A gendered approach to climate smart agriculture adoption by smallholder farmers in Malawi and Zambia

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PREFACE

This PhD research was conducted as a PhD-by-articles, and fulfilled the stipulated requirements for thesis submission at the North-West University, that at least one research article be published in a reputable accredited journal. In line with the PhD-by-articles format, the thesis is presented in a total of seven chapters. Chapter 1 presents the overview of the study and theoretical frameworks are presented in Chapter 2. The four individual articles produced from the research are chronologically presented in Chapters 3-6. The overall conclusion and recommendations from the research are presented in Chapter 7.

Specifically, the following articles were produced:

1. **Khoza S.**, Van Niekerk, D and Nemakonde L. D. (2019), Understanding gender dimensions of climate-smart agriculture adoption in disaster-prone smallholder farming communities in Malawi and Zambia, *Disaster Prevention and Management: An International Journal* **(published)**
2. **Khoza S.**, Van Niekerk, D and Nemakonde L. D. (2019), Vulnerability and inequality: understanding drivers of climate-smart agriculture adoption among smallholder-farmers in Malawi and Zambia, **(submitted to Journal of Peasant Studies)**
3. **Khoza S.**, De Beer, L., Van Niekerk, D and Nemakonde L. D. (2019), A gender-differentiated analysis of climate smart agriculture adoption by smallholder farmers: Application of the Extended Technology Acceptance Model, **(submitted to Gender, Technology and Development)**
4. **Khoza S.**, Van Niekerk, D and Nemakonde L. D. (2019), Rethinking climate-smart agriculture adoption by smallholder-farmers: A proposed new gender-sensitive adoption framework **(upcoming book chapter)**

The abstract for Article 4 was selected for presentation at the **2nd Symposium on Climate Change Adaptation in Africa: AFRICA 2030-Strengthening the Capacity of African Countries to Handle the Challenges of a Changing Environment**, to be held in Nairobi, Kenya on 23rd-24th January 2020. The full paper will be included as a Chapter in the upcoming *African Handbook of Climate Change Adaptation: Learning, Sharing and Advancing Efforts to Promote Climate Change Adaptation in Africa*. Conference conveners state that the articles for publication will undergo peer-review and the Handbook will be launched at the Symposium. The correspondence on acceptance of the abstract and the requirements for the Chapter are included in Appendix E.

In all the four articles the student was the main author, with supervisors as co-authors. In Article 3 there was collaboration with an associate professor from the WorkWell Research Unit in the Faculty of Economic and Management Sciences at the North-West University. Prof. Leon De Beer, who is an expert in the field of psychology was mainly responsible for data analysis and results interpretation, and is cited as a co-author.

The appendices include the following;

Appendix A: letters of permission from all the co-authors involved in the research to use the articles in the thesis.

Appendix B: Editor's Letter

Appendix C: Research Ethics clearance

Appendix D: Correspondence for study clearance in Malawi and Zambia

Appendix E: Journal requirements and author guidelines

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ABSTRACT

The negative impacts of climate change on smallholder agrarian livelihoods in developing countries will be devastating, threatening to negate even the development gains made thus far, while offering opportunities for resilient development. One approach currently taking centre stage in the development sector is promotion of climate-smart agriculture (CSA), which is expected to primarily increase agricultural productivity and build climate resilience for farmers, and where relevant reduce greenhouse gas emissions. Therefore, at global and national levels CSA has been widely embraced, except for dissentions from antagonists. However, concerns have arisen on low adoption of CSA technologies by smallholder-farmers. Even more concerning is low adoption by women farmers, given the gender-differentiated impacts of climate change. Unfortunately, current literature on CSA adoption is dominantly informed by econometrics, which has not been able to adequately capture the issues, drivers, challenges and opportunities surrounding CSA decisions made by smallholder-farmers across different genders. Furthermore, existing literature on CSA adoption is marred by a parochial and simplistic understanding of the decision-making context of CSA. Decision making seems to be conceptualised in linear fashion where decisions favouring adoption are likely to be made on basis of the benefits offered by new CSA technologies over conventional practices. Consequently, this limited view on decision-making has not been able to adequately address the CSA adoption enigma, which defies benefits of CSA adoption. Actually, the paradox in CSA adoption could be suggestive of a broader context of decision-making than is usually portrayed by existing literature.

Based on the identified gaps in current knowledge this research took on a gendered approach to understand CSA adoption among smallholder-farmers. Given the aim of the study to probe tensions between gender and CSA adoption in disaster-prone smallholder farming regions in Malawi and Zambia, this study was informed by a combination of transformative and pragmatic worldviews. On the basis of these philosophical paradigms, an exploratory-sequential mixed methods study design, with a bias on qualitative findings was conducted. A qualitative bias ensured that the study captured local gender perspectives, contexts and realities, and in all the articles quotes drawn from diverse study participants were captured. The preliminary qualitative phase of the study comprised interviews conducted with key informants and focus group discussants in the

two study sites, Chikwawa district in Malawi and Gwembe district in Zambia. The qualitative phase was essential as it established themes that were then quantitatively explored for generalisability through a cross-sectional household survey. A total of 172 individuals participated in the whole study either at the qualitative or quantitative phase. A mixed methods research design was essential for the study to be able to identify where transformative measures were required in building resilience of smallholder-farmers through pragmatic strategies. In order to address the research problem, the study answered five research questions through the four research articles developed during the course of the study.

In Article 1, two research questions were answered, which were framed firstly, to establish gender-differentiated profiles of CSA adopters, dis-adopters and non-adopters. Secondly, the article sought to apply a feminist theoretical lens to the gender mainstreaming approaches applied in CSA in relation to observed gender-differentiated farmer profiles. The article established heterogeneity of smallholder-farmers who adopted, dis-adopted or did not adopt CSA, and the profiles were shaped by underlying socio-cultural contexts. In both study sites, largely similar socio-cultural practices and norms influenced resource ownership and access, education, decision-making power, and opportunities to participate in CSA. Application of a gender lens showed dominance of traditional gender mainstreaming approaches in CSA, and the paper introduced a contemporary view by exploring potential contribution of emergent feminist theories such as intersectionality and African feminisms. The paper accentuated the need for an integrated application of both traditional and contemporary gender mainstreaming paradigms. Also, based on the challenges faced mainly by *de jure* household-heads, the paper recommended that CSA implementation needed to be holistic, bringing together practitioners from different disciplines to address social imbalances driven by patriarchy and women's subordination. A holistic approach to CSA also required that factors driving CSA adoption, dis-adoption and non-adoption be probed from a technology adoption perspective.

Therefore, Article 2 sought to understand gender-differentiated drivers of CSA technology adoption, dis-adoption and non-adoption. A disaster risk reduction (DRR) lens was applied here, on the basis of the interconnectedness of CSA and DRR. The gendered Pressure-and-Release (PAR) model was applied to provide an in-depth assessment of the drivers of CSA technology adoption which were categorised as institutional, social, economic and environmental. Viewing these drivers through the gendered-PAR model

established gendered-vulnerability responsible for the gender-differentiated drivers identified in the study. Underlying risk factors and dynamic pressures, as a result of gender inequality were responsible for CSA adoption, dis-adoption and non-adoption decisions made by smallholder-farmers.

Establishment of gendered-vulnerability in Article 2, subsequently led to a need to further explore how this shaped farmers' behaviours and attitudes towards CSA adoption, which was addressed in Article 3. In Article 3 CSA adoption was explored through a socio-psychological theoretical paradigm that sought to understand micro-level decision-making in relation to perceptions, behaviours and attitudes. This approach was necessary so as to establish the role of socio-psychology in shaping resilience-building and adaptation decisions. The article established that gender-differentiated socio-psychological determinants shaped farmers' decisions to adopt, dis-adopt or not to adopt. Findings from this study showed that CSA adoption strategies needed to have gender-specific strategies to tackle behavioural and attitudinal perspectives that resulted in dis-adoption or non-adoption. At the same time, it was also essential to leverage key determinants that could improve adoption, such as the role of social influencers in driving adoption decisions. The broader context within which CSA adoption across different gender groups occurs was considered, specifically socio-cultural, socio-psychological, gendered-vulnerability and inequality aspects, which magnified the need for normative strategies to improve CSA adoption, especially by *de jure* women household-heads.

Subsequently, Article 4 focused on how gender-specific CSA adoption may be achieved. This article built on the three preceding articles, and empirical data collected. A normative gender-sensitive CSA adoption framework was proposed in the article. The framework was developed from a resilience perspective on the basis of the resilience-building arm of the CSA concept. In view of the fact that climate resilience will likely usher in new or unfamiliar CSA technologies, the framework has two core components of risk-informed decision-making and gender-sensitive technology development and dissemination. These core components are interlinked to the other various components of the framework. The utilitarian value of the framework lies in that it views adoption decision-making from a broader perspective and advocates for a systems approach, inclusive participation, transformation towards gender equality and equity in access to and ownership of resilience capitals. Practical gender-sensitive CSA enablers and strategies

need to be in place to ensure collective action that will improve CSA adoption across genders.

