawo zvakare kuti mundibatsirewo nekundisarudzira vatambi vandingashande navo pamatanho ese etsvakurudzo iyoyi. Vatambi ava anosanganisira madzimai nevarume vave nemakore anoraudzira gumi nemasere. Vanogona kuvazve varipamabasa mumabazi anezvekuita nenyaya dzemvura, chikafu kana zvevasimba anoshandiswa mudzimba semagetsi, huni nezvimwewo. Mudzidzi anozoita sarudzo yekupedzisira kubva kune avo vamunenge mamusarudzira. Ndinovimbisa kuzochengetedza zvichataurwa muhurukuro muchivande asi ndichazonyora gwaro runobudisa zvandinenge ndawana rinozopiawo kwamuri uye kuvatambi vese kuti muonewo zvandinenge ndabuda nazvo.

Ndinokumbirawo muvewo mumiriri wangu pandinouyawo ndichipinda munharaunda ndiwane pekutangira. kana muchibvumirana nazvo ndinokumbirawo mundinyorere kana kusaina bepa rino moripa kumudzidzi.

Ndini wenyu akavimbika

Hilda Jaka

Zadzisai gwaro rechibvumirano rinotevera.

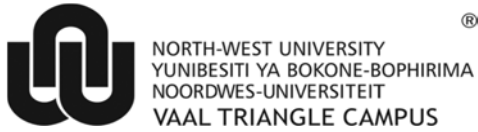
Ini _____ sa _____ munzvimbo yemaChivi ndaverenga zvanyorwa mutsamba ndikanzwisisa. Chinzvimbo changu chinonditendera kubetsera, uye ndinobvuma kubatsira mudzidzi pakuwana vatambi vanokodzera sekurehwa

kwazvo. Ndinopawo mudzidzi mvumo yekufamba munharaunda yemachivi achiita tsvakurudzo inodiwa. ndagara munzvimbo yema Chivi mudunhu rekwa_____ kwemakore _____ saka ndine ruzivo rwakawanda runoita kuti ndigone kubatsira mudzidzi uyu.

Chisaino: _____

Zuva: _____

Annexure C: Permission Letters-Relevant Authorities



1174 Hendrick Van Eck Boulevard

Vanderbijlpark

1900

Date: _____

Dear Sir/Madam

RE: REQUEST FOR PERMISSION TO CONDUCT INTERVIEWS FOR ACADEMIC RESEARCH.

I do hereby seek for permission to conduct interviews for academic research within your organization.

My name is Hilda Jaka. I am a postgraduate student studying for a PhD in Development and management, Water studies at the North-West University (NWU) in South Africa. I am carrying out research on the **Water-Energy-Food-Nexus coping strategies of rural women in Masvingo Province, Zimbabwe and Limpopo Province, South Africa**. My mission is to explore the possible coping strategies that may be used to reduce the effects of water, energy and food insecurity especially in rural areas. The study aims to draw on local and grounded knowledge of women in coping with challenges thereof. It also aims to determine, evaluate and suggest possible ways for the improvement in the governance of water, energy and food as resources within households. The information you provide will be treated as confidential and meant only for academic purposes.

The study will hugely benefit from the grounded knowledge of different service providers that deal with water-energy-food nexus. Your permission to conduct interviews within your organization will be greatly appreciated.

Yours sincerely

Hilda Jaka

Annexure D: Participant Consent Letters

English Consent

BASSREC Stamp



PO Box 1174, Vanderbijlpark
South Africa, 1900

Web: <http://www.nwu.ac.za>

Date: ____/____/____

PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM FOR

TITLE OF THE RESEARCH PROJECT: An exploration of WEF-Nexus coping strategies of rural women in Masvingo Province, Zimbabwe and Limpopo Province, South Africa

REFERENCE NUMBERS:

PRINCIPAL INVESTIGATOR: Hilda Jaka

ADDRESS: School of Basic Sciences,

North-West University

PO Box 1174

Vanderbijlpark, South Africa

1900

CONTACT NUMBER: (+27)621950389/ (+263) 773 907 827

You are being invited to take part in a research project that forms part of my PhD in Development and management, water studies. Please take some time to read the information presented here, which will explain the details of this project. Please ask the

researcher any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research is about and how you could be involved. Also, your participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

This study has been approved by the **Humanities and Health Research Ethics Committee (HHREC) of the Faculty of Humanities of the North-West University (NWU Vaal Triangle Campus)** and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki and the ethical guidelines of the National Health Research Ethics Council. It might be necessary for the research ethics committee members or relevant authorities to inspect the research records to make sure that we (the researchers) are conducting research in an ethical manner.

What is this research study all about?

- *The study seeks to look at the coping strategies of rural women to challenges brought by water-energy-food insecurity.*
- *This study will be conducted in Chivi district, Zimbabwe and in Vhembe district, South Africa.*
- *The researcher will need to ask you a few questions on the availability, accessibility and uses of water-energy and food as resources in your household. They will also need to ask questions on the things that you do in-order to deal with problems of getting enough water-energy and food for your families and households. In the past most of these problems were looked at as single sectors, however there are arguments arising within the society among those who seek to provide enough for the whole world, i.e., governments, organisations and scholars; that water-energy-food can only be secured by looking at the relationships among them and finding solution at once. For the research to be successful the researcher need you to give her correct information which is related to the discussion.*
- *The researcher will need to do some observations in your community and maybe your household's activities, the only information the researcher will look for will be related only to the collection of water, energy and food and possibly the uses within your households, no information from these observations will be used without your prior agreement if it is personal. The researcher will not be observing you as an outsider but will kindly ask you to become part of the group or part of the activities being done.*

- *The researcher may also ask you to answer a few questions in an interview. The researcher will only guide the interview but you are allowed to answer what you are comfortable to answer though the researcher will not likely ask any uncomfortable questions. This process may take approximately an hour or so of discussion.*
- *To find more information on the subject or to validate some aspects the researcher may also ask you to participate in a group discussion with other participants. It is important to know that privacy and confidentiality will be upheld throughout the research process.*
- *Approximately 50 participants will be included in this study.*
- *The objectives of this research are: To understand the relationship of water energy and food roles within rural households, to find the things that affect water, energy and food security in households, to find out the sources available, how reliable they are, uses of, and ways of finding water, energy and food within households, to find out what rural women are doing to reduce the effects of challenges caused by water, energy and food insecurity in their households. To find out what the women in rural areas consider to be helpful in dealing with the problems associated with water-energy-food security.*

Why have you been invited to participate?

- *You have been invited to participate because fulfil the following criteria:*
- *You are an individual who is permanently living in the rural areas;*
- *You are above the age of 18;*
- *You are permanently working for an organisation or institute with direct influence on water, energy and food nexus.*

You will be excluded if:

- *You are below the age of 18;*
- *If you are temporarily living in the rural areas;*
- *If you are just visiting the area; and*
- *If you are not employed by any organisation or institution with direct influence on water, energy and food security (for stakeholder respondents).*

What will your responsibilities be?

You may be expected to be a part of discussion in a group and also to respond to interview questions truthfully. You will be asked to answer questions about your expectations, opinions and experiences. Interviews may take up to one hour or more of your time and these may happen for more than once and on different days until the researcher gets enough information for the study. You may be asked to talk about yourself and other things pertaining to your household.

Will you benefit from taking part in this research?

- *There are no direct benefits for you as a participant.*

- *However, you may indirectly benefit through sharing of information in focus group discussions.*
- *The indirect benefit will probably be the spread of the knowledge WEF security nexus in rural areas. This may lead to improvement of solutions that can be used to reduce the effects of WEF security in rural areas; it may also serve to inform the responsible authorities on rural women’s views on the WEF security.*

Are there risks involved in your taking part in this research and how will these be managed?

The risks in this study, and how these will be managed, are summarised in the table below:

<i>Probable/possible risks/discomforts</i>	<i>Strategies to minimize risk/discomfort</i>
You might spend more than an hour in the interview and group discussion	The researcher will give you a few minutes break with refreshments.
There is less confidentiality in group discussions	In group discussions we will also talk about rules to ensure what we say will remain confidential

However, the benefits (as noted above) outweigh the risk.

Who will have access to the data?

- *To protect your privacy, your responses to the interview will only be identified with a code number. The results will not be linked to your identity. Confidentiality will be ensured by using code names on all interview sheets, in focus group discussions we will negotiate the ground rules and ensure your privacy will be respected. Reporting of findings will be anonymous by not associating findings to your identity.*
- *Only the researchers and promoters will have access to data. Data will be kept safe and secure by locking hard copies in locked cupboards in the researcher’s office and for electronic data it will be password protected.*

- *Audio-recorded data will be transcribed and as soon as data has been transcribed it will be deleted from the recorders. The transcripts will be stored on a password-protected computer.*
- *Data will be stored for 5 years in a locked cupboard.*

What will happen to the data?

The data from this study will be reported in the following ways: results may be made available to interested research participants, may also be used by the government, researchers and the faculty to improve and develop programs to support rural women in both countries. The results will be written up as research reports and may be published in scientific journals; they may be presented at professional meetings. The visual data may also be reproduced in publications and shown at conferences. In all of this reporting, you will not be personally identified. This means that the reporting will not include your name or details that will help others to know that you participated.

This is a once-off study, so the data will not be re-used.

Will you be paid/ compensated to take part in this study and are there any costs involved?

You will not be paid/ compensated to take part in the study, but refreshments will be provided. If participating in the research means that you have to travel especially for the purpose of participating, then your travel costs will be paid. There will thus be no costs involved.

How will you know about the findings?

The general findings of the research will be shared with you by reports and meetings

Is there anything else that you should know or do?

You can contact Hilda Jaka at (+27)621950389/ (+263)773907827 hjaka2@gmail.com if you have any further queries or encounter any problems.

You can also contact the promoter Prof JWN Tempelhoff at Johann.tempelhoff@nwu.ac.za (016 910 3450) or the Co-supervisor Prof MCC Musingafi at mmusingafi@gmail.com (+263775162748).

You can contact the chair of the Basic Sciences Research Ethics Committee (Prof Jaco Hoffman) at 016 910 3456 or Jaco.Hoffman@nwu.ac.za

If you have any concerns or complaints that have not been adequately addressed by the researcher. You can also contact, the co-chair, 016 910 3456. You can leave a message for either Prof Hoffman or Dr Magezi with Ms Charmaine Lekonyane (016 910 3483)

You will receive a copy of this information and consent form for your own records.

Declaration by participant

By signing below, I agree to take part in a research study entitled:

I declare that:

- I have read and understood this information and consent form and it is written in a language with which I am fluent and comfortable.
- I have had a chance to ask questions to both the person obtaining consent, as well as the researcher (if this is a different person), and all my questions have been adequately answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.
- I understand that what I contribute (what I say/write/produce visually) could be reproduced publically and/or quoted, but without reference to my personal identity.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- I may be asked to leave the study before it has finished, if the researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.

Signed at (*place*) On (*date*) 20....

Signature of participant: _____ Signature of witness:

You may contact me again Yes No

I would like a summary of the findings of this research Yes No

The best way to reach me is:

Name & Surname: _____

Postal Address: _____

Email: _____

Phone Number: _____

Cell Phone Number: _____

In case the above details change, please contact the following person who knows me well and who does not live with me and who will help you to contact me:

Name & Surname:

Phone/ Cell Phone Number /Email:

Declaration by person obtaining consent

I (*name*) declare that:

- I explained the information in this document to
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I did/did not use an interpreter.