In taking a gendered approach to CSA adoption by smallholder-farmers this study, through its articles, makes various contributions to literature. Firstly, the thesis contributes to literature in the 'gender-CSA-DRR' nexus. Literature that tackles all three concepts simultaneously is scanty despite the dominance of all three on the development agenda in the face of climate change. The research brings a contemporary perspective to gender mainstreaming, specifically through African feminism which is dominantly domiciled within the literary arts. Yet, its consideration in this study proves its potential in tackling gender inequality and inequity within African contexts. The thesis contributes to both CSA and DRR literature paying attention to socio-psychological determinants of decision-making which, while essential, is still in its infancy. Additionally, the resilience arm of CSA has not been adequately explored in literature, hence this thesis in general, and more specifically through the proposed framework makes its contribution. Altogether, such a holistic gendered approach to CSA adoption contributes to nascent literature on equitable resilience at farmer-level in the face of gender-differentiated negative impacts of climate change.

Keywords: gender; climate-smart agriculture, technology adoption, smallholder-farmers, disaster risk reduction, resilience

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CHAPTER 1: INTRODUCTION

This thesis focuses on assessing gendered approaches to climate-smart agriculture (CSA) adoption by smallholder-farmers in disaster-prone, climate change-affected regions of Malawi and Zambia. The introductory chapter forms the base of a study that was conducted over a three-year period, 2017-2019. It gives the contextual alignment and the research problem the study addresses. The central theoretical statements provide insights into the theoretical basis of the research. The chapter also includes the research objectives and corresponding research questions the study sought to answer. The chapter comprehensively outlines the research process which informed this research throughout the study period. In addition, it includes the philosophical assumptions and research methodology, outlining how both empirical data and existing literature were used to explore the CSA adoption, contributing to the existing body of knowledge. The chapter concludes with an outline of the different chapters that constitute the entire thesis.

1.1 Orientation and Problem Statement

According to Intergovernmental Panel on Climate Change (IPCC) projections, crop and fodder growing periods will be reduced by an approximate mean of 20 percent by 2050, resulting in reduced cereal yields of approximately 40 percent (Barnard et al., 2015, Cline, 2008, IPCC, 2014). In the Southern Africa region mean annual rainfall will likely be reduced by an estimated five percent, intensity and frequency of droughts is expected to increase, giving rise to a five to eight percent increase in arid and semi-arid conditions by 2080 (Kotir, 2011, Shah et al., 2008). The sub-continent is identified as one of the emerging climate change hotspots where projections for climate-related hazards indicate their likely increase in frequency and magnitude and corresponding disaster risks (Davis and Vincent, 2017, Williams et al., 2015).

In the last three decades, Southern Africa has faced a number of climate-related disasters of hydrological, meteorological or biological nature. A look at agricultural seasons since 2014 show that almost successively the Southern Africa region has been faced with climate-related disasters that affected smallholder farmers, with individual states declaring state of national disasters. For example, in 2016 Zambia declared the Fall Armyworm *Spodoptera frugiperda* outbreak a national disaster (Mulenga et al., 2018), while in 2017 Malawi declared a State of Disaster over the Fall Armyworm infestation in 20 out of 28 of Malawi's districts (Banson et al., 2019). In some instances, the hazards have been transboundary affecting more than one country simultaneously, often resulting in regional disasters. For example the 2015/16 El-Nino Southern Oscillation induced drought where four SADC member states (Lesotho, Malawi, eSwatini and Zimbabwe) declared

state of drought emergency (Nhamo et al., 2019), and the recent Cyclone Idai which affected Malawi, Mozambique and Zimbabwe (Devi, 2019). Of greater concern is how the various climate-associated disasters affect the smallholder agriculture sector, which is comprised of at least 75 percent of the rural economically active majority in the sub-continent (Grainger-Jones, 2011). While in some regions climate change is expected to bring wetter conditions, for southern Africa the projected changes are likely to increase drier conditions (Gizaw and Gan, 2017, Williams et al., 2015, Davis and Vincent, 2017). Such changes pose serious concerns as they threaten the agrarian livelihoods of the farmers, particularly smallholder farmers. Consequently, food security, poverty alleviation and sustainable development ambitions of individual countries and the region at large may be cut back. Although there is pervasive debate on attribution of all these disasters to climate change and the role of other risk drivers such as inadequate early warning systems, urbanisation and poor governance (Eckstein et al., 2019), it is essential to consider the disasters within the context of a changing climate. In addition to the negative impacts of climate change, Mango et al. (2017) and Makondo et al. (2014) state that Southern Africa is also characterised by infertile and unproductive soils, as well as an inclination towards mono-cropping. Projections of a growing population that will require more food also give currency to transformation in the smallholder agriculture sector (FAO, 2010, Pye-Smith, 2011).

Taken together, the contextual setting of Southern Africa compels smallholder agriculture to transform from traditional technologies and practices, towards more sustainable and resilient farming options (Arslan et al., 2016, Belay et al., 2017, Di Falco, 2014, Williams et al., 2015). As a result of the expected changes in the climate system the United Nations Food and Agriculture Organisation (FAO) introduced the concept of CSA in 2010, premised on realisation of the inclement impacts of climate change on agriculture, food security, poverty alleviation and sustainable development (FAO, 2013). CSA is defined on the basis of its three pillars, viz., sustainable improvement of agricultural productivity and incomes, adaptation and resilience-building, and reduction of greenhouse gases where possible (FAO, 2010). Furthermore, some scholars have suggested that CSA is sustainable agriculture that enhances food production in a changing climate, while also contributing towards building resilience and adaptation as well as mitigation (Arslan et al., 2018, Kaczan et al., 2013, Rosenstock et al., 2015). Branca et al. (2011) state that CSA promotes sustainable intensified food production systems that contributes towards food security, while at the same time improving resilience and adaptation of systems and livelihoods and mitigation through efficient production processes. It is anticipated that through its core pillars, CSA will help countries ameliorate the development challenges they face.

While CSA has been hailed as offering solutions to the threats of food insecurity and decline in economic growth due to climate change, its critics have dismissed it mainly on the basis of political

ecology and in relation to its third pillar that advocates reduction of greenhouse gas emissions from agriculture (Taylor, 2018). Opponents of CSA suggest that the concept is merely an attempt by developed countries, who are increasingly under pressure to reduce their own GHG emissions, to divert attention. This argument is in relation to the disproportionate impacts of climate change between developed and developing regions, and the fact that emissions from agriculture in Africa may be low compared to developed countries (O'Brien and Leichenko, 2000, Paavola and Adger, 2006, Beddington et al., 2012). Perhaps this is the reason why Africa has opted to focus mainly on the first two pillars of CSA as will be discussed elsewhere in this section. More scholarly work is emerging in criticism of CSA for its political dimensions, lack of scientific agenda and its generalised rubric (Taylor, 2018, Neufeldt et al., 2013). Yet other dissentions about CSA arise from its piecemeal approach to farmer participation through innovation, technology development and local knowledge (Whitfield, 2015). Such criticism may be expected for a concept that is still less than a decade in existence, and also given the global politics around climate change.

However, there exists an important yet sparsely explored dimension of CSA. There is an emerging notion on the interconnectedness of CSA with disaster risk reduction (DRR) (Lei, 2014, FAO, 2013, Mathews et al., 2018), which largely remains under-investigated. Within DRR, practices, policies and strategies are systematically developed and applied to reduce vulnerability to hazards and anticipated disasters in communities, ultimately reducing disaster risk and contributing to sustainable development (UNISDR, 2004, Amaratunga et al., 2009, Kelman, 2015). The pursuance of DRR helps guide development decision-making and protection of development ambitions from environmental risks through vulnerability reduction and resilience-building (Mercer, 2010). Therefore, the relational fulcrum of CSA and DRR is founded on the second pillar of CSA, which is to *'strengthen resilience and adaptation to climate change and variability'* (FAO, 2013). According to FAO (2013), a DRR perspective in CSA may provide the required enabling environment for CSA while simultaneously enhancing achievement of CSA objectives. Therefore, it is unsurprising that FAO has dedicated a whole chapter in its Climate-smart Agriculture Sourcebook, which to date remains the major blueprint to CSA, to pervasively discuss CSA and DRR. In addition, the post-2015 global development agenda guided by the Sendai Framework for Disaster Risk Reduction (SFDRR), the Paris Agreement and the 2030 Agenda for sustainable development all outline the importance of reducing disaster risks, building resilience and adaptation to climate change for sustainable development (IPCC, 2012). For smallholder rural communities who are at the frontline of climate change-related disasters, DRR in CSA may offer an alternative paradigm to improving CSA adoption. Unfortunately, for the greater part, little attention has been paid to the connection between DRR and CSA, which translates to potential to build resilience for households and agriculture food systems through CSA not being adequately leveraged.