Signed at (*place*) On (*date*) 20....

Signature of person obtaining consent: _____ **Signature of witness:**

Declaration by researcher

I (*name*) declare that:

- I explained the information in this document to

- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I did/did not use an interpreter.

Signed at (*place*) On (*date*) 20....

Signature of researcher: _____ **Signature of witness:**

Shona Consent



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PO Box 1174, Vanderbijlpark

South Africa, 1900

Web: <http://www.nwu.ac.za>

Date: _____/_____/_____

Gwaro rekubvuma kuva mutambi/mukwikwidzi/mupinduri mutsvakurudzo yedzidzo.

Gwaro rino richatsanangura zvizere nezvedzidzo iri kuda kuitwa.

Musoro: Tsvakurudzo yezviri kuitwa nemadzimai anogara mumaruwa kutapudza matambudziko anokonzera nekushomeka kana kushaikwa kwemvura, chikafu kana mafuta/moto/simba.

Mutsvakurudzi: Hilda Jaka

Kero: School of Basic Sciences,

North-West University

PO Box 1174

Vanderbijlpark, South Africa

1900

Nhamba dzefoni: (+263) 773 907 827/ (+27)621950389

Murikukokwa kuti muve mutambi/ mupinduri/ mukwikwidzi patsvakurudzo irikuda kuitwa namuzvare Hilda Jaka yekuvavarira kuva ne PhD mudzidzo dzeDevelopment and Management, Water studies. Torai nguva yenyu kuverenga tsananguro inotevera, kana pane zvamusina kunzwisisa makasununguka kubvunza mutsvakurudzi ari pamuri. Zvakakosha chose kuti munyatse kunzwisisa nezve tsvakurudzo irikuda kuitwa iyi, uye kuti imi sei makakosha kuva pakati payo. Kuva mutambi mutsvakurudzo iyi hakusi kumanikidzwa bodo, munobvumirwa zvenyu kuramba kana musina kusununguka kuva mutambi pane zvinoda kuitwa mutsvakurudzo. Kuramba kwenyu kuve mutambi hakuna zvakuno kukonzereserai paupenyu hwenyu zvakaipa. munotenderwa zvakare kuti

kunyangwe dayi makambobvuma kuva mutambi, murambe zvakare kunyangwe makambotanga kana muchinge maona kuti hamusi kuwirirana nezvinenge zvichiitwa.

Tsvakurudzo iyi yakatenderwa nebazi rinoona nezvekuchengetedzwa kwetsika nemagariro evanhu munyika reUnivesiti ye North West mu South Africa. ichaitwa ichitevedzera mitemo yebazi irori inokurudzira kuti tsika nemagariro uye rukudzo rwevanhu ruchengetedzwe, panedzimwe nguva vamiririri vebazi irori vanogona kuuya kuva pakati pedu vachiongorora kana tsvakurudzo dzirikuitwa nemazvo.

Tsvakurudzo iyi iri pamusoro peyi?

- Tsvakurudzo iyi iripo kuongorora zvirikuitwa nemadzimai arimumaruwa kuedza kutapudza kana kupedza matambudziko anouya nokushaikwa kwemvura, chikafu kana moto/mafuta/simba zvakaringana nemhuri.
- Tsvakurudzo iyi ichaitwa munzvimbo dzeruzevha dziri machivi
- Mudzidzi achakumbira kuti akubvunzei mibvunzo pamusoro pekuwanikwa nemawaniro amunoita chikafu chemhuri, mvura yekushandisa zvakasiyana siyana, zvamunoshandisa mudzimba kuti muve nemwenje, moto kana kwamunowana simba rekuti mabasa akasiyana siyana abudirire. Vachadazve kubvunza mibvunzo inoenderana nezvimwe zvinhu zvamunoidza kuita kuti mutapudze matambudziko ekushaikwa kwezvarehwa. Nguva dzapfuura hurumende dzinotonga munyika, mabazi anoona nezvebudiriro nana muzvinafundo vakaedza chose kutsvaga nzira dzekutapudza matambudziko aya asi nokuda kwokusabatana pakutsvaga nzira idzi zvakaedzwa hazvina kubudisa zvaitarisirwa. Naizvozvo vakatenderana kubatana pamwe kuti vatarise dambudziko rekushaikwa kwemasimba anoshandiswa mudzimba nekusiyana kwawo, kushaikwa kwechikafu nokushaikwa kwemvura sedambudziko rimwe chete. Zvakaonekwa kuti izvi zvine ukama nokubatidzana kukuru pakushandiswa, kugadzirwa, nokuwanikwa kwazvo. Tinoda kuona ukama hwezvinhu izvi hunobuda mudzimba dzenyu uye zvamuri kuita parizvino kutapudza matambudziko amungasangane nawo pakuzviwana, kuzvishandisa uye kugadzirwa kwazvo semadzimai. Tinokumbirawo kuti muchinge mabvuma kutibatsira mutipewo mhinduro dzechokwadi.
- Pane dzimwe nguva mudzidzi anogona kungodawo kuita ongororo yezvimwe zvamunoita, pangave pakuwanikwa kwezvimwe zvakaita semvura kana dzingave huni kana mabasa anoita muwane chikafu. Mudzidzi anokumbirazve kuti ave pakati penyu kana musha wenyu wazosarudzwa. Zvinowanikwa pakuongorora uku nemudzidzi hazvizoshandiswi imi musina kutenderana nazvo.
- Tsvakurudzo iyi inogona kukukumbirai kuti muve mutambi muboka rinosarudzwa kuita nhaurirano inoenderana nezvirikutsvakurudzwa zvatsanangurwa.

- Vanhu vanodiwa makumi mashanu

Sei imi masarudzwa kuva mutambi?

Masarudzwa nokuda kwekuti:

- Murikugara muruzevha ruri maChivi nguva zhinji;
- Mune makore anodatika gumi nemasere okuberekwa;
- Kana masarudzwa muri pabasa zvinoreva kuti murikushandira hofisi/bazi/bato rinoona nezvekuchengetedzwa, kuwanikwa nemashandisirwo emvura, chikafu nemagetsi munzvimbo yekwachivi.

Mungatadza kusarudzwa kupinda mutsvakurudzo kana:

- Musingagari munzvimbo iyi nguva zhinji;
- Murimushanyi/ muenzi;
- Mune makore aripasi pegumi nemasere okuberekwa;
- Muripa basa henyu asi risineyi nezvemawanirwo, machengetedzerwo, nemashandisirwo emvura, magetsi kana chikafu munharaunda yarehwa.

Zvii zvinotarisirwa kwamuri semutambi?

Munotarisirwa kupindura mibvunzo ichabvunzwa muchokwadi. Mibvunzo iyi haizovi nekukukanganisai pamagariro enyu, hainei nokuita nezvematongerwo enyika kana dzimwe nyaya dzakadzama dzoupenyu. Munotarisirwa kusungunuka kutaura maonero enyu, pfungwa dzenyu uye ruzivo rwenyu maringe nezvirimutsvakurudzo. Nguva yemibvunzo ingatore zvichida chidimbu cheawa kana awa rese. Mudzidzi anogonazve kuda rubatsiro rwenyu nekudzoka kwamuri kana umbowo hunodiwa husati hwakwana kutsanangura zvirikutsvagwa nemazvo. Mibvunzo iyi ingada zvakare kuti mutaure pamusoro penyu, uye zvirikuitika mudzimba pamusoro pezvirikutsvagwa.

Munowanei patsvakurudzo irikuitwa.

- Hapana batsiro inopiwa pakupindura mibvunzo kwamuchaita.
- Kuva mutambi kunokubatsirai kuvhurika kwepfungwa nokuwana mazano akasiyana siyana kubvawo kune vamwe vatambi kunogona kubatsira imi semudzimai kuita zvunhu neimwewo nzira.
- Kutibatsira kwenyu kunonyanyisa kuzokubetserai kana varipananzvimbo yekukubatsirai vakave neumbowo hwezviri kuitika mumisha. zvavanoronga kukuitirai zvinozova nebetsero zhinji kwamuri sezvo vanenge vaveneruzivo rwakadzama nezvezvamuri kusangana nazvo mumaruwa umu.

Dambudziko ringasanikwa naro pakuva mutambi nezvichaitwa nemudzidzi kuripedza

- Munogona kugara muchipindura mibvunzo kwenguva inosvika kana kudarika awa. Naizvozvo mudzidzi achagadzira nguva dzokuzorora pakati penhaurirano nokuwana zvinwiwa.
- Sezvo tichikurudzira kuti zvinotaurwa zvive zvakavanzika, zvinonetsa kana vanhu vakawanda nokuti varimuboka vanonzwawo zvinokurukurwa. Kupedza dambudziko iri, mudzidzi achakumbira kuti varimuboka vavemuchibvumirano kuti zvinotauriranwa zvisazotaurwa kunze. Izvi zvichaitwa hurukuro dzisati dzatanga.

Ndiani achaona zvinobuda mutsvakurudzo?

- Kuedza kuchengetedza vatambi kuti vasazikanwe kuti ndivanani, mudzidzi achashandisa manhamba panzvimbo yemazita evatambi.
- Vatungamiriri vepedo vemudzidzi kuchikoro naiye mudzidzi voga ndivo vanogona kuona zvinobuda muhurukuro kana nhaurirano. Hurukuro idzi dzikatapwa nechitapa mazwi, mudzidzi anozononyora asvika mberi zvatauriranwa odzima mazwi pachitapa mazwi. Asi zvinyorwa izvi zvichaiswa pakabata panokiyiwa.
- Zvinyorwa zvichachengetedzwa pakabata kwemakore mashanu.

Zvinowanikwa mutsvakurudzo zvichashandiswa sei?

Zvinowanikwa mutsvakurudzo zvinonyorwa zvakanaka setsananguro dzinogona kupiwa kuvatambi, kuhurumemde, kune vamwewo vanoda kuita tsvakurudzo yerudzi urwu, uyewo vamwewo vadzidzi varikuitawo zvinoenderana naizvozvi. Zvinyorwa zvinogona kutsikiswa semabhuku kana mapepa. Mapikicha anogona kuratidzwa mumisangano kana miunganidzwa yakasiyana siyana. Asi zviwanikwa zvichashandiswa kamwe.

Mudzidzi achaedza kudzoka kwamuri kana kukunyorera achikuudzai zvinenge zvabuda mutsvakurudzo.

Kana paine zvimwe zvamungade kuziva kana kutaura munogoba kubata vanhu vanotevera pasi.

- Hilda Jaka panhamba dzinoti (+27)621950389/(+263)773907827, hjaka2@gmail.com
- Vatungamiri vedzidzo Prof JWN Tempelhoff panhamba dzinoti +27(0)16 910 3450 Johann.tempelhoff@nwu.ac.za kana mutevedzeri wavo Prof MCC Musingafi panhamba dzinoti +263 (0)775162748 mmusingafi@gmail.com
- Vakuru vebazi rekuchengetedzwa kwetsika nemagariro avanhu: - Prof Jaco Hoffman panhamba 016 910 3456 or Jaco.Hoffman@nwu.ac.za, na Dr Magezi panhamba dzinoti 016 910 3483.
- Muchapiwawo bepa renyu rechibvumirano ramuchachengetawo.