Based on the foregoing exposition, CSA may be of relevance to the Southern African region, the greater African continent and other developing regions at large increasingly ravaged by climate-related hazards. More-so given that CSA is helpful in tackling the combined challenges of food insecurity, population growth, poverty and climate change. The level of commitment displayed by both governments and donors embodies the relevance of CSA for Africa. At continental level, the African Climate-smart Agriculture Alliance (ACSAA) was established in 2015, made up of African Union Member States through the New Economic Partnership for African Development (NEPAD) and five international non-governmental organisations (INGOs). Under the ACSAA, the continent set up the 'Vision 25x25', which is the continent's vision towards 25 million farming households practicing CSA by 2025 (GACSA, 2016). At national level countries have also embraced CSA, as epitomised by Kenya which has a CSA strategy (GoK, 2017), Zambia which has a CSA investment plan (WB, 2019), and Malawi in its Agriculture Sector-wide Approach (ASWAp) (GoM, 2012). One common element throughout all these documents is the need for CSA technology innovation, generation and dissemination. In terms of donor commitment, one prominent CSA project is the Consultative Group on International Agriculture Research (CGIAR) Research Program on Climate Change, Agriculture and Food Security (CCAFS) which covers countries such as Rwanda, Kenya and Ethiopia in Africa (Dinesh et al., 2015). In East and Southern Africa, the VUNA (isiZulu for harvest) project funded to the tune of 23 million GBP by the Department for International Development (DFID) is one prominent CSA project that was implemented between 2015 to 2018 (Sibanda et al., 2017). There are numerous other CSA projects implemented at various scope within individual countries.

Notwithstanding the highlighted CSA initiatives, its merits and relevance for the African context, discourse on the adoption of CSA remains unclear, highly debated and inconclusive. Moreover, conservation agriculture (CA) adoption has largely been misconstrued to be synonymous with CSA adoption, yet CA is just one form of CSA, among many others. Furthermore, most of the adoption studies conducted to date have been supported by existing donor-funded projects which does not absolve them of any potential bias to portray a positive picture on adoption (Andersson and D'Souza, 2014, Giller et al., 2009, Glover et al., 2016). Even for conservation agriculture, the adoption and dis-adoption rates are not commensurate to the potential benefits and the investment made in the promotion of CSA. Adoption still remains low, dis-adoption high, non-adoption significant, and the achievement of the continental Vision 25x25, remains doubtful. There is nominal independent published literature about the results of farmer surveys which document the reliable statistics of CSA adoption rates, specifically for Southern Africa, although vast literature exists on CA adoption (Andersson and D'Souza, 2014, Arslan et al., 2014, Murray et al., 2016, WBG et al., 2015). Additionally, of the existing scholarly pool of knowledge, there is

a marked dominance of econometric analyses and an overt lack of social dynamics analyses on CSA adoption.

When considering social dynamics in what is already known about CSA adoption, a knowledge gap exists on the interplay of gender dynamics with CSA adoption at smallholder-farmer level in Southern Africa (Nelson and Huyer, 2016). Such observations have been made in Malawi and Zambia (Kaczan et al., 2013, Murray et al., 2016, Farnworth et al., 2016). Some scholars have alluded that technologies, including in CSA, are not gender-neutral, often being introduced into pre-existing, socio-culturally constructed, unequal power relations underpinning opportunities and responsibilities within communities (Milder et al., 2011, WBG et al., 2015). For the African communities, smallholder farming is not just about the farming practices, but also includes the socio-cultural practices in the communities such as the roles for food provision, income earning and household nutrition and family welfare. Hence, these same roles may affect CSA adoption. Arguably, when barriers to adoption of CSA are explored, they often focus on the innovation itself and the agro-ecological contexts, excluding the profile of the targeted farmers and the socio-cultural context within which adoption must occur.

Understanding gender dynamics in relation to CSA adoption is essential given that statistics show that women are the majority of smallholder-farmers, and they are also one of the groups most vulnerable to climate change (Sibanda et al., 2017). Previous studies have shown that due to existing structural and non-structural bottlenecks, very few women farmers practice CSA (Barnard et al., 2015, Farnworth et al., 2013, Sullivan et al., 2012). Thus, attempts to improve CSA adoption by smallholder-farmers need to give serious consideration to gender issues, and this may require departure from predominantly top-down approaches to promotion of CSA, towards more inclusive approaches. While a good starting point would be knowledge on the characteristics of smallholder-farmers who are adopting CSA, unfortunately, from the existing scholarly work little is known concerning the gender-differentiated profiles of smallholder-farmers who adopt, dis-adopt or do-not-adopt CSA technologies. Furthermore, neither are the gender-differentiated drivers of CSA adoption, dis-adoption and non-adoption clearly understood. Therefore, there is a chance that CSA may fail to attain much of the intended outcomes and may be ineffective, unless active attention is not paid to gender issues (Beuchelt and Badstue, 2013, Farnwortha and Colversonb, 2015, Glover et al., 2016, WBG et al., 2015).

Additionally, arguments have been advanced that, should CSA be gender-blind, then there is a potential risk that promotion of CSA technologies and practices could aggravate inequalities and fail to benefit from new opportunities to address gender disparity (Beuchelt and Badstue, 2013, Farnworth et al., 2013, Nelson and Huyer, 2016). Ultimately, gender remains a critical aspect of

CSA efforts thus far, and looking towards a future characterised by a likely demand for generation of new CSA technologies, which will also need to be gender-sensitive.

Given the existing *status quo*, this study attempts to fill the existing research gap by investigating gender dimensions in CSA adoption in the face of climate change in Southern Africa. The study makes its point of departure from a realisation that there remains critical need for theoretical perspectives drawn from both CSA adoption and gender mainstreaming in CSA. Accordingly, the study made its theoretical departure from technology acceptance and adoption theories and models on socio-psychological behaviour, and applied feminist theories in gender mainstreaming. Based on the literature, it is apparent that for the outcomes of CSA to be achieved there is cause to also consider the concept from a DRR perspective, especially with regard to resilience-building for smallholder-farmers. A possible starting point could be to change from CSA being an exclusive preserve of the agriculture sector, towards inclusion of other disciplines too, for example gender, disaster risk management, social development and technology development. It is against the foregoing exposition that the purpose of the study was to develop a gender-sensitive CSA adoption framework that can be adapted to various contexts, specifically within Southern Africa, and other developing countries faced with increasing risk of climate change. Development of such a framework would need to build from an understanding of farmer profiles, gender-differentiated drivers of CSA adoption and possible prediction of CSA adoption, which was all explored in this study. In order to fulfil the purpose of the study a set of five objectives were formulated as stated in the ensuing sub-section.

1.2 Research Objectives

This section details the set of objectives that were formulated in relation to the study purpose. The thesis was based on the following research objectives:

(i) To formulate gender-differentiated profiles of smallholder-farmers who adopt, dis-adopt and do not adopt CSA;
(ii) To provide theoretical imperatives on gender mainstreaming in CSA adoption for DRR;
(iii) To identify gender-differentiated drivers of CSA adoption, dis- and non-adoption among smallholder-farmers;
(iv) To provide theoretical perspectives on prediction of adoption of new CSA technologies by smallholder farmers; and
(v) To formulate a CSA adoption framework that considers gender mainstreaming in the promotion of CSA in a changing climate.

The achievement of the set objectives was contingent upon identification of relevant study sites which would enrich comprehension of the gender dynamics in CSA adoption. The following sub-section presents the context of the selected study sites.

1.3 Context of study sites

The study was conducted in two Southern African countries, namely Malawi and Zambia. These countries were purposively selected because in both there is rain-fed smallholder-farming where smallholder-farmers owning on average less than two hectares of arable land, are already affected by negative climate change impacts and its associated disasters affecting agriculture. In both countries, climate-related disasters have been identified to contribute to constrictions in economic growth. For example, in Zambia, due to droughts, dry spells and floods, contribution of agriculture to that country's annual Gross Domestic Product (GDP) growth decreased from 8.2 percent to less than five percent over a five-year period between 2011 and 2015 (WB, 2018). Both selected countries are party to the Comprehensive Africa Agriculture Development Programme (CAADP), a policy framework guiding the continent's goals for agricultural transformation, public agricultural investment set at 10 percent of annual national budgets, food security and nutrition and poverty alleviation (Golooba-Mutebi, 2014). Evidence of CSA being well received at macro-level in the two countries is seen by formulation of blueprints such as the ZCSAIP for Zambia, which was formulated in 2018, while in Malawi CSA has been implied in the Agriculture Sector-wide Approach (ASWAp) (GoM, 2012). In each of the two countries a disaster-prone district was selected as a study site, Chikwawa district in Malawi and Gwembe district in Zambia.