Chitsidzo chemutambi/mupinduri/mukwikwidzi

Ini _____ ndinobvuma kuva mutambi/mupinduri/mukwikwidzi mutsvakurudzo irikuda kuitwa yekuongorora zvirikuitwa

nemadzimai kupedza/kutapudza kana kurarama nematambudziko anouya nokushomeka kana kushaikwa kwechikafu, mvura kana moto/ simba/ magetsi mukati medzimba.

Ndinobvuma kuti:

- Ndaverenga ndikanzwisisa zvanyorwa muchinyorwa chekubvuma kuva mutambi, uye kuti chanyorwa nekutsanangurwa nerurimi rwandinogona kuverenga nemazvo.
- Ndapiwa mukana wekuvhunza mibvunzo kumudzidzi nevatumwa vese, uye mibvunzo yese yapindurwa nemazvo.
- Ndinonzwisisa zvakare kuti kuva mutambi isarudzo yangu ndega pasina kumanikidzwa kana kusundwa.
- Ndinonzwisisa kuti zvandichapindura, kana kunyora, kana mifananidzo inogona kuzoshandiswa pajekerere pachena asi zita rangu harizoshandiswi.
- Ndinotenderwa kuramba kuva mutsvakurudzo chero nguva pasina kuripiswa, kutsamwirwa kana kutukwa.
- Ndinogonazve kukumbirwa kubuda mutsvakurudzo iyi nyangwe isina kupera kana mudzidzi achiona zvakandinakira kusava mairi, kana kuti ndisiri kufambirana nezviri kuitwa sezviri muchibvumirano.
- Ndakumbirwa nekubvuma kuti mudzidzi panhaurirano angade kutapa mazwi, kana pamwe mumabasa angade kutora mifananidzo asi mifananidzo haizoshandiswi kana ndiri pairi ndisina kupa mvumo.

Nzvimbo: **Zuva:**

Signature _____ **Murevereri** **wechiitiko:**

- Munogona kundiona zvekare Hongu/Kwete
- Ndinodawo chinyorwa chezvichabuda mutsvakurudzo Hongu/Kwete

Munogona kundibata nekushandisa zvinotevera.

Zita:

Kero _____ **yetsamba:**

Email:

—

Nhambadzenhare:

Kuti zvimwe zviripamusoro zvikashanduka munokwanisa kuti mutaure nehama yangu yandichanyora pasi, haagari neni asi anozokwanisa kuti akubatsirei kuwana kwandinenge ndiri:

Zita:

Nhamba

dzenhare:

Chitsidzo chemutsvaki wechibvumirano chino:

Ini.....ndinotsid
za kuti:

- Ndatsanangura zvinyorwa zviru muchibvumirano chino kuna:

- Ndavakurudzira zvekare kuti vabvunze mibvunzo uye ndikatora nguva yakaringana kupindura mibvunzo iyoyi.
- Ndagutsikana kuti vanzwisisa zvose zvine chekuita netsvakurudzo ino.
- Ndashandisa/ kana kusashandisa muturikiri wemazwi.

Nzvimbo.....**Zuva**.....
.....

Zita

remutsvakurudzi:

Zita

remurevereri:

Venda Consent



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PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM FOR

THOHO YA THODULUSO: Ndila dzine vhafumakadzi vha mahayani vha shuma nga dzo u lwa na dzi thaidzo dza madi-zwivhaswa na zwiliwa, hu vhambedzwa vha mahayani shangoni la Zimbabwe na shangoni la Afrika Tshipembe.

Nomboro ya u laedza:

Mutodulusi muhulwane: Hilda Jaka

Adiresi: School of Basic Sciences,

North-West University

PO Box 1174

Vanderbijlpark, South Africa

1900

Nomboro dza lutingo: (+27)621950389/ (+263) 773907827

Vha khou rambiwa u dzhenelela kha thoduluso dzanga na u dzhenelela u vha tshipida tsha pfunzo dzanga nthu dza PhD kha Mveledzizso na Vhulanguli, na u nguda dza nga ha madi. Vha humbelwa u vhala ulwu lunwalo zwavhudi lune lwa khou talutshedzwa nga

ha zwine zwa dovha kha **project**. Vha humbelwa u vhudzisa mutodulusi arali hu na zwine vha sa zwipfesese. Ndi zwandeme uri vhone vha pfesese zwothe zwire kha lunwalo ulwu na uri vha do dzhenelela hani. Vha dovhe hafhu vha humbule uri u dzhenelele ndi u tou di khetha iwe mune, vha na ppanelo dza u dzhenelela kana vha hana. Naho vha hana azwi ambi uri hezwi zwi do kwana thoduluso idzi nga ndila isi yavhudi. Vha na ndugelo dza u di bvisa kha u dzhenelela kha idzi ngudo.

Ngudo hedzi dzo khwathisedzwa nga tshi imiswa hetshi, **Humanities and Health Research Ethics Committee (HHREC) of the Faculty of Humanities of the North-West University (NWU Vaal Triangle Campus)**.

Ngudo idzi dzi dovha hafhu dza tshimbizwa ho tevhelewa vhuvha na milayo ya National Health Research Ethics Council.

Ndi zwifhio zwine thoduluso dza u guda dza do vha dzo sedza zwone:

- *Ngudo dzi do sedza kha uri vhafumakadzi vha mahayani vha tangana na kheudu dzi ifhio nga ha u wana madi –zwivhaswa na u di tsireledza.*
- *Ngudo hedzi dzi do farelwa tshotirikini tsha Chibi kha la Zimbabwe na tshitirikini tsha Afrika Tshipembe.*
- *Mutodulusi u do vhudzisa mbudziso nga ha u wanala ha madi –zwivhaswa na zwiliwa na zwinwe zwishumiswa zwa mutani wavho. U do dovha hafhu a vhudzisa nga ha dzi khaedu dzine vha tangana nadzo nga u wana madi-zwivhaswa na zwiliwa kha muta wavho.*
- *Mutoduluso u do tea u lingula na ulavhelesa zwine vha shumisa zwone vha mutani wavho na kha tshitshavha tsha henefho hune vha dzula hone, mutodulusi u do vha o sedzana nga maanda na u wanala ha madi-zwivhaswa na zwiliwa mudini wavho, ahuna zwinwe zwine zwa do shumiselwa zwone nga nnda ha maelana na thoduluso idzi, mutodulusi u dovha asi khou vhudzisa kana u lavhelesa kha vhone sa muthu wa nnda fhedzi u do tou humbela uri vha vhe tshipida dza zwigwada zwine zwa do dzhenele kha zwine zwa do vha zwi tshi khou itiwa.*
- *Mutodulusi u do vhudzisa mbudziso uri vha fhindule kha dzi ndingo. U do dovha hafhu avha eletshedza uri vha fhindule vha sa tshuwi tshithu na hone vho di geda, ha nga do vhudzisa zwinwe zwine vha do pfa vha songo farea zwavhudi. Zwi nga vha dzhiela iri nthihi kha nyambedzano idzi.*
- *U wana ndivho nnzhi vha nga vhudzisa mutodulusi musi vha tshi khou dzhenelela nga u tou amba a vhanwe hanefho, ndi zwa ndeme u divha vhune hafho na u tsireledza vhuvha hafho u bva nyambedzano dzi tshi thoma u swika dzi tshi fhela.*
- *Ngau tou angaredza hu nga dzhenelele vhathu vhalinganaho fumi thanu(50).*

- *Vhudeme vha thoduluso idzi ndi hu tevhelaho:ndi u pfesesa vhushaka vhure hone kha madi –zwivhaswa na zwiliwa na uri zwi tamba tshipida tshifhio afho mutani wavho, na u wana zwitisi zwine zwa vha nga u sa zwanala ha madi, zwivhaswa na zwiliwa khathihi na u di tsireledza mutani wavho,na u wana zwi shumiswa zwire hone, na u uri zwi wanala tshifhinga tshothe naa, na ndila ya u wana madi, khuni na zwiliwa nga ngomu mudini wavho, na u wana uri vhafumakadzi vha mahayani vha khou ita mini u fhungudza zwitisi zwothe zwine zwa ita uri madi-khuni na zwiliwa zwi si wanale, na u wana uri vhafumakadzi vha mayani vha khou ita mini u fhungudza thahelero ya madi –zwivhaswa na zwiliwa.*

Ndi ngani vho rambiwa uri vhadzhenelele?

Vho rambiwa uri vha dzhenele uri vha bveledzise zwitevhelaho:

- *Vhamudzulapo ane a dzula vhupopni ha mayani*
- *Minwaha ya fumi malo uya ntha*
- *Vha khou shuma kha tshi imiswa tshine tsha sedzana na disedzo ya madi –khuni na zwiliwa.*

Avha nga dzheneleli arali:

- *Minwaha ifhasi haya fumi malo.*
- *Arali vha simudzulapo wa avho mahayani;*
- *Arali vho tou da nga udala;*
- *Arali vha songo tholwa kha tshi imiswa tsha u disa madi-khuni na zwiliwa.*

Vhudifhinduleli havho ndi vhufhio?

- *Vha lavhelewa u dzhenelela u vha hone kha nyambedzano dza zwigwada na u fhindula mbudziso nga ufulufhedzea. Vha do vhudziswa mbudziso vha fhindula uya nga ha zwine vhadivha zwone, vhudipfi havho na tshenzhemo yavho.Ndingo dzi nga dzhia iri nthihi na ufhira kha tshifhinga tshavho, izwi zwi do itea hu sini luthihi na hone maduvha o vhambanaho u swikela mutodulusi a tshi wana ndivho yo teaho ya ngudo dzawe.Vha do vhudziswa na nga u amba nga ha vhone mune na zwinwe vho zwine zwa dzhenelela mutani wavho.*

Vha do vhuvelwa ngani nga u dzhenelela kha thoduluso idzi?

- *A hu tou vha na mbuelo ine ya da kha vhone mune yo vha livha lini.*
- *Fhedzi vha nga wana mbuelo nga u nea na ndivho musi vha tshi khou ita nyambedzano ya zwigwada.*

- *Mbuelo yavho ine ya vha yo dzumbama ido phadaladzwa nga ha ndivho yavho ya nga ha madi-khuni na zwiliwa hanefho vhuponi havho ha mahayani.*
- *Hezwi zwi khou livhisa kha u wana thanduluso na u vhungudz a khaedzu dza madi –zwivhaswa na zwiliwa mutani wavho,i dovha hafhu ya eletshedza vhathu vhare na vhudifhinduleli kha zwi imiswa zwa disedzo ya madi khuni na zwiliwa*
- *zwiliwa vhuponi havho .*

Huna khaidzo dzi fhio dzine dzi nga vha hoine kha thoduluso idzi nahone dzi nga thogomelwa hani?

Khaidzo dzine dza vha hone kha ngudo idzi na uri dzo langiwa hani, dzo angaredzwa afha fhasi:

<i>Probable/possible risks/discomforts</i>	<i>Strategies to minimize risk/discomfort</i>
Vha nga fhedze tshifhinga tshifhiraho iri nthihi kha nyambedzano dza zwi gwada.	Mutodulusi u do vha nne tshifhinga tsha u a wela na u nwa madi.
Hu do vha na nyambedzano ya tshi phirini	Nyambedzano dza zwi gwada dzi do amba nga ha milayo u itela uri naymbedzano ya tshiphiri i thonifhiwe

Khaidzo dzo katelwa tshileme afho ntha.