Chikwawa is found in the Southern province in the Lower Shire River Valley, along parts of the African Rift Valley, between altitude of 30 and 150m above sea level. The low altitude is responsible for the climate attributes of the district, with erratic annual rainfall ranging from a low of 170mm to 900mm, with one major rainfall season between November and April, and mean annual temperature of 37^{o}C (Joshua et al., 2016). The rainfall season is highly variable, with delayed onset and uneven distribution that affects cropping. In addition to rain-fed subsistence agriculture, and owing to the Shire River and its floodplain, farmers also practice recessional agriculture. Recessional agriculture is where farmers utilise the residual moisture along the floodplain when flood waters recede. In terms of economic development and disaster profile, Chikwawa is described as one of Malawi's poorest districts where poverty is high with a daily living rate of less than USD1 per day, and so is vulnerability to disaster events (Coulibaly et al., 2015, Mudege et al., 2017, Mwale et al., 2015). Some of the recent disasters experienced in the district include the floods in 2015, the El-Nino related drought of 2015/16, the fall armyworm *Spodoptera frugiperda* outbreak in 2017/2018 (Kita, 2019) and the Cyclone Idai and Kenneth in

2018/19 agricultural seasons. While Malawi is known to have matrilineal communities, the cultural practice is not found in Chikwawa, with marriages mainly by customary law (Mwambene, 2010).

Similarly, Gwembe district is also situated in Zambia's own Southern province, along the Middle Zambezi River Valley. Gwembe district shares Lake Kariba along the Zambezi River, with Zimbabwe's Binga and Kariba districts, and the Tonga tribe who are known as the 'people of the great river' are the main tribe. Gwembe is found in agro-ecological region 1, which receives average annual rainfall of 800mm, and average annual temperature of 27^{o}C (Makondo et al., 2014, Arslan et al., 2015). While livelihoods are mainly rain-fed subsistence agriculture, farmers also practice recessional agriculture on the river banks. Additionally, fishing is also a major source of livelihood owing to the lake. In terms of economic development, Gwembe is one of Zambia's poorest districts (ZVAC, 2015), with very little infrastructure to stimulate a thriving economic environment. In terms of disaster profile the district is generally vulnerable to flooding, droughts and pest outbreaks, such as the fall armyworm in 2017/18 agricultural season, and is often a target for food aid assistance (Makondo et al., 2014). Concerning gender, the culture is permissive to polygamous marriages, and customary marriages are most common (Cliggett, 2007). Although the two districts are in different countries, they do have similar disaster and poverty profiles. On the basis of the physical, socio-cultural, economic and disaster profiles of the two districts, it was befitting that they be considered in understanding a gendered approach to CSA adoption by smallholder-farmers. The study was anchored on central theoretical statements as outlined in the following section.

1.4 Central Theoretical Statements

In an attempt to contribute to existing comprehension of the gender-CSA adoption conundrum, this study was guided by a combination of theoretical framings on gender, CSA technology adoption and DRR. The study was premised on the interconnectedness of CSA and DRR as initially posited by FAO (2013). Scholarship on the said interconnection is nascent, notwithstanding the valuable contribution that application of a DRR lens in CSA adoption could add. The linkage of CSA and DRR derives from the existence of climate change related disasters, whose negative impacts and risks could be alleviated through CSA. Therefore, in taking a gendered approach to assessing CSA adoption by smallholder farmers a combination of gender, CSA technology adoption and DRR theories informed the thesis. This section is a primer to Chapter 2, which gives an in-depth espousal of the theories informing this study. The central theories applied in this study were determined by the philosophical worldviews of the study whose detailed outline forms the following section.

1.5 Philosophical worldviews

According to Creswell and Plano Clark (2011), the philosophical worldview in a mixed methods research design informs the whole study design from the theoretical framings, to the research questions and the methodology. Furthermore, they highlight the possibility that such a research design be informed by more than one worldview. With the research questions probing issues of socio-cultural and power relations within the different gender groups in the farming communities affected by climate-related hazards and disasters, the transformative worldview formed the primary philosophical tenet of the study while the pragmatic worldview was secondary (Teddlie and Tashakkori, 2009).

The transformative worldview taken in the study was derived from the research's line of inquisition. A transformative worldview embodied the theoretical underpinnings and research design of the study in order to provide multiple truths (DeCuir-Gunby and Schutz, 2016) to answer the research questions. On the basis of the investigation into gender dynamics in CSA adoption, it was inevitable that the study would take on a transformative worldview contributing to advocacy for gender-responsive and gender-transformative CSA approaches, as well as gender-sensitive CSA adoption framework. Inquisition into gender issues that interplay with CSA adoption meant the study aim would ultimately advocate, or be used to advocate, for transformation within the CSA adoption decision-making landscape and policy architecture.

In tackling a social issue such as gender, and looking at how it interplays with smallholder-farmers' decisions to adopt, dis-adopt or non-adoption of CSA, this thesis also took on a pragmatic philosophical worldview. The importance of pragmatism is that in building knowledge, or in trying to understand a certain phenomenon, a study's inquiry also assesses practical implications (Creswell and Plano Clark, 2011). This is quite relevant in trying to enhance understanding of certain real-life perspectives and lived out experiences, such as is the case in trying to understand gender tensions in CSA adoption. Also, use of the eclectic pragmatism precept allowed for use in different approaches whose consolidation was necessary to answer the set of research questions. Hence, pragmatism was commensurate with the thesis' analytical logic of being both deductive and inductive, which combined the establishment of patterns and distribution, tested theories and harnessed the ability of qualitative text to explain the findings.

Consequently, employment of a combination of philosophical assumptions equipped the study to probe into possible interpretations of ways in which gender interacted with CSA adoption. Such a philosophical approach also enabled the intricacies of the farmers' detailed narrations of real-life experiences and contexts that altogether interact to shape their adoption decisions to be

established. Taken together, the philosophical worldviews provided a basis for practical transformation in CSA policy, technology development, implementation and future research. It goes without saying that such transformation towards resilience is requisite in the milieu of relentless climate-related hazards and disasters threatening the livelihoods of smallholder farmers. The philosophical paradigms were key in informing the methodological design of the study, which is discussed in the following section.

1.6 Overview of Research Design and Methodology

This section outlines in detail *how* data was collected, *what* data was collected, from *where* and *who* the data was collected from. Taken together, this was a crucial step towards the development of a gender-sensitive CSA adoption framework for use in promotion of CSA for DRR in a changing climate. The overall research design was based on the philosophical paradigms.

1.6.1 Research Questions

In relation to the study aim and objectives, a set of research questions were formulated as outlined in this section. The successful achievement of the objectives was dependent upon answering the corresponding research questions which are outlined in the following section. In undertaking this study, the researcher envisioned that the thesis would answer the overarching research question (RQ):

> *How can CSA adoption by both men and women smallholder-farmers be enhanced for disaster risk reduction in a changing climate?*

Subsequently, a set of five sub-research questions were formulated for investigation to answer the overall research question. Firstly, attention was paid to establishing the status of the profiles of smallholder-farmers who adopted, dis-adopted or did-not-adopt CSA. Secondly, theoretical imperatives were applied to probe into and explain the observed profiles from a gender perspective. As such, the first two research questions were stated as:

> RQ 1: What are the gender-differentiated profiles of smallholder-farmers who adopt, dis-adopt and do-not-adopt CSA?
>
> RQ 2: What are the theoretical imperatives on gender mainstreaming in DRR and CSA adoption in smallholder agriculture?

Research question 1 was tackled simultaneously with Research question 2 because they were closely related. In trying to establish the gender-differentiated profiles of smallholder-farmers who adopted, dis-adopted or rejected CSA, a gender theoretical lens was used. This provided opportunity to assess how gender mainstreaming imperatives shaped the profiles of the farmers who adopt, dis-adopt or do-not-adopt CSA. Underlying to this was a theorisation that, currently CSA adoption by men and women smallholder-farmers was different and influenced by gender mainstreaming approaches within a certain socio-cultural milieu.

Upon establishing the gender-differentiated profiles of adopters, dis-adopters and non-adopters it was imperative for inquisition to follow up on the decision-making process. This was in relation to the theorisation that there were gender-differentiated drivers that shaped the adoption decisions taken by different groups of men and women smallholder-farmers.

Furthermore, speculation was that these drivers could actually give insights into existing gender-differentiated vulnerabilities that shape the farmers' decisions. Thus, Research question 3 was formulated as follows;

> RQ 3: What are the gender-differentiated drivers of CSA adoption, dis- and non-adoption among smallholder-farmers?

Once gender-differentiated drivers of CSA adoption, dis-adoption and non-adoption were established, there was need to consider prediction of adoption decision-making at micro-level. This was essential in further interrogating the role of socio-cultural practices, gender inequality and vulnerability in CSA technology adoption, hence Research Question 4 was posed as follows:

> RQ 4: What are the theoretical perspectives that can be applied to predict adoption of new CSA technologies by smallholder-farmers?

By focusing on decision-making at micro-level to answer this research question, the study applied theoretical perspectives surrounding perceptions, behaviours and attitudes to predict CSA adoption.

All the four preceding RQs were instrumental in formulating the evidence base to answer RQ 5, which was formulated as follows:

> RQ 5: What framework considers gender mainstreaming in the promotion of CSA adoption in a changing climate?

Ultimately, in seeking to understand the CSA adoption conundrum in smallholder agriculture, and to suggest critical pathways to be pursued in the addressing thereof, there was need to propose

a gender-sensitive CSA adoption framework. In formulating this research question, the study sought to consolidate and draw from empirical findings of preceding research questions to address identified gender issues.

1.6.2 Literature study

Theories and assumptions gained through a literature study on gender and CSA adoption, ranging from country to global scale, supported the research. Through the consulted literature, theories on CSA adoption and gender mainstreaming were studied so as to effectively locate the research within the prevailing pool of knowledge. The literature enhanced comprehension of the identified problem and directed the study. Material such as academic books, reports from research conducted by non-governmental organisations, peer-reviewed journals and government-specific publications, were consulted and analysed.

1.6.3 Empirical data

The empirical component of the thesis involved creation of an evidence base and this was achieved through collection of both quantitative and qualitative data, as is typical of mixed methods research.

1.6.4 Research design

The achievement of the purpose of the study, which was to develop a framework which takes into consideration gender in CSA adoption by smallholder farmers, was contingent upon a good research design. Thus, a mixed methods research design was the design of choice for the study. Creswell and Plano Clark (2011) state that a mixed methods design acknowledges that either qualitative or quantitative design alone has its own merits and shortcomings. Rather, the mix helped strike a balance between the two, by optimisation and consolidation of their individual strengths, while each also mitigated the weaknesses of the other and provided the best possible route towards answering the research questions (Johnson and Onwuegbuzie, 2004, DeCuir-Gunby and Schutz, 2016).

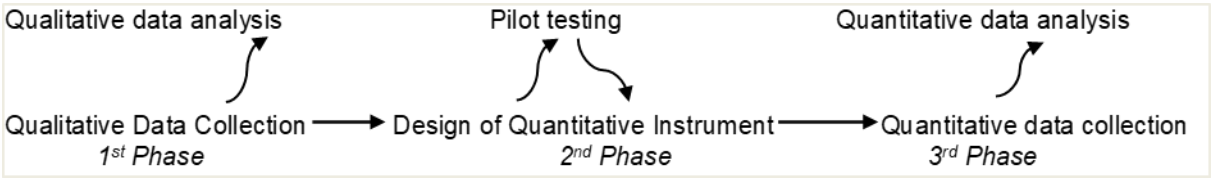

Figure 1: Interrelationship of exploratory sequential study design phases

Given that the study is grounded on both adoption and feminist theories informing gender mainstreaming approaches, the exploratory-sequential mixed methods design was applied. In

this instance, qualitative data was collected and analysed in the initial phase, feeding into the second phase of design and pre-testing of the quantitative data collection instrument and finally collection and analysis of quantitative data (Creswell and Creswell, 2017). The sequence of the different phases of data collection and analyses in this exploratory-sequential study is illustrated in Figure 1-1, which also depicts relationship between the stages.

The exploratory-sequential mixed methods research design provided for a possible situation where gender-differentiated quantitative results may have been deemed statistically non-significant, by heavily leaning on the qualitative approach. Qualitative findings served to explain such a situation without outright dismissal of certain observations on the basis of statistical non-significance. According to Johnson (2014), a mixed methods research design can either take on a bias towards qualitative (QUAL), or quantitative (QUAN) findings. From a transformative philosophical worldview, there was a deliberate bias towards qualitative findings. A qualitative bias was necessitated by the study's requirements to capture real-life, lived-out experiences of the farmers, some of which may have been watered down in a quantitative statistical biased mixed methods research design.

1.6.5 Sampling

In order to fully realise the objectives of this thesis and answer the research questions as outlined in section 1.4.1, empirical evidence was obtained at the local farmer level where CSA adoption occurs. Thus, the researcher acquired the required information from research participants, which is known as primary data collection (Kothari, 2004, Johnson, 2014). Primary data is obtained close to the event and is the nearest one can get to the actual true representation of the larger population. It is on that premise that the inquisition of this study only started at the district level, cascading through traditional authority or ward level, up to village level where farmers were identified for the quantitative survey. The local level is the frontline of climate-related disaster risks, where farmers have to adapt and be resilient to climate change and its associated hazards.

The mixed methods approach allowed for the sequential collection of both qualitative and quantitative data, integration and the grounding of such data on substantive content theoretical frameworks and philosophical assumptions (Creswell, 2014, Teddlie and Tashakkori, 2009). The research used mixed methods sampling strategies where both purposive and random probability sampling were used for qualitative and quantitative data collection respectively (Teddlie and Tashakkori, 2009). For the qualitative phase, purposive sampling was employed to identify and select key informants at district level, and also in the identification of smallholder-farmers who participated in the focus group discussions (see Table 1-1). Systematic random sampling was

used in the quantitative phase where every fourth household was sampled. Sampled households were assigned to one of the three groups of adopters, dis-adopters and non-adopters based on their responses to the question on CSA adoption. The categories of adopters, dis-adopters and non-adopters were established during qualitative data collection. Overall, multi-stage sequential sampling design was applied, where qualitative and quantitative samples were drawn from different population levels and data collection was conducted in sequence, *see* Table 1-1 (Johnson, 2014, Creswell and Plano Clark, 2011).

It is worth noting that the study also relied on the researcher's expert judgement to inform sampling decisions (Teddlie and Tashakkori, 2009). It is on this justification that consideration was given to the representativeness and saturation trade-off. Thus, provision was made for more emphasis to be on data saturation and forego sampling representativeness, where data saturation was the point at which continued data collection ceased to generate any new information of value in the study (Tashakkori and Teddlie, 2010). This was encountered firstly in the qualitative phase, and secondly as saturation of quantitative data in relation to the qualitative data that was under exploration. The representativeness and saturation trade-off was the basis for the final sample size of 51 households in the cross-sectional survey in each site, as the researcher was informed by preliminary qualitative data analysis in the field to apply her judgement in identifying the data saturation point.

Focus on saturation was also premised on the fact that the study was qualitative biased, with more interest ascribed to the rich qualitative textual detail of real-life gender perspectives of the different farmers in CSA adoption, which fashioned the core component of the investigation of the research. Arrival at this position was also informed by existing scholarly work, which revealed that most of the CSA adoption studies were predominantly quantitative in nature. However, if a substantive argument is to be made for transformation towards more inclusive and participatory CSA, ultimately improving uptake of CSA by smallholder-farmers, then it was essential that qualitative findings be prioritised in research.

1.6.6 Data collection

Key informants included representatives from relevant government departments, such as Agriculture, Fisheries, Forestry, Livestock, Community Development, Disaster Management and Gender, NGOs promoting Gender, CSA (separately or combined), farmer associations/groups and local leadership. Key informant interviews (KIIs) were semi-structured, and were employed on the basis of their merits as compared to closed interviews to adequately capture detailed narration of respondents' perspectives on subject matter. For focus group discussions (FGDs)

local leaders, lead farmers, representatives from farmer field schools/clubs and women's groups, including both CSA and non-CSA farmers, were included. A total of 54 people participated in the six FGDs, including women, which were conducted at ward level in each study site. In total, 102 people participated through the various levels of data collection as illustrated in Table 2-1.

In the second phase, a questionnaire was developed using dominant themes and quotes from qualitative findings to identify the variables and formulate the questions that allowed further exploration of the emerging themes at household level. The questionnaire was used in the collection of quantitative data from individual adopters, dis-adopters and non-adopters. In each study site the household questionnaire was pilot tested to a total of 20 farmers to help identify problems and gaps in the data collection instruments and to allow the research teams to familiarise with the questionnaire (Thabane et al., 2010). In both sites the questionnaire was mainly administered in the local languages. The third phase of the study was the actual quantitative data collection through a cross-sectional household survey.