Ndi nnyi ane a dovha na ndugelo dza u tola....

- *U dzumbambisa vhuvha na phindulo dzavho zwi do itwa hu tshi tevhedzwa nomboro ya tshiphirini.Mvelelo dzi do itwa dza sa tanganywe na vhune havho.Tshiphiri tsha nyambedzano dzavho tshi do itwa na uhone hu u khwathisedza nomboro ya tshiphiri kha vha lingiwa vhothe, misi yothe kha zwigwada zwothe hu do simiswa u amba nga milayo hu u itela u dzumba tshifhiri dza mafhungo avho.*
- *Ndi mutodulusi na mukhwathisedzi ane a do vha na vhukwami ha mafhungo aya. ndivho yavho i do thogomelwa na hone ya vhewa tshiphirini ya khieledwa nga dzi khapondo ofisini ya mutoduluso ine ya do vha i kha computha ido itelwa nomboro ya tshiphirini ya u i tsireledza.*

- *Ine ya do vha yo rikhodiwa nga maipfi nga murahu ha musu yo no shumiswa ido thuthiwa.*
- *Mafungo a do vhulungwa lwa minwaha mitanu o valelwa khapndoni.*

Hu do itea mini kha mafungo o angaredzwaho?

Mafungo a ngudo iyi ado ripotiwa nga ndila dzi tevhelaho: mvelelo dzi do wanala kha vhatu vho dzhenelelaho vhare na lutamo, dzi do vha hafhu dza shumiswa nga muvhuso, vhatodulusi na muhasho uri u bveledzise mbekanya mushumo dza u tikedza vhafumakadzi vha mahayani kha mashango othe.

Mvelelo dzi do nwalwa sa dzi ripoto dza thoduluso dzi do dovha hafhu dza phadaladzwa kha dzi bugu dza santhifiki, dzine dza do sumbedzwa na mitangano ya tshiofisi. Mafungo a zwifanyiso a do sumbedzwa kha maguvhangano. Kha zwothe zwine zwa do sumbedzwa afha ahuna mafungo a vhune ane do bviselwa khangala. Hezwi zwi amba uri ripoto dzothe adzi nga kateli madzina kana zwinwe zwine zwa thusa vhanwe u divha uri ndi nnyi we a vha tshipida tsha thoduluso.

Hedzi ndi thoduluso dzine dza do itwa luthihi mafungo awanalaho afha ha nga dovhi a shumiswa.

Ndi nnyi ane do badelwa/kana u livhuwa kha uvha tshipida tsha ngudo idzi kana huna badelo dzine dza vha hone naa?

Avha nga badelwi kha u vha tshipida tsha ngudo idzi, vhedzi hu do vha na zwiniwa zwine zwa do nekedzwa. Arali vha vha vhatshipida tsha ngudo idzi zwi amba uri vha do tea u u tshimbila nga maanda zwi tshi itiswa ngauri vha tshipida tsha thoduluso idzi, fhedzi u tshimbila havho hu do badelwa. Fhedzi ahuna dzinwe badelo dzire hone.

Vha do divha hani nga mawanwa a ngudo idzi?

Mawanwa a thoduluso idzi vha do dzi divhadzwa mitanganoni.

Arali huna zwinwe zwine vha tea u divha kana u ita?

Vha nga kwama Hilda Jaka kha (+27)621950389/(+263)773907827 hjaka2@gmail.com arali vha na dzinwe mbudziso kana u sa pfesesa.

Vha nga kwana na mulavhelisi Prof JWN Tempelhoff at Johann.tempelhoff@nwu.ac.za (016 910 3450) or the Co-supervisor Prof MCC Musingafi at mmusingafi@gmail.com (+263775162748).

Vha nga kwama hafhu na mudzula tshidulo kha muhashu wa Humanities and Health Research Ethics Committee (Prof Linda Theron) at 016 910 3076 or Linda.theron@nwu.ac.za arali vha dzi mbilahelo dze dza sa pfukiswe zwavhudi nga muthodulusi.

Vha nga dovha hafhu vha kwana Prof Tumi Khumalo (016 910 3397 or Tumi.khumalo@nwu.ac.za). Kana nga kwa ma na na MS Daleen Classens(016 910 3041) vha sia mulaedza uri u kone u swika kha Tumi kan Linda.

Vha do wana khophi ya mafhungo othe na consent form.

Khwathisedzo nga u vha tshipada tsha ngudo

Nga u saina afhao, Nne.....ndi khou tenda u vha tshipda dza thoduluso na ngudo dzo ambiwa afho ntha.

Ndi khou tenda uri :

- Ndo vhala na pfesesa nga ha mafhungo na nga ha fomo iyi yo nwalwa nga luambo lune nda lupfesesa na hone nda pfa ndo di geda ngalwo.
- Ndo vha na tshifhinga tsha u vhudzisa mbudziso kha vhatu vhothe na kha mutodulusi nahone mbudziso dzanga dzo fhindulwa zwavhudi.
- Ndo pfesesa uri u dzhenelela kha heyi thoduluso thingo tou kombetshedzwa ndo tou khetha
- Ndi a pfesesa uri u dzhenelela hanga nga zwe nda amba kana u nwala zwi nga bviselwa khagala fhedzi zwi do vha zwi sina mafhungo avhuvha hanga.
- Ndi nga litsha u isa phanda na u dzhenelela ngudo idzi ndi si dzhielwe vhukando.
- Ndi nga humbelwa u litsha ngudo idzi naho dzi sathu fhela, arali mutodulusi a tshi vhona uri ndi zwa khwine, kana arali ndi songo tevhela maga o vheiwa nga ndila ye thendelano yavha ngayo.

Fhethu ha tsaino.....duvha.....20.....

.....
Tsaino ya mudzheneleli

.....
Tsaino ya thanzi

- Vha nga nkwama habe Ee Hai
- Ndi a tama u wana manweledzo a ngudo idzi Ee Hai

Ndila ya khwine ya u nkwama i tevhela nga fhasi:

Dzina na Tshifani: _____

Diresi ya poso: _____

Email: _____

Nomboro ya founi: _____

Nomboro dza lutingo: _____

Arali zwa itea vhukwamani hanga hure afho nthha ha shanduka, vha nga kwama muthu a tevhelaho ano divha zwavhudi, naho ndi sa dzuli nae anga vhathusa uri a Kwame zwavhudi;

Dzina na Tshifani

Khwathisedzo nga muthu o tendelanaho nga fomo iyi

Nne(Dzina).....ndi khou tenda uri:

- Ndo talutshedza mafhungo are kha lunwalo ulwu uri.....
- Ndo vhatutuwedza uri vha vhudzise mbudziso na u wna tshifhinga tsha vhudi tsha u nea phindula
- Ndo fushea uri nga zwiitwana zwothe zwo itea kha thoduluso idzo sa zwe zwa talutshedzwa afho nthha.
- Ndo shumisa mutalutshedzi

Fhethu ha tsaino.....duvha.....20.....

.....
Tsaino ya mudzheneleli

.....
Tsaino ya thanzi

Khwathisedzo nga mutodulusi

Nne(Dzina).....ndi khou
tenda uri:

- Ndo talutshedza mafhungo are kha lunwalo ulwu uri.....
- Ndo vhatutuwedza uri vha vhudzise mbudziso na u wna tshifhinga tsha vhudi tsha u nea phindula

- Ndo fushea uri nga zwiitwana zwothe zwo itea kha thoduluso idzo sa zwe zwa talutshedzwa afho nntha.
- Ndo shumisa mutalutshedzi

Fhethu ha tsaino.....duvha.....20.....

.....
Tsaino ya mudzheneleli

.....
Tsaino ya thanzi

Interview guide

Introduction

I am Hilda Jaka from North West University.

The researcher then explains:-

- ✓ General purpose of the study
- ✓ Aims of the interview and expected duration
- ✓ Who is involved in the process (other participants if any)
- ✓ Why the participant's cooperation is important
- ✓ What will happen with the collected information and how the participant/target group will benefit
- ✓ The researcher asks for consent to record and take pictures.
- ✓ Any questions?
- ✓ Consent

Warm up [demographic & work history]

Can I ask some details about you and your job?

Job Title _____

Highest Educational Grade attained ____ Year of graduation _____

Years living in this community |__|__|yrs|__|__|mths

Are you originally from this area/district? Yes No

How old are you? Under 30yrs 30-40yrs Over 40yrs

Do you have any children over 5yrs old? Yes No

Do you have any children under 5yrs old living with you now? Yes No

Please note that the researcher will use the same questions marked with a () to work separately on water security, food security and energy security. The interviews will focus on perceptions, views and life experiences in relation to water-energy-food security. The researcher will also have a cover sheet for each interview that will have provision to write notes during the research to capture data.*

1. Tell us about your household, the number of people in your household and the role each member has in the household.
2. What are your main livelihood strategies and are they capable to cater for the needs of your family?
3. What are the major sources of water, energy and food in this community?*
4. How reliable are these sources in supplying the household needs?

5. How do you access water, energy and food for your households? Explain your answer?*
6. What are the uses of water, energy and food in your households and do you identify any relationship among these resources in your households?*
7. Which sources of Water, Energy and Food do you rely on in your household and why? *
8. What are the relationships between water, energy and food in your households?
9. Does getting one resource (water, energy and food) for your household have an impact on the other two resources?*
10. What are the major challenges that you face as a woman in achieving the water-energy-food security for your household and what do you think are major causes for these challenges?*
11. What have you been doing to minimize the effects of these challenges to WEF security in your households and communities?*
12. What have women been doing to ensure adequate supply of water, energy and food for your families and households?*
13. Would you say that the challenges that you are facing in relation to water energy and food are same or they seem to change over time, explain your answer. *
14. If they are changing over time, what have you been doing to meet up with these changes? Explain. *
15. Are you receiving any form of assistance for Water-energy-food security from different sources, what are the sources, form of assistance and how helpful is the aid. Explain in detail.*
16. What do you think you can do (with assistance) as a woman to have WEF security of your households?*
17. What do you think the government and civil organisations should do for you to achieve household water-energy-food security?
18. What are your views towards the forms of assistance and interventions made by the state and non-governmental sects, to ensure WEF security?
19. What is your household situation on water, energy and food security?*
20. How would you rate your household water-energy-food security?

- | | |
|--------------|--------------------------|
| a) Poor | <input type="checkbox"/> |
| b) Average | <input type="checkbox"/> |
| c) Good | <input type="checkbox"/> |
| d) Excellent | <input type="checkbox"/> |

Probes for Discussion:

- *Estimated income per month*
- *Livelihoods*
- *Remunerations*
- *Living conditions*
 - *Access to supplies, equipment, etc*
- *Respect/recognition from management or others*
- *Available sources*
 - *Water, energy, food*

- ✓ *Management and supervision of activities(livelihoods)*
- ✓ *Preferences on sources of water, energy and food and reasons*
- ✓ *Standards of living*
 - *Cost of living*
 - *Housing*
 - *Electricity and other sources of energy*
 - *Water*
 - *Food*
 - *Transportation*
- *Education for children*
- *Work/home balance*

Closing

Is there anything else that you think is important in this area that we have not talked about?