Table 2-1: Summary of data collection outline

Study site	Composition of KIIs	Composition of FGDs	Composition of household survey
Chikwawa, Malawi	• Sector departments in Agriculture all involved in CSA and Gender • NGOs • Local leaders Total: 10	• CSA adopters, dis-adopters and non-adopters • Lead farmers 1 men only, 1 women only and 1 mixed Average eight people/ FGD Total: 24	Adopters Dis-adopters Non-adopters *N=51*
Gwembe, Zambia	• Sector departments • NGOs • Local leaders Total: 6	• CSA adopters, dis-adopters and non-adopters • Lead farmers 1 men only, 1 women only and 1 mixed Average ten people/ FGD Total: 30	Adopters Non-adopters *N=51*

1.6.7 Data analysis

Data analysis took on a connected mixed methods data analysis approach, derived from the existing connection between the qualitative findings that were explored through the quantitative

instrument (Creswell and Plano Clark, 2011, Teddlie and Tashakkori, 2009). Therefore, data was analysed through a three-step process. Firstly, qualitative data analysis was conducted for the development of a quantitative instrument, and involved data transcription into Word Text, coding and establishment of themes and quotes which were useful in identification of variables that were explored in the quantitative phase (Creswell and Plano Clark, 2011). The same procedure was followed for qualitative data analysis for all the four articles developed in the study. The second stage was quantitative data analysis which initially involved creation of a spreadsheet on MS Excel, data cleaning and exported into respective computer software package. For research objectives 1 and 2 addressed in Article 1 (Chapter 3), research objective 3 addressed in Article 2 (Chapter 4) and research objective 5 addressed in Article 4 (Chapter 6), SPSS version 26 was used for descriptive statistical analysis. The Jamovi Project (Jamovi, 2019) was used for inferential statistical analysis in Article 3 addressing research objective 4 (Chapter 5). Essentially, both descriptive and inferential statistical analysis was conducted to explore the themes and establish generalisability of qualitative findings to a wider population. Descriptive statistics were used to establish prevalence, trends and distribution of variables, while inferential statistics were for testing relationships among identified variables. Tables and figures were used to present quantitative data.

For each Article developed in this thesis, the final stage of data analysis was interpretation of the connected results in line with the research questions the data sought to answer, and in comparison to existing literature and theories. Meta-inferences were made drawing from both qualitative and quantitative findings to answer the question on extent of generalisability of qualitative findings on gender dynamics in CSA adoption (Creswell and Plano Clark, 2011). On the basis of the philosophical worldviews underpinning this study it is worth reiterating that qualitative findings were given prominence in the discussions and conclusions drawn, as well as recommendations made, from meta-inferences in each of the four papers.

1.6.8 Validation and triangulation of results

Creswell (2014) states that in mixed methods design, validity of both qualitative and quantitative data should be upheld in data collection, analysis and interpretation. In this study validity was ensured by use of well-designed instruments for the qualitative data, whose analysis and findings were in turn used for development of the quantitative tools. Furthermore, samples for both qualitative and quantitative phases were drawn from different populations which eliminated response bias (Creswell and Plano Clark, 2011). The use of multiple sources of data employed by the study enabled triangulation by providing latitude to establish whether there was convergence or divergence between the qualitative and quantitative data (Johnson and Onwuegbuzie, 2004, Teddlie and Tashakkori, 2009). In both study sites research teams were

trained on use of the different tools, with emphasis on tactful probing during interviews to check for consistencies. Validity was ensured at analysis stage where quotes were used alongside matching statistical data. At interpretation stage validity was established on the basis of consistency with between meta-inferences and theories within which the study was framed.

1.6.9 Ethical considerations

It was important to uphold ethical standards during the study so as to ensure dignity and rights of study participants were upheld, and that data collected was not compromised especially by bias (Creswell, 2014). Given the social and qualitative nature of the research probing into social components of the communities, there was need for direct interface with individuals and groups. Clearance to conduct the study was sought from relevant government departments in the two countries (see Appendix C), and in each respective site, government personnel were identified as gate-keepers. For each site, local research teams comprising men and women who could speak local languages, were recruited and trained on the data collection. During data collection, voluntary and informed consent was granted by research participants after they had been informed of the purpose, methods and intended uses of the research findings. The time schedule and venues for FGDs was also considered based on the gender roles within the respective communities. Thereafter, in the Articles produced, there was no specific identification of individuals where quotes from research participants were used.

1.7 Research Process and Layout of Chapters

Based on the philosophical worldviews and the corresponding research design outlined in sections 1.3 and 1.4 respectively, it was then important to frame a process that would guide the direction of the study over the three-year period. The research process that was followed by the study is as shown in the following Figure 1-2 which illustrates the interconnectedness of the three stages of the study, all underpinned by logic. Each of the three stages is concisely outlined in the following sub-sections.

1.7.1 Stage 1

The initial stage of the research process involved conceptualisation of the overall research and laying the theoretical grounding on the basis of the identified philosophical worldviews. Stage 1 was comprised of two Chapters. Firstly, Chapter 1 which provides the study overview by outlining the research problem, concise statement of the central theories, research objectives and questions. In the same chapter, the philosophical worldviews and overall research methodology are also provided. Secondly, this stage included Chapter 2 where the theoretical frameworks underpinning the study are presented.

Precisely, contemporary and traditional feminist theories underlying gender mainstreaming approaches were established (essential for Article 1, Chapter 3), whose application in CSA adoption could be assessed to enable identification of different farmer typologies who formed the different categories of adopters, dis-adopters and non-adopters (essential for Article 2, Chapter 4). Furthermore, theoretical setting also enabled identification of technology adoption theories that could assist in unravelling the enigma of driving factors that shaped adoption decisions by different smallholder-farmer typologies in the adopters, dis-adopters and non-adopters' categories (in Article 3, Chapter 5). Theoretical underpinnings from DRR and resilience were used to inform the gender-sensitive CSA adoption framework developed in Article 4, Chapter 6. Broadly, the theoretical basis of Stage 1 anchored the overall investigation of all the research questions. This stage was also vital in the formulation of the data collection tools for the qualitative phase.

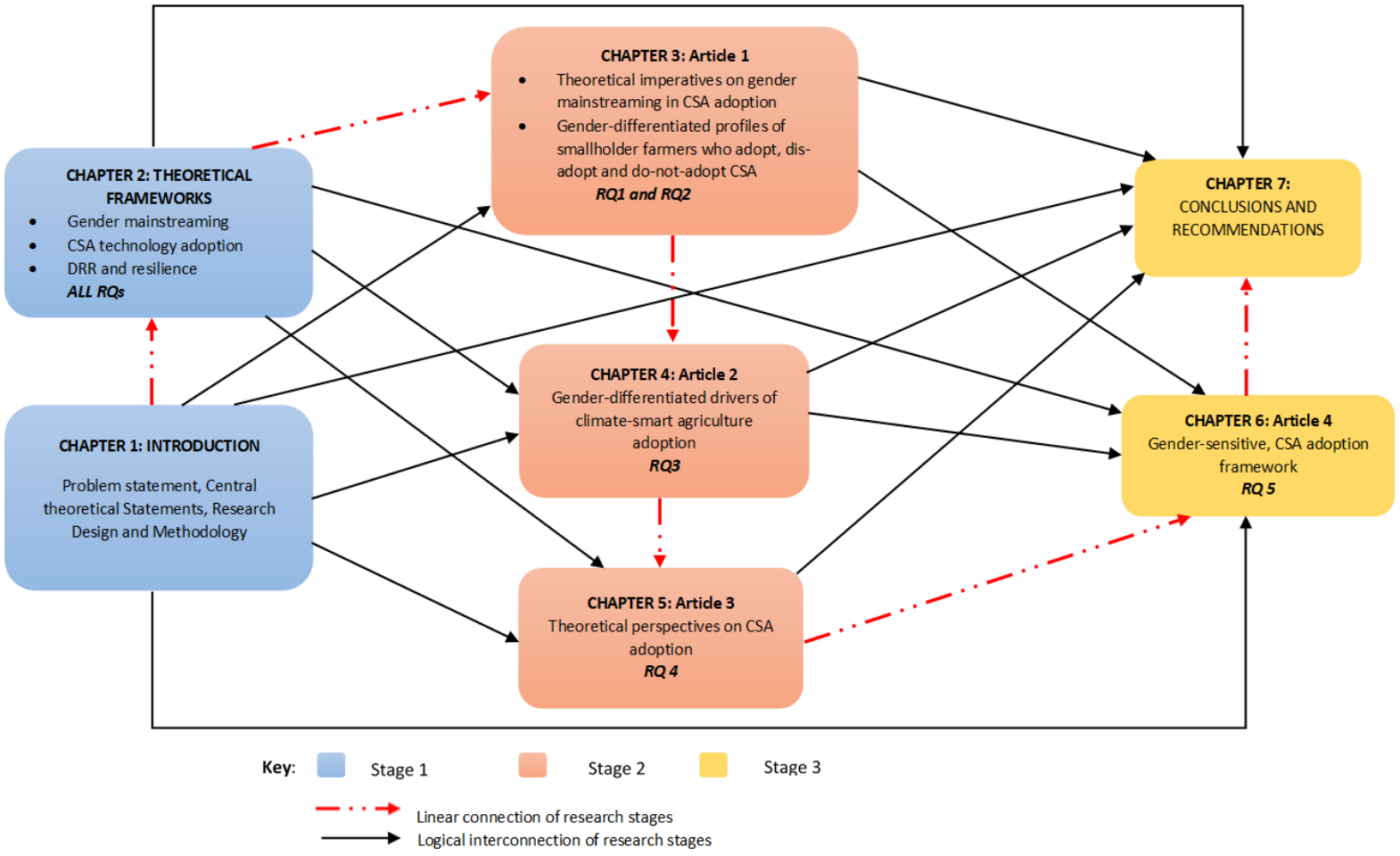

Figure 2: Outline of research process

1.7.2 Stage 2

The second stage of the study involved the development of research Articles based on empirical data collected from study sites. Again, an interlinkage of all the papers must be acknowledged where Article 1 that established the heterogeneity of farmer profiles, answering research questions 1 and 2, led to the development of Article 2. Article 2 sought to establish what drivers shaped the adoption decisions that were responsible for the heterogeneous farmer profiles established in Article 1, thereby answering research question 3.