- ✓ Summarise
- ✓ Thank participant
- ✓ Provide extra information and contacts to participants

NB: *The researcher may also come up with other questions during the discussion if there is need to get more, additional data, in order to come up with an in-depth understanding of the WEF nexus and coping strategies of rural women in the selected rural communities.*

Introduction

My name is Hilda Jaka. I am a postgraduate student studying for a PhD in Development and management, Water studies at the North-West University (NWU) in South Africa. I am carrying out research on coping strategies of rural women to water, energy and food security in Zimbabwe and South Africa. My mission is to explore the possible coping strategies that may be used to reduce the effects of water, energy and food insecurity especially in rural areas. The study aims to draw on local and grounded knowledge of women in coping with challenges thereof. It also aims to determine, evaluate and suggest possible ways for the improvement in the governance of water, energy and food as resources within households. The information you provide will be treated as confidential and meant only for academic purposes. I therefore kindly request you answer the questions as truthfully as possible.

Warm up [demographic & work history]

Can I ask some details about you and your job?

Name of Organisation _____

Job Title _____

Responsibilities _____

Highest Educational Grade attained _____

Years living in this community |__|__|yrs|__|__|mths

Are you originally from this area/district? Yes / No

How old are you? Under 30yrs

30-40yrs

Over 40yrs

Please note that the researcher will use the same questions marked with a () to work separately on water security, food security and energy security. The interviews will focus on perceptions, views and life experiences in relation to water-energy-food security. The researcher will also have a cover sheet for each interview that will have provision to write notes during the research to capture data.*

Questions

1. Which organisation are you working for and what does it do in relation to water, energy and food?
2. How long have you been working in the district?
3. Do you ever hold resource management meetings with the local residents?
4. Have you ever heard of the water-energy-food nexus concept?
5. If you answered yes to the above, how applicable do you think the concept is to local grassroots levels in enhancing WEF nexus sustainability?
6. Are you happy with the management of resources supply (municipality/ council) and utilization (local residents) in the community?*

7. How do you rate the quality of WEF nexus issues in the community?*
8. Would you say that resources are readily available and affordable to households in the communities?*
9. What do you think are the major challenges facing your organisation in management of resource/s?
10. In your view what do you think are the coping strategies used by women to WEF nexus issues?*
11. How do you perceive the coping strategies being used by women on sustainability of resources?*
12. What do you think women should do to ensure resources sustainability?
13. What do you think should be done by the stakeholders and government to mitigate challenges posed by WEF nexus security?
14. How do you rate the WEF nexus security of most households in this community?

Thank you for your participation.

Introduction

I am Hilda Jaka from North West University.

The researcher then explains:-

- ✓ General purpose of the study
- ✓ Aims of the interview and expected duration
- ✓ Who is involved in the process (other participants if any)
- ✓ Why the participant's cooperation is important
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- ✓ Consent

Warm up [demographic & work history]

Can I ask some details about you and your job?

Job Title _____

Highest Educational Grade attained ____ Year of graduation _____

Years living in this community |__|__|yrs|__|__|mths

Are you originally from this area/district? Yes No

How old are you? Under 30yrs 30-40yrs Over 40yrs

Please note that the researcher will use the same questions marked with a () to work separately on water security, food security and energy security. The interviews will focus on perceptions, views and life experiences in relation to water-energy-food security. The researcher will also have a cover sheet for each interview that will have provision to write notes during the research to capture data.*

Questions:

1. How long have you been living in the district?
2. What are the major sources of water, energy and food in this community?*
3. How reliable are these sources in supplying the household needs?
4. How do you access water, energy and food for your households? Explain your answer?*
5. Would you say that water, energy and food as resources are readily available and affordable to households in the communities?*
6. What are the major challenges being faced by households in trying to achieve adequate water, energy and food?

7. What do you think are the major roles being played by women, to ensure that there is adequate water, energy and food supplies for households?
 8. In your view what do you think are the coping strategies used by women to WEF nexus issues?
 9. How do you perceive the coping strategies being used by women on sustainability of resources?
 10. Are you receiving any form of assistance for Water-energy-food security from different sources, what are the sources, form of assistance and how helpful is the aid. Explain in detail.*
 11. What do you think should be done by the stakeholders and government to mitigate challenges posed by WEF nexus security?
- Thank you for your participation.

Nhungamiri yehurukuro

Kwaziso

Ini ndinonzi Hilda Jaka ndabva paunivesiti ye North West munyika yeSouth Africa.

Mudzidzi ngaatsanangure zvinotevera.

- ✓ Chinangwa chetsvakurudzo
- ✓ Chinangwa chehurukuro uye kuti zvinitora nguva yakareba sei
- ✓ Sei zvakakosha kuti vatambi vadaire mibvunzo yose
- ✓ Tsananguro kana pane vamwe vatambi varipowo.
- ✓ Zvichashandiswa ruzivo runenge rwabuda mutsvakurudzo, huye kuti zvinobatsirei mutambi
- ✓ Kukumbira mvumo yekushandisa chitapa mazwi uye kutora mifananidzo kana pane chikonzero
- ✓ Kana pane mibvunzo ingavepo mudzidzi ape nguva kwairi
- ✓ Chibvumirano

Nhungamiri (kutura pachiumbwa ukama hukoita kuti mutambi asununguke)

Ndingabvunzawo here mibvunzo pamusoro penyu?

Basa remutambi: _____

Makadzidza kusvika papi _____gore
ripi _____

Mave nemakore mangani muchigara munzvimbo ino _____ mwedzi

Munobva munharaunda muno here pakuberekwa Hongu/ kwete

Mave nemakore mangani okuberekwa _____

Mune vana vangani mumhuri menyu _____

Mava nevana vavenemakore anodarika mashanu here? hongu/ kwete

Munenevana vanemakore aripasi pemashanu here vanogara nemi?

Pamibvunzo yese yaikaswa chinyenyedzi mudzidzi achashandisa mubvunzo mumwe chete kubvunza asi achitarira mvura, chikafu nemasimba zvakasiyana. Hurukuro dzichanangana nemafungiro evanhu, uye zvavakasangana nazvo paupenyu munyaya dzemvura, chikafu nemasimba. mudzidzi achanyora manotsi ezvinokurukurwa achiona nekukosha kwazvo.

Mibvunzo

1. Titaurirei pamusoro pemhuri yenyu, uwandu hwenyu uyemagoverwo emabasa muripamusha penyu.
2. Ndeipi mishando yamunoita semhuri kuti muwane raramo uye inobatsira zvakadii kuti muwane zvamunoda semhuri?
3. Munowana mvura, masimba/moto/magetsi uye chikafu kubva kupi munharaunda muno?*

4. Kwamunowana zvinhu izvi chimwe nechimwe chakamira choga kwakavimbika zvakadii kuwanisa mhuri yenyu zvakafanira?
5. Tisanangurirei zvamunoshingaira nokuita kuti mhuri yenyu iwane chikafu, mvura nemoto wekushandisa zvakarungana?
6. Zvii zvamunoshandisa mvura, chikafu uye moto mudzimba dzenyu, pazviri pne ukama hupi hwamunoono pakati pezvinhu izvi uye mawanikirwo azvo.
7. Ndedzipi nzvimbo, kana zviro, zvinokupai mvura, moto kana chikafu zvamunoshandisa kana kuvimba nazvo semhuri. Uye sei muchisarudza kushandisa nzvimbo, nzira idzi kana zviro izvi?
8. Tisanangurai zvizere hukama huripo pakati pemvura, moto nechikafu kubvira mawanirwo nemashandisirwo hwamunoono pazvinhu izvi.
9. Ngatiti kutsvaga nemawanirwo echimwe pakati pemvura, moto kana chikafu kungave here nedambudziko rinoonekwa pakuwaniwa kwezvimwe. Tisanangurai zvizere.*
10. Ndeapi matambudziko arikusanganikwa nawo kuedza kuti mhuri dzenyu dziwane mvura, moto kana chikafu chakakwana uye ndezvipi zvamunoti zvirikukonzeresisa matambudziko awa?*
11. Zvii zvamurikuita kuedza kupedza, kuderedza kana kurarama zvirinani namatambudziko aya semhuri uyesenharanda?*
12. Zvii zvirikuitwa nemadzimai kuti mhuri dzavo dziwane chikafu, mvura uye moto wakakwanirana pazvinodiwa pamusha uye nemhuri?*
13. Kana muchitarisisa matambudziko aya anouya pakuti mvura, moto nechikafu zviwanike kumhuri nezvinomakonzeresa ndizvo zvimwe chete here makore ese kana kuti zvirikushanduka nenguva. Tisanangurai maoner enyu.*
14. Kana mati zvirikushanduka nenguva zvii zvamungati makadzidza kuita kuti muderedze kana kupedza kana kusangana nematambudziko aya nezvinomakonzeresa?*
15. Muri kuwana rubatsiro here kuti muwane raramo uye mvura, moto nechikafu chakarungana nemhuri, kana ruripo rurikubvepi uye zvirikubatsira zvakadii semadzimai uye semhuri. Tisanangurai?*
16. Ndezvipi zvamunogona kuita semudzimai kana mukawana rubatsiro kuti mugone kuwana mvura, moto kana chikafu chakarungana nemhuri yenyu?*
17. Ndezvipi zvamunofunga kuti dayi hurumende nemamwe mabazi anobatsira yakuitirai munharanda muno uye semudzimainkuti mhuri dzenyu dzigone kuwana mvura, moto kana chikafu chakarungana?
18. Pane zvese zvamunorangerira zvamboitwawo nehurumende kana mamwe mabazi anobatsira, mungati kudii pamusoro perubatsiro irworwo kuedza kupedza zvikonzero uye matambudziko ekuwanikwa kwemvura, moto kana chikafu zvakarungana pamhuri?
19. Makatarisa musha wenyu nemhuri yenyu mungagona here kuti munowana mvura, moto uye chikafu zvakakwana uye zvakarungana nemhuri yenyu.
20. Kana tikati dudzirai kukwanirwa/kuringanirwa kwemhuri yenyu nemvura, moto kana chikafu munoti kudii? Makaringanirwa here kana kwete, tsanangurai.

Mibvunzo imwe inogona kudzikiswa kuchitariswa

- Zviwanikwa pamwedzi
- Mibato yemaoko
- Rubatsiro
 - *Tsika nemagariro*
- *Ukama nevashandi vemumahofisi*
 - *Zviwanikwa zvirimunzvimbo iyi*

- *Rubatsiro runopiwa pamibato yemaoko*
- *Zvido zvevanhu pakusarudza zvekushandisa*
- *Magariro*
 - *Cost of living*
 - *Housing*
 - *Electricity and other sources of energy*
 - *Water*
 - *Food*
 - *Transportation*
- *Udzamu hwedzidzo munzvimbo*

Mhedziso

Pane zvimwe here zvamungade kutaura pamusoro pehurukuro yataita.

Nhungamiri yehurukuro

Kwaziso

Ini ndinonzi Hilda Jaka ndabva paunivesiti ye North West munyika yeSouth Africa.

Mudzidzi ngaatsanangure zvinotevera.

- ✓ Chinangwa chetsvakurudzo
- ✓ Chinangwa chehurukuro uye kuti zvinitora nguva yakareba sei
- ✓ Sei zvakakosha kuti vatambi vadaire mibvunzo yose
- ✓ Tsananguro kana pane vamwe vatambi varipowo.
- ✓ Zvichashandiswa ruzivo runenge rwabuda mutsvakurudzo, huye kuti zvinobatsirei mutambi
- ✓ Kukumbira mvumo yekushandisa chitapa mazwi uye kutora mifananidzo kana pane chikonzero
- ✓ Kana pane mibvunzo ingavepo mudzidzi ape nguva kwairi
- ✓ Chibvumirano

Nhungamiri (kutura pachumbwa ukama hukoita kuti mutambi asununguke)

Ndingabvunzawo here mibvunzo pamusoro penyu?

Basa remutambi: _____

Makadzidza kusvika papi _____gore
ripi _____

Mave nemakore mangani muchigara munzvimbo ino _____ mwedzi

Munobva munharaunda muno here pakuberekwa Hongu/ kwete

Mave nemakore mangani okuberekwa _____

Pamibvunzo yese yaikaswa chinyenyedzi mudzidzi achashandisa mubvunzo mumwe chete kubvunza asi achitarira mvura, chikafu nemasimba zvakasiyana. Hurukuro dzichanangana nemafungiro evanhu, uye zvavakasangana nazvo paupenyu munyaya dzemvura, chikafu nemasimba. mudzidzi achanyora manotsi ezvinokurukurwa achiona nekukosha kwazvo.

Mibvunzo

1. Mave nenguva yakareba zvakadini muchigara munharaunda muno.
2. Munowana mvura, masimba/moto/magetsi uye chikafu kubva kupi munharaunda muno?*
3. Kwamunowana zvunhu izvi chimwe nechimwe chakamira choga kwakavimbika zvakadii kuwanisa mhuri yenyu zvakafanira?
4. Titsanangurirei zvamunoshingaira nokuita kuti mhuri yenyu iwane chikafu, mvura nemoto wekushandisa zvakaranga?
5. Semaonero enyu pazviwanikwa izvi makatarisa munharaunda mungati zvinhu izvi zvirikuwanikwa nyore kumhuri dzose here, tsanangurai zvizere?
6. Ndeapi matambudziko arikuwanikwa mumhuri pakuwana mvura, moto kana chikafu chaaringana nemhuri?

7. Ndezvipi zvirikuitwa nemadzimai mudzimba kuti mhuri dzive nemvura, moto nechikafu zvinoringana nemhuri?
8. Takatarisana nematambudziko arikusanganikwa nawo kuwana zvitatu izvi, ndezvipi zvirikuedzwa kana zvirikutoitwa nemadzimai kuti mvura,moto kana chikafu zvikwanire mhuri?
9. Takatarisana nezviedzwa zvese izvi zvirikuitwa nemadzimai, mungati ramangwana rakamira sei munoono zvichigadzirisa ramangwana rezviwanikwa izvi here, tsanangurai zvizere?
10. Muri kuwana rubatsiro here kuti muwane raramo uye mvura, moto nechikafu chakaringana nemhuri, kana ruripo rurikubvepi uye zvirikukubatsirai zvakadii semhuri. Tsanangurai?*
11. Ndezvipi zvamunofunga kuti dayi hurumende nemamwe mabazi anobatsira yakuitirai munharaunda muno uye semudzimainkuti mhuri dzenyu dzigone kuwana mvura, moto kana chikafu chakaringana?

Tinotenda nenguva yenyu.

Mathomele

Ndi nne Hilda Jaka ubva North West University;

Musedzulusi o talutshedza zwi tevhelaho

- ✓ Ndivho ya ngudo
- ✓ Ndivho ya ndingo na tshifhinga tsho lavhelelwaho u dzi fhedza.
- ✓ Ndi ngani u dzhenelela ha mulingiwa zwi zwa ndeme.
- ✓ Hu do iteani nga ndingo dzothe dzo kuvhangangwaho uri vhalingiwa vha vha do vhuelwa nga mini.
- ✓ Musedzulisi u do vhudzisa nga ha vhune na u vhulunga ndivho na zwinepe.
- ✓ Dzinwe vho mbudziso?

Ndi nga kona u vhudzisa vho zwinwe nga ha vhone:

Vhuimo ha mushumo _____

Ndalunganyo ya pfunzo dza nth _____nwaha wa u nekedzwa ndalukanyo _____

Vha na minwaha mingana vha tshi dzula fano _____nwaha _____nwedzi.

Vha mudzulapo wa fano ? Ee Hai

Minwaha yavho ndi mingana fhasi ha 30 30-40 yrs nth ha 40yrs

Vha na vhana vhare na minwaha ire nth ha mitani Ee Hai

Vha na vhana vha re na minwaha ire fhais ha mitanu vhane vha dzula navho naa? Ee Hai

Mutodulusi u do shumisa mbudziso dzino fana dzine dz ado vha dzi na (*) u shuma nga ha madi –zwivhaswa na zwiliwa khathihi na tsireledzo.

1. Ndi humbela uri vha di talulise na u talutshedza dzina lavho, Pfunzo yavho na uri vho fhedza mihwaha migana vha tshi khou dzula shangoni lino, vha mmbudze hafhu na uri vha vha ngana mutani wavho?
2. Vha tshila nga mini fano mutani wavho nahone vha khou vhona zwine vha tshila ngazwo zwi tshi khou kona u swikela thodea dzavho naa?
3. Ndi zwifhio zwiko zwihulwane zwa madi na zwiliwa fano?*
4. Zwiko izwo zwi a thembea kha ndisedzo ya tshumelo mutani wavho naa?
5. Vha wana hani madi , zwivhaswa na zwiliwa mudini wavho ? Kha vha talutshedze phindulo ya vho?*
6. Madi, zwivhaswa na zwiliwa zwi shumiswa mini fano mutani , vhangana kona u talutshedza vhushaka hazwo?
7. Ndi zwifhio zwiko zwa madi ,zwivhaswa na zwiliwiwa zwine vha tshila ngazwo nahone ndi ngani?
8. Ndi vhushuka de vhu re hone vhukati ha madi, zwiliwi na mudagasi mutani wavho?
9. Musi arali vha wana tshithihi tsha zwilishumiswa hezwi madi, zwiliwa kana mudagasi zwi kamisa hani zwinwe zwi shumisa?*
10. Ndi khaedu dzifhio dzine vha tangana nadzo dza mufumakadzi zwi tshiya kha u wana madi,zwivhaswa na zwiliwa mutani wanga?

11. Ndi zwifhio zwe vha ita khau fhungudza khaendu ya madi zwiliwa na mudagasi mutani wavho na kha muvhundu wavho?*
12. Ndi zwifhio zwine vhafumakadzi vha ita u khwathisedza uri huvhe na ndisedzo ya madi, zwivhaswa na zwiliwa mutani wavho?*
13. Khaedu dzine vha vha nadzo vha madi , zwivhaswa na zwiliwa vha vhona vha tshi nga kona u dzi vhenya kana u dzifhelisa hu sikale, na hone ndi ngani vha tshi ralo?*
14. Arali dzi tshi do shanduka khaendu dza madi nga murahu ha tshifhinga vha do ita mini u swikela idzi tshanduko? kha vha taluteshedze?*
15. Vho no vhuya vha tangedza thuso ya madi kana zwiliwa u bvafho kha madzangano kana zwiimiswa, nahone arali vho tangedza thuso yo vha yavhudi? kha vhatalutshedze?*
16. Ndi zwifhio zwine vhahumbula uri vha nga ita zwone uthusa vhanwe vhafumakadzi uri vha vhe na madi na zwiliwa mitani yavho?*
17. Ndi zwifhio zwine vha humbula uri muvhuso u nga ita na zwi imiswa zwa u imela vhadzulapo u thusa kha ndisedzo ya tshumelo, madi na zwiliwa?
18. Vha ngari mini nga ha ndila ine zwi imiswa zwi si zwa muvhuso zwa dzhenelela kha u thusa na u ita uri madi na zwiliwa zwi vhe hone tshifhinga tshothe?
19. Nyimela ya madi na zwiliwa mutani wavho inga ndila de?*
20. Vha nga vhea muta wavho kha tshiimo tshifhio kha nyimele ya madi na mudagasi?

- a) Ya u tambula
- b) Ya vha khwine
- c) Ya vhudi
- d) Ya vhudisa

Zwinwe zwine ri nga amba vho khezwi

- *Tshelede ine vha i wana nga nwedzi*
- *Muholo wavho*
- *Fhethu vhupo hune vha dzula hone*
- *Dzisedzo ya zwishumiswa..etc*
- *Thonifho kana u takalewa nga vhanwe vhathu kana vhalanguli*
- *Madi,zwivhaswa na zwiliwa*
- *Vhulanguli na thogomelo ya zwothe zwine vha ita mutani*
- *Tshiimo tsha matshilele*
Lutshilele zwi tshi elana na masheleni
Ndu
Mudagasi na zwinwe zwi shumiswa zwa zwivhaswa
Madi
Zwiiwa
Zwiendedzi
- *Pfunzo ya vhana*

Ri tshi vala.

Arali hu na zwinwe zwine vha hambula uri ndi zwa ndeme kha vhupo havho zwe ri ambe vha nga kona u:

Nea manweledzo

U livhuwa vhatu vhothe vho dzhenelela kha ngudo idzi

U nekedze inwe ndivho na vhukwamani ha vhatu vhothe vho dzhenelelaho

NB: *Mutoduliso u do da na dzinwe mbudziso nga tshifhinga tsha nyambeno arali hu na inwe divho ane akhou i toda, u itela uri avhe na vhutanzi ho khwathaho nga ndisedzo ya madi ,zwivhaswa na zwiliwa, nauir vhafumakadzi vha mahayani vha tshila hani na khaedu idzi.*

Focus Group Discussion Guides

English

Focus Group Discussion Guide

Introduction:

1. Welcome and introductions of the group members and the facilitators.
 - The researcher allows time for completion of the Sign-In Sheet around the group.

NB this can be done while introducing the focus group explaining what the research is trying to achieve, what will be done with the information obtained, why the members were asked to participate.

2. Explanation of the process
The researcher will ask the group if anyone has participated in a focus group before. The researcher will then explain why the focus group discussion is being used for the research and why it is relevant to this particular study.

Include the following points in the explanation:

- Focus group discussion focus on learning from the group members (positive and negative)
- The discussions are not to achieve consensus, but to gather information on the WEF security nexus.
- The discussions will be guided by priorities and objectives of the study and only information related is most appreciated.
- In this project, we are doing both one on one interviews and focus group discussions. The reason for using both of these tools is that we can get more in-depth information from a smaller group of people in focus groups. This allows us to understand the context behind the answers given in the one on one interviews and helps us explore topics in more detail.
- Ask for consent to record and take photographs

Inform the group member on logistics e.g

- Focus group may last about one hour
- Feel free to move around
- Showing them the toilets for use during discussions.
- Information on how refreshments will be served

3. Ground Rules

The researcher will ask the group to suggest some ground rules. After they brainstorm some, make sure the following are on the list.

- Everyone should participate.
- Information provided in the focus group must be kept confidential
- Stay with the group and please don't have side conversations
- Turn off cell phones if possible
- Have fun

4. Turn on Video or Tape Recorder
5. Ask the group if there are any questions before we get started, and address those questions.
6. Introductions
 - The introductions will be done with respondents giving a general introduction about them. This session may look at also the form of livelihoods these women are doing and why they chose to do that, dietary preferences and general interests. This will ensure that respondents become comfortable with each other before answering serious questions.