Emanating from Article 2, Article 3 was developed to answer Research question 4. The third article used theoretical basis provided in Stage 1, and was also linked to Article 2, based on the need to understand the theoretical basis of CSA technology adoption (research question 4) using socio-psychological theories. Article 3 was essential in generating understanding on theorisation of CSA adoption before CSA technologies and practices were generated.

1.7.3 Stage 3

Stage 3 was the final stage of the research process and was made up of two components. The first component of this stage was the development of Article 4, through which the overall aim of the study to develop a gender-sensitive, context-specific CSA adoption framework, was achieved. This entailed an integration of all the three preceding articles of Stage 2, while also drawing from the theoretical basis established in Stage 1, to answer research question 5.

The final component of this stage was the consolidation of conclusions of the research and recommendations made for future research, practice and policy. This drew from Stages 1 and 2, which had set the theoretical grounding of the study and investigated research questions 1 to 5. Quite importantly in this part of stage 3 was how the individual research questions had been answered to address the overall research question and achievement of the objectives of the thesis.

Taken together, all three stages of the study ensured all research questions were answered and the study objectives were met. In going through all these stages, the study was then able to generate findings, draw conclusions and make recommendations that ultimately contribute to the existing body of knowledge. It is important to note that based on the research problem and objectives the chapters follow a logical interlinked web that ultimately leads to the conclusions and recommendations. The interlinked logic characterising the outline of chapters arises from the fact that the study investigation is grounded on two major areas of gender mainstreaming and CSA adoption. The write-up of the study will be outlined as follows:

Chapter 1: Introduction

Chapter 2: Theoretical frameworks

Chapter 3: Understanding the gender dimensions of climate-smart agriculture adoption by smallholder farmers in disaster-prone regions in Malawi and Zambia

Chapter 4: Vulnerability and inequality: understanding drivers of climate-smart agriculture adoption among smallholder-farmers in Malawi and Zambia

Chapter 5: A gender-differentiated analysis of climate smart agriculture adoption by smallholder farmers: Application of the Extended Technology Acceptance Model

Chapter 6: Rethinking climate-smart agriculture adoption by smallholder-farmers: A proposed new gender-sensitive adoption framework

Chapter 7: Conclusions and recommendations

1.8 Chapter conclusion

This chapter has given a detailed outline of the thesis from the orientation and problem statement, through to the central theoretical statements, an overview of the research design and methodology, up to how the study contributes to the existing body of knowledge. Through the orientation and problem statement the chapter was able to present the prevailing situation that necessitated undertaking the study in the two study sites. The objectives of the study and the corresponding research questions, as well as the philosophical worldviews were highlighted to portray the study's line of inquiry. This culminated in a detailed outline of the research design that showed the overall process that was followed, and the rationale behind, to ensure comprehensive data was collected from the relevant sources. The following chapter outlines the theoretical underpinnings that anchored the study.

CHAPTER 2: THEORETICAL FRAMEWORKS

2.1 Introduction

The preceding chapter introduced the central theoretical statements that underpinned the study. Subsequently, this chapter builds upon Chapter 1, section 1.2 by providing a detailed outline of the theories that informed the thesis. The theoretical framework was instrumental in answering the research questions and fulfilment of the purpose of the study, which was to develop a gender-sensitive, context-specific CSA adoption framework for use in developing regions. Theories on feminism and gender mainstreaming, CSA adoption and DRR were all applied in the various components of this thesis, and the corresponding research articles produced. Accordingly, in taking a gendered approach to CSA adoption by smallholder farmers, the theoretical framework of the study was situated within the gender-CSA-DRR nexus. This means gender was the main analytical unit, and the interconnectedness of CSA and DRR was recognised. The following sections present a detailed outline of the various theories as applied in the study.

2.2 Gender mainstreaming

Gender is used in reference to the socio-cultural constructions of roles and responsibilities between men and women, which correspondingly define opportunities, power, access and control to resources and shapes real-life experiences of the different groups of individuals in a society (Lorber, 2010, Holmes, 2007). Furthermore, Nelson and Huyer (2016) highlight that gender refers to socially-ascribed characteristics of being masculine or feminine, which also determine power and resources distribution. This is the traditional framing of gender that pertains to the male female binary spectrum. More contemporary framings of gender have since emerged which are broader in recognition of the complexity, multiplicity and fluidity of gender in different societies (Kulish, 2010). However, while existence of other gender identities and sexualities is acknowledged, a detailed espousal of the multiple forms of gender is beyond the scope of this study. Instead the gender lens applied in this study was informed by the dominant prevailing gender context within the two study sites, as shared by the communities themselves.

There are instances when technologies, projects, policies and decisions fall short in paying attention to the gender differences in terms of roles, responsibilities, resource access and control, experiences, opportunities and power in a society, resulting in what is referred to as being gender-blind (Asfaw and Maggio, 2016). Gender mainstreaming is usually employed, which is basically assessing the implications of projects, policies, institutions, legislation and activities, on different individuals across different levels of a society (Amaratunga et al., 2009, March et al., 1999). Gender mainstreaming also seeks to achieve gender equality through gender empowerment

initiatives aimed at promoting equal participation in decision-making, which should be informed by the voices and experiences of the different genders, especially those often disempowered (Moser and Moser, 2005). When such assessment has been made, efforts are then made to address the identified differential implications through adoption of gender-sensitive approaches (Asfaw and Maggio, 2016). Within the context of CSA, it is therefore vital to acknowledge gender as a relational concept in the smallholder-farming communities, and not merely a synonym for women, and explore gender mainstreaming therein (Ashby et al., 2012, Murray et al., 2016, FAO, 2011, Farnwortha and Colversonb, 2015, Sullivan et al., 2012, WBG et al., 2015).

There have been suggestions for gender mainstreaming to pay attention to local contextualisation and perspectives of gender, acknowledge heterogeneity of gender, and abandoning tokenistic approaches where women are considered in terms of numbers or as a synonym for gender (Arora-Jonsson, 2014, Asfaw and Maggio, 2016, Chaudhury et al., 2012, Collins, 2017, Jost et al., 2016, Asfaw et al., 2015). Therefore, this study deliberately selected to also learn from the communities themselves what gender meant to them, and whether their conceptualisation of gender was any different or could be situated in existing theories. The study made its initial attempt in unravelling gender issues in CSA adoption, by not only applying the 'gender lens' from an outsider's perspective in the study, but rather enabling the communities to 'hold the gender lens and look through it too.' This was a critical anchor towards the study's attempt to be inclusive and capture gender perspectives from those at the frontline of climate vagaries. Therefore, the following sub-sections capture the chronological order of theoretical underpinnings that informed the study and can shape the gender discourse in CSA.

2.2.1 Women in Development

The Women in Development (WID) framework was primarily important between the 1960s to early 1970s, and is applauded for being first in bringing women's issues in development to the fore (Okali, 2012, Singh, 2007). Through WID, women's reproductive roles and need for provision of equal opportunities for women and men were highlighted. This was especially in areas of economic empowerment, employment and education, and WID advocated for women's collective agency and their inclusion in economic development so they could equally enjoy economic benefits (Parpart et al., 2000).

WID's approach to women's integration into economic development was informed by liberal feminism (Singh, 2007, Chilisa and Ntseane, 2010). As an approach, WID is conservative, grounded on economic development and modernisation, whose goals are growth and productivity (Rathgeber, 1990, Wilson, 2015). These conceptual underpinnings are responsible for its shortcomings as it is said to be characterised by Western hegemonic assumptions (Kolawole,

2004). Such as the paradox of rural women empowerment which maintains a top-down approach with external researchers who may not give the concerned women opportunity to fully participate in decision-making. WID is also critiqued for its primary focus on roles of women as producers, regarding women as a homogeneous group, ignoring gender division of labour and women's subordination (Okali, 2012). Consequently, WID is said to have failed to challenge social and structural inhibitors deterring women from fully participating in development. Nevertheless, WID is still applied in some projects in developing countries (Wilson, 2015). Some CSA projects tend to display this approach in their attempts to address gender and women's issues among smallholder-farmers, for example when a CSA project distributes wood-saving stoves exclusively to women, whose gender role is seen as food preparation in some communities. A successor approach emerged to address some of the shortcomings identified with WID.