NB: Discussion begins, make sure to give people time to think before answering the questions and don't move too quickly. Use the probes to make sure that all issues are addressed, but move on when you feel you are starting to hear repetitive information.

Questions:

1. Let's start the discussion by talking about the availability, accessibility, stability of supply of water-energy-food nexus. (*focus on one element of the nexus at a time*)*
2. What is the relationship between water-food-energy nexus in the rural household setting?*
3. What are we doing as women to secure water, energy and food for our respective households?
4. What is the role of women in households in the WEF security nexus and the challenges faced?*
5. What are we doing as women to try and reduce the effects of WEF insecurity in your household?
6. What form of aid has been rendered to you as households or communities to try and alleviate the challenges of water, energy and food insecurity?
7. What role has been played by the government, or government bodies to try and address the challenges posed by WEF insecurity?
8. What suggestions do you have to improve the WEF security nexus so that poverty and instability could be reduced?

Probes for Discussion:

- *Estimated income per month*
- *Livelihoods*
- *Remunerations*
- *Living conditions*
 - *Access to supplies, equipment, etc*
- *Respect/recognition from management or others*
- *Available sources*
 - *Water, energy, food*
- *Management and supervision of activities(livelihoods)*
- *Preferences on sources of water, energy and food and reasons*
- *Standards of living*

- *Cost of living*
- *Housing*
- *Electricity and other sources of energy*
- *Water*
- *Food*
- *Transportation*
- *Education for children*
- *Work/home balance*

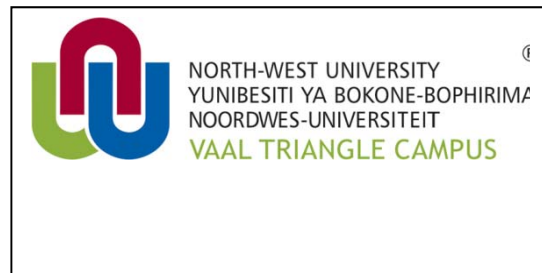
That concludes the focus group discussion. Thank you so much for coming and sharing your thoughts and opinions with us. We have a short evaluation form that we would like you to fill out if you time. If you have additional information that you did not get to say in the focus group, please feel free to write it on this evaluation form.

Materials and supplies for focus groups

- Sign-in sheet
- Consent forms
- Evaluation sheets, one for each participant
- Name tents
- Pads & Pencils for each participant
- Focus Group Discussion Guide for Facilitator
- Recording devices
- Batteries for recording devices
- Notebook for note-taking
- Refreshments

Focus Group Evaluation Form

Your feedback will help us to plan for the next focus group.



Name _____ of _____ community:

Date of discussion: _____

Male Female

Beside each of the following statements, please place a tick in the appropriate box.	Yes	No	Not Sure
The focus group was better than I expected			
The topics discussed were interesting			
The questions were easy to understand			
I enjoyed discussing this topic with the other members			
We were given enough time for discussion			
The facilitators encouraged participation			
I got a chance to have my say			
I felt that I was listened to			
A focus group is a good way of consulting with students			
I would participate in another focus group			

Please tick the response you agree with:

Overall, the focus group was.....	<input type="checkbox"/> Great	<input type="checkbox"/> Good	<input type="checkbox"/> OK	<input type="checkbox"/> Poor
The facilitators were.....	<input type="checkbox"/> Great	<input type="checkbox"/> Good	<input type="checkbox"/> OK	<input type="checkbox"/> Boring

Was there something you think we should have discussed but didn't?

Write any other comments in the space provided below (*e.g. what you liked or didn't like; how the group could be improved*).

Thank you.

Focus group discussion, sign-up sheet

Date: _____

Time: _____

Location: _____

Please record your name and contact information so that we can get back to you with more information.

	PRINT NAME	ADDRESS	PHONE #	EMAIL ADDRESS
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				

Shona

Nhaurirano dzemumapoka mapoka

1. Kwaziso

Ini ndinonzi _____ ndiri mudzidzi paUnivesiti yeNorth West , kuSouth Africa. Tiripano nhasi nemi madzimai emuno machivi kuti tiite hurukuro pamusoro penyaya dzine chekuita nemvura, chikafu uye zvevasimba anoshanda mudzimba kuti zvakasiyana siyana zvifambire mberi. Tichakumbira kuti umwe neumwe anore zita rake pabepa ririkutenderera kuitira umbowo hwekuti muzuva ranhasi tambosangana tichikurukura nezve nyaya iyi. Hurukuro iyi inobatsira kuti tione mararamiro arikuita mhuri dzirimumaruwa kuti vagone kurarama vaine matambudziko anouya nekuda kwekushomeka kana kushaikwa kwezvadomewa pamusoro. Tichakumbira kwamuri madzimai kuti zvatichataura pano zvisazove nevamwe vanozoziva nezvazvo, kunyanya tisazonoti mai nhingi vati zvakati kuhurukuro. Tinokumbira kuti kubva pane vekutanga tizvizivise kunevamwe vese. Tichakumbira mutipewo zita renyu nokutiudza zvisvishoma zvamunofarira semudzimai. Tichakumbira musununguke chose.

Tsananguro yemafambiro ehurukuro

Tinotenda nekwaziso yakanaka yabva kwamuri. Sezvo tese tave kuzivana, tinoda kuti tionewo vakambova vatambi muhurukuro dzerudzi urwu. Hurukuro idzi dziri kuitwa kuitira kuti tiwane ruzivo rwakaringana pamusoro pezviri kusanganikwa nazvo nemadzimai. Dziripo dzimwe nzira dzirikushandiswa kutsvaga ruzivo urwu nokudaro hurukuro idzi dzakakosha chaizvo kugona kutibatsira nekusimbaradza umbowo hwatinenge tapiwa nedzimwe nzira dzirikushandiswa. Takaona zvakare kuti kana madzimai akaungana sezvatakaita izvi zvinotiitira nyore chose kuti tigone kutaurirana takasununguka tichikwapana mazano neruzivo. Hurukuro idzi hadzisi dzekuti tione vanogona kudarika vamwe, bodo, hadzisi dzekuti tibudise chibvumirano chezvinoita nezvisingaiti, bodo, hapana chinotaurwa pano chisina maturo. Tinoda kuunganidza ruzivo saka zvese zvichataurwa pano zvinebasa, uye tese tisununguke kutaura pfungwa dzedu, hapana anozobuda arishasha kana dofo nokuti hatisi pamakwikwi. Tinokukumbirai zvakare mvumo yekutapa mazwi nekutora mifananidzo pane zvakakosha.

2. Zvinotarisiwa

- Tinotarisiwa kuita hurukuro iyi kweawa imwe chete kana kudarika.
- Makasununguka zvenyu kufamba famba kana muchida kushandisa zvimbu.
- Zvimbu zvatichashandisa ndezvizvi.
- Kana paine zvimwiwa tichagadzira nguva yekuwana zvimwiwa izvi pamwechete.

3. Mitemo yepahurukuro.

Tinokumbira kuti tikurukure pamisoro pemitemo yatingaise kuti hurukuro yedu ifambire mberi zvakanaka. tinoda kuti imi mutaure mitemo yamunoona yakakosha . kusanganisira:

- Munhu wese anotarisirwa kutaura pahurukuro ichaitwa.
- Zvichataurwa zvinofanirwa kuva zvedu toga, hatidi vanofamba vachizozvitaurea.
- Ngatitaurei seboka rimwechete.
- Ngatidzimei kana kunyaradza mbozhanhare dzedu.
- Tese ngatifarei tichikurura zvedu.

4. Mutambisi/ mudzidzi anobatidza chitapa manzwi.

5. Pane vanemibvunzo here tisati tatangisa hurukuro yedu.

6. Hurukuro dzinonyatsa kutangiswa zvino vatambi vachipa kwaziso, uye vachizvizivisa kunevamwe. Mumwe neumwe achataura zita rake, oreva kuti vangani pamusha pavo, oreva mibato yamaoko yaanoedza kuita, oreva mibato yemaoko yavari kuita uye sei vakaisarudza, chikafu chavanofarira uye zvimwewo zvavanofarira paupenyu. Izvi zvinoitirwa kuti vatambi vagadzikane uye vasununguke kuva pakati pevamwe.

Mibvunzo yekutungamira hurukuro

1. Tinoda kukurukura pamusoro pemawanirwo , mashandisirwo, nzvimbo dzekuwana, mabasa atinoita kuwana, kukwana kana kushota kwe mvura ,chikafu nemasimba anoshandiswa mudzimba, tichataura chimwe nechimwe chiri choga asi tichitevedza zviripamusoro.

- Mvura
- Chikafu
- Masimba-magetsi,huni nezvimwewo.

2. Izvo zvunhu zvitatu izvi zvinoti mvura ,chikafu nemasimba aya zvineukama hweyi mukati medzimba. Ndezvipi zvinosunganidza zvitatu izvi pamashandisirwo kana mawanirwo azvo mukati medzimba dzedu.

3. Zvii zvatiri kuita mukati medzimba dzedu kuti tiwane chikafu, mvura ne masimba/moto zvakakwana kana kuti zvinoringana.

4. Ndeapi mabasa anoitwa nemadzimai kuti chikafu, mvura nemasimba aya zviwanike zvinoringana nekushandisa mudzimba. Ndeapi matambudziko atinosangana nawo kuedza kuti zvikwanirane mukati medzimba.

5. Zvii zvatiri kuita kubvisa kana kutapudza matambudziko atinosangana nawo pakuva nechikafu, mvura kana masimba/moto wakaringana mudzimba.

6. Nderwupi rubatsiro rwatiri kuwana, kubva kunaani, zvirikubatsira zvakadii pakuedza kutapudza matambudziko edu mudzimba semadzimai.

6. Ndezvipi zvirikuitwa nehurumende yedu kana mabazi anomiririra hurumende kuedzawo kutibatsira pamatambudziko aya.

6. Ndezvipi zvamunoona zvingade kuitwa kuti titapudze kana kupedza matambudziko anouya nekushaikwa kana kushomeka kwechikafu, mvura kana masimba/moto zvinoshanda mudzimba.

Jera pfungwa rehurukuro.

- Nzira dzekuwana mari pamwedzi
- Mibato yemaoko
- Miripo kana zvipo zvemari
- Mararamiro maringe nekuwanikwa kwezvikanisiro pamabasa
- Rukudzo uye kubatwawo zvakanaka nenhengo dzeutungamiri hunoona nezvemvura, chikafu kana masimba semadzimai
- Rubatsiro runopiwa nevane ruzivo mumibato yamaoko.
- Mararamiro
 - Mari dzinodiwa kuwana mvura, masimba/moto kana chikafu, nekuwanika kwadzo.
 - Pekugara
 - Mabazi emasimba anogona kushandiswa nemawanirwo
 - Mabazi ekunowanikwa mvura yemudzimba nemawanirwo
 - Mabazi ekunowanika chikafu nemawanirwo
 - Nzira dzemafambiro pakuwanikwa kwazvo
- Kuwanikwa kwezvikororo zviripedyo nekudzidza kwevana mudzimba
- Kurongedzwa kwamabasa emudzimba.

Kana hurukuro dzapera madzimai anokumbirwa kuzadzisa bepa rine mibvunzo inoda kuziva zvinoringana nehurukuro yaitwa.

Gwaro rekuongorora hurukuro yaitwa.

Ongororo yenyu ichatibatsira pagadziriro yehurukuro inotevera.

Zita redunhu: _____

Zuva rehurukuro: _____



Murume Mukadzi

Tsvunhai pamunoona panoindirana nemhinduro yenyu	Hongu	Kwete	Handiziviwo
Hurukuro yagonekwa kudarika tarisiro yangu			
Hurukuro yafambiswa zvakakanaka takasununguka			
Mibvunzo yabvunzwa yanga ichinzwisika.			
Ndakarira kuita hurukuro iyi ndiri muboka nevamwe.			
Tanga tichipiwa nguva yakaringana yekukurukura.			
Vatungamiriri vanga vachitikurudzira kutaurawo.			
Ndawanawo mukana wekutaurawo pfungwa dzangu			
Ndazwawo kuti zvandanga ndichitaura zvanga zvichiteererwa.			
Hurukuro ndoomhando kwayo yekuwana umboo kumadzimai.			
Ndingade zvakare kuita imwe hurukuro.			

Tsvunhai pamunotenderana napo:

Hurukuro iyi yanga	<input type="checkbox"/>	zvakanaka	<input type="checkbox"/>	ndizvowo	<input type="checkbox"/>	zvishoma yakarongeka
Vatungamiri	<input type="checkbox"/>	ishasha	<input type="checkbox"/>	vagonesa	<input type="checkbox"/>	vagona
					<input type="checkbox"/>	vakonewa

Pane zvimwe here zvatingadai taura zvaisina kutaura nezvazvo?

Nyorai zvimwewo zvamaona zvamungade kuti tizive (e.g. *zvamafarira kana zvamusina kufarira; zvingaitwe kuvandudza hurukuro dzerudzi urwu*).

Tatenda.

Vhenda

Maitele a Nyambedzano ya zwigwada

Mathomele:

1. Ndi khou tanganedza vhathu vhothe na zwigwada zwothe na vha tshimbidzi vhothe.

- Mutodulusi u do vha tendela u dadza na u saina fomo kha zwigwada zwavho.

NB: Hezwi zwi do itwa hu tshi divhadzwa ndivho ine thoduluso ya tea u swikela yone, nauri hu do itea mini nga mafhungo ane a do wanala, nauri ndi ngani vhathu vhothe vho dzhenelelaho vha tshi do vhudziswa.

2. Ndivho ya zwine thoduluso ya do tshimbilisa zwone.

Mutodulusi u do vhudzisa zwigwada uri huna munwe naa we a vhuya a dzhenela kha zwigwada zwa nyambedzano tshifhingani tsho fhiraho. Mutodulusi u do dovha hafhu a talutshedza uri ndi ngani hu tshi tea uvha na zwigwada zwa nyambedzano na hone zwi thusa hani kha ngudo iyi.

Hu do katelwa zwitevhelaho kha nyambedzano iyi:

- Nyambedzano ya zwigwada i do vha yo lavhelesana na u guda u bva kha vhathu vhane vho do dzhenelela zwi nga vha na vhudi kana vhuvhi.
- Nyambedzano i dzi a dzi khou itelwa u swikela thendelano, fhedzi u kuvhanganya mafhungo nga ha madi, zwivhaswa na zwiliwa khathihi na tsireledzo.
- Nyambedzano dzi do langulwa, mafhungo ane a do elena na ngudo ado takalelwa.
- Kha thandela iyi ri do ita ndingo dza u vhudzisa muthu nga muthihi nga muthihi ra dovha hafhu ra sedza na nyambedzano ya zwigwada. Ndivho ya u ita izwi ndi u wana vhu dzivha ha mafhungo u bva kha zwigwada zwituku zwa vhathu. Hezwi zwi do ita uri ri pfesese vhuvha ha mafhungo na phindulo dzine dza do nekedzwa nga tshifhinga tsha ndingo, hezwi zwi thusa hafhu u tandavhudza thoho ya mufhungo nga vhudalo.

Mafhungo a mirado ya zwigwada , tsumbo;

- Nyambedzano i do fhedza iri nthihi.
- Vha pfe vho vhotholowa u mona mona.
- U sumbedzwa mabunga ane a do shumiswa nga tshifhinga tsha nyambedzano.
- Vha do talutshedzwa uri zwinwiwa zwi do nekedzwa hani.

3. Maitele ane atea u tevhedzwa

Mutoduluso u do vhudzisa zwigwada nga ha manwe a maitele. Musi mirado yo no elekanya vha tea u vha na vhutanzi uri zwitevhelaho zwi hone.

- Munwe na munwe utea u dzhenelela.
- Mafhungo othe ane ado ambiwa kha zwigwada zwa nyambedzano a tea u farwa nga ndila ya tshiphiri.
- Mirado itea u dzula hanefho kha zwigwada zwezwo a i ngo tendelwa u fara dzinwe nyambedzano nga thungo.
- Vha dzime thingo thendeleki dzavho arali zwi tshi nga konadzea.
- Vha di phine

4. Vha funge vidio kana tape recorder

5. Vha tea u vhudzisa mvudziso nyambedzano ya zwigwada isa thu thoma.

6. Mathomele

- Mathomele a do itiwa nga mirado ine ya do dzhenelela hu tshi khou divhdzwa mirado nga u angaredza. Hezwi zwi do thusa uri mirado ipfe yo tangedzea musi vha sathu thoma u fhindula mbudziso.

NB: Nyambedzano dzi tshi thoma vha vhe na vhutanzi uri vha khou nea vhathu tshifhinga tsha u humbula vha sathu fhindula mbudziso.

Mbudziso

1. Kha ri thome nyambedzano nga u amba nga ha u wanala ,thodea, na u nekedzwa ha madi-zwivhaswa na zwiliwa.(vha ambe nga tshithu tshithihi vha fhedze vha kone u pfukela kha tshinwe)*

2. Ndi vhushaka de vhure hone vhukatini ha madi-zwivhaswa na zwiliwa mitani ya mahayani?*

3. Vhuimo ha mufumkadzi ngomu mutani vhi vhufhio zwitshi elana na madi-zwivhaswa, zwiliwa na tsireledzo na khaedu dzine vha tangana nadzo ?*

4. Vho no itani zwa zwino u lingedza ufhelisa khaedu dza madi-zwivhaswa na zwiliwa, na uri vho no guma ngafhi kha u kunda khaedu idzo?*

5. Vha nga topola masia de ane vha vhona unga anga thusa kha u khwinivhafhadza ndisedzo ya madi-zwiliwa na zwivhaswa u fhedza thambula kana u i fhungudza?

Zwinwe zwine ri nga amba vho khezwi

- *Tshelede ine vha i wana nga nwedzi*
- *Muholo wavho*
- *Fhethu vhupo hune vha dzula hone*
- *Dzisedzo ya zwishumiswa..etc*
- *Thonifho kana u takalewa nga vhanwe vhathu kana vhalanguli*

- *Madi, zwivhaswa na zwiliwa*
- *Vhulanguli na thogomelo ya zwothe zwine vha ita mutani*
- *Tshiimo tsha matshilele*
- *Lutshilele zwi tshi elana na masheleni*

Ndu

Mudagasi na zwinwe zwi shumiswa zwa zwivhaswa

Madi

Zwiiwa

Zwiendedzi

Pfunzo ya vhana

Hezwi zwi ri swikisa kha mafhedziselo a nyambedzano dza zwigwada. Ndi khou livhuwa nga maanda vho da vha talutshedza nga ha ndivho yavho na mihumbulo yavho nga ha ngudo dzanga. Huna fomo ine vha tea u i dadza ya u vhalingula. Arali huna divho ye vha balelwa u i nekedza nga tshifhinga tsha nyambedzano dza zwigwada kha vhapfe vho vholowa u zwi nwala kha fomo iyi.

Zwishumiswa na ndisedzo ine ya do nekedzwa kha zwigwada ;

- Sign-in sheet
- Consent forms
- Evaluation sheets, one for each participant
- Name tents
- Pads & Pencils for each participant
- Focus Group Discussion Guide for Facilitator
- Recording devices
- Batteries for recording devices
- Notebook for note-taking
- Refreshments

Focus Group Evaluation Form

Zwe vha ri nekedza zwi do ri thusa musi ri tshi pulana inwe nyambedzano ya zwigwada.



Dzina of shangoni: _____

Duvha la nyambedzano: _____

Munna Mufumakadzi

Beside each of the following statements, please place a tick in the appropriate box.	Ee	Hai	Thina vhutanzi
Zwigwada zwa vhathu zwo vha zwavhudi u fhira zwe nda vha ndo lavhelela.			
Thoho ya mafhungo yo vha i takadzaho.			
Mbudziso dzo vha dzo leluwa u dzi fhindula.			
Ndo takalela u vha na nyambedzano na vhanwe vha mirado.			
Ro newa tshifhinga tshi nzhi tsha nyambedzano.			
Mulavhelisi ori tutuwedza u dzhenelela.			
Ndo wana tshifhinga tsha u amba.			
Ndo thetshelwa kha zwe nda amba.			
Nyambedzano ya zwigwada ndi ndila yavhudi ya u tangana na matshudeni.			
Ndi do dovha hafhu nda dzhenelela kha inwe nyambedzano ya zwigwada.			

Kha vha nwale zwine vha tendelana nazwo:

Zwigwada zwothe zwo vha..... Great Good OK Poor

Mugudusi o vha awa..... Great Good OK Boring

Vha hambula uri hu na zwinwe zwo tahelaho zwe ri si zwi ambe zwe zwa vha zwo tea u ambiwa?

Kha vha nwale zwinwe afho fhasi zwine vha tama u zwi engedza(Tsumbo, zwe vha zwi funa na zwe vha sa zwi fune kha zwigwada zwa nyambedzano

Ndo livhuwa.

Focus group discussion, sign-up sheet

Duvha: _____

Tshifhinga: _____

Vhethufhupo: _____

Kha vha nwale dzina na na ndila ine vha nga kwamiwa ngayo, u itela uri ri kone u vha kwama arali havha na manwe mafhungo.

	PRINT NAME	ADDRESS	PHONE #	EMAIL ADDRESS
1				
2				
3				
4				
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10				
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15				
16				

Observation tool

The researcher used this guideline to look for patterns, preferences and factors that affect rural household choices towards certain coping mechanisms, household activities, and livelihoods in the case of rural women in Zimbabwe and South Africa.

The researcher gave an introduction and explain in detail the purpose of the study as well as reasons for observation. Consent to observe, take notes, record and take photographs is sought from the community and the respective households. The researcher explained what observation is all about and explained that no information will be disclosed without consent form the participants.

What to observe:

1. Household sources of

- Water
- Energy
- Food

2. Distance of houses from sources

- Water
- Energy
- Food

3. Reliability of sources

- Water
- Energy
- Food

4. The number of people using a certain source

- Water
- Energy
- Food

5. Household preferences of Sources

- Water

- Energy
- Food

6. Major household uses of

- Water
- Energy
- Food

7. Possible causes of insecurity

- Water
- Energy
- Food

8. Household activities and division of labour

- Water
- Energy
- Food

9. Coping mechanisms of households

- Water
- Energy
- Food

10. Household livelihood strategies practised to secure

- Water
- Energy
- Food

NB: The researcher may during the observation period find other aspects that may also need to be added and taken not of. The observation will be done for individual / or a group of households.