2.2.2 Women and Development

Women and Development (WAD) advances economic agency of women and was influenced by Marxist feminism. It was mainly important between the mid-1970s and mid-1980s, with a distinct focus on contribution of class disaggregation to women's marginalisation and discrimination (Benería et al., 2015, Singh, 2007). WAD posits that women have always been included in development and are just one among many exploited and disadvantaged classes in society. Marxist feminism interpreted women's subordinate position to originate from capitalist stratifications in society. Hence the suggestions that through removal of capitalism, gender inequalities could be removed too (Parpart et al., 2000, Wilson, 2015). The framework additionally states that women have potential for self-sufficiency and patriarchy is identified as a product of capitalist development (Rathgeber, 1990).

To address patriarchy, WAD demanded creation of women-specific institutions where women's needs would be met (Rathgeber, 1990). Non-governmental organisations (NGOs) implemented women-specific projects to protect them from patriarchal dominance and capacitate them on how to challenge male privilege. Furthermore, WAD focuses on women's productive role through recognition of women's knowledge, work and responsibilities in development. Where women's contribution was overlooked by governments and NGOs, WAD advocates for recognition of the important role they play (Parpart et al., 2000).

Although seemingly addressing some pertinent issues regarding the role of women in development, WAD also has been criticised. Critique of WAD originated from its nature to view women as a standalone category among many other social stratifications (Wilson, 2015, Singh, 2007). Such a stance comes with potential danger that variations within this group may eventually be overlooked. Solutions may be taken to be applicable across the whole group, yet women may differ along racial, ethnic, wealth and marital status. Another shortcoming is its main emphasis on

equality of international structures paving the way for gender equality (Singh, 2007). Such a broad and global viewpoint minimises the role of patriarchy in women's subjugation in local contexts. It may ignore how relationships between men and women contribute to development at a lower community level. Like its predecessor, WAD failed to address certain critical areas hence another approach was devised to fill the gaps.

2.2.3 Gender and Development

Gender and Development (GAD) is widely renowned for its assessment of development from both men and women perspectives. This framework emerged in the 1980s and has remained in application in gender mainstreaming programs to date (Singh, 2007, Parpart et al., 2000). It argues that patriarchy significantly contributes to creation of unequal social relations between men and women (Rathgeber, 1990). GAD looks at how social relations between men and women favour the former, and disadvantage the latter, starting from the private to the public sphere of women's lives (Wilson, 2015, Singh, 2007). This approach is prominent for its effort to promote participation and equality of both men and women in development. This is especially regarding equal access to, and control of resources, in pursuit of more egalitarian societies. More outstanding about GAD when compared to its forerunners, is its consideration for gender division of labour between men and women. While the division of labour is dynamic and varies across societies and cultures, roles should be assessed to understand how they affect or are affected by developmental projects (Parpart et al., 2000).

The strength of GAD lies in that it was informed by social feminisms whose primary focus is confronting power disparities (Rathgeber, 1990). Power disparities influence social interactions between men and women, and how women are often affected by such. The influence of radical feminism in GAD emphasises existence of patriarchy in societies and identifies it as the root cause of inequality (Parpart et al., 2000, Singh, 2007). Thus, GAD diverges from an economical and productive view of women's issues to delve deeper into socio-cultural influences of patriarchy and gender inequalities. The approach advances that when patriarchal privilege is fully addressed, women's vulnerability, discrimination and subjugation are eradicated. Through gender mainstreaming GAD brought a solution to the gender inequality dialogue (Chilisa and Ntseane, 2010), although some feminists have also criticised it for watering down women's issues as discussed in detail in the following section.

2.2.4 Critique of traditional feminist theories in gender mainstreaming

Gender mainstreaming has been criticised for its duplicitous and paradoxical nature where it tackles certain gender issues, while at the same time watering down others. Suggestions are that this results from top-down donor interests in aid-receiving communities of Africa and other

developing regions (Arnfred, 2004). It is argued that gender mainstreaming bears Western hegemony and fails to consider local contexts, values and realities (Singh, 2007). Additionally, Western feminisms are grounded on modernisation and capitalist development theories. The basis of these theories is that development could only be attained through adoption of Western technologies, values and systems. Likewise, women's development would be measured on modernisation from primitive systems to modern societies. These development theories on their own have also remained a bone of contention in Africa and other regions of the South. It could be that demerits of gender mainstreaming in these developing countries has lost its momentum on the basis of the development theories that form its base. Its birth within economic development may be the underlying weakness of the gender paradigm of feminism. It tends to quantify development on economic outcomes, excluding socio-cultural development.

The gender paradigm is also criticised for setting unrealistic goals for women, often detached from their contextual realities (Singh, 2007). While gender mainstreaming seeks to advance women's issues in development, it gives minimal space to their opinions and worldviews and is generally driven by external agents in a society (Benería et al., 2015). Of greater concern is the possible exclusion of experiences of women smallholder-farmers in developing regions in the CSA discourse.

Another drawback of gender mainstreaming is that it tends to generalise women's issues broadly across different societies. Rather, critical variances may exist as both men and women are not globally homogeneous (Benería et al., 2015). Gender mainstreaming has been dismissed as a piecemeal representation of women's views resulting from how they are oppressed in their societies (Singh, 2007). This has resulted in tensions within the gender and feminism discourse itself, and also between gender and development. Concerns within the women's movement are that inclusion of men in the discourse denatures women's issues (Arora-Jonsson, 2014, Cornwall and Rivas, 2015). Views are that the approach has romanticised patriarchy, downplayed women's subordination role and failed to address the crux of inequalities and injustices.

The women's movement has been criticised for focusing mainly on women's practical needs, with little effort towards addressing strategic needs (Perch, 2014). In some cases it is men who received capacity development and improved opportunities, with benefits to women as an undertone (Doss, 2001). Another critique that could be explored is that much of the feminist theories also use women as a proxy for gender, which may mean that the needs of other gender identities may not be addressed. Consequently, this stimulates debate and interrogation of the sufficiency and adequacy of traditional feminist theories that were originally aimed at fighting for women's equality in fighting for equality for other gender identities. Arguably, this may be true even in CSA adoption specifically, and in the wider resilience-building and adaptation agenda.

Some projects initiated by developed countries in developing regions may tend to side-line women or other gender identities, especially where technology is concerned. Concerning CSA, such a blinkered focus on CSA technology development and adoption needs to be avoided as smallholder-farmers need to adapt and be resilient to climate-related extreme events. On that basis, this study also endeavoured to explore contemporary gender discourse, although this was limited to the contexts of the study sites based on the perspectives of the communities in the study areas.

2.2.5 Contemporary gender approaches

Identified inadequacies of gender mainstreaming in development, and more specifically in CSA require exploration of applicability of contemporary gender approaches. Although not entirely adequate on their own, these later approaches are hailed for addressing some of the omissions made by initial gender mainstreaming. For instance, in failing to consider local contexts and building on the indigenous traditions, gender mainstreaming lost out on being informed by some good values benefitting women in earlier societies. For example, the pre-colonial egalitarian societies which were able to protect the environment through their indigenous, environmentally-friendly value systems, such as the pre-colonial Egyptian societies (Parpart et al., 2000). Given the different nuances advanced by emerging feminist scholarship, their theoretical advancements deserve consideration.

2.2.5.1 Intersectionality

Contemporary feminism and gender approaches have moved from exclusive focus on patriarchy and women's subordination to critical gender analysis that includes complex interactions of multiple identifiers (Kaijser and Kronsell, 2014). Between the 1980s and 1990s intersectionality emerged to address dissentions over perceived Western hegemonic feminist scholarship. Intersectionality is defined as interactions between different categories such as gender, race, marriage, education and any other such categories that may define a society's strata (Hankivsky, 2014). These interactions determine individual experiences, socio-cultural ideologies and practices, and power dynamics (Davis, 2008). Underpinning intersectionality are three key tenets, viz., recognition of heterogeneity within social groups, power dynamics resulting from existing social structures may advantage or disempower certain social groups, and the possibility that individuals may identify with more than one social group with unique but non-additive effects (Stewart and McDermott, 2004). On that basis, it follows then that not all men or women by simply falling into the same gender group, will experience same impacts of climate change, and will be drawn by the persuasions of a CSA. Other factors may intersect with gender, for example wealth, marital or employment status, thereby affecting their adoption decisions.

Furthermore, intersectionality helps explain that social inequalities are not a product of unique singular factors. Instead they originate from complex interactions of various social factors that in turn influence opportunities, power dynamics and experiences of both men and women in a community (Thompson-Hall et al., 2016). As a concept in the gender field it has been used to increase understanding on social inequalities and injustices that exist in societies (Hankivsky, 2014). Additionally, the approach has been used to understand complexities that interact to influence certain outcomes and statuses of individuals and groups in a particular community. This assertion justifies why any gender lens in CSA needs to consider intersectionality, which may help explain different statuses of individuals and the decisions they make.

More importantly, intersectionality moves beyond traditional linear analysis of gender disaggregated data, and acknowledges that women do not exist in a vacuum. They live alongside and together with men in their communities, and are interdependent allies for development or as some scholars have argued, in confronting and overcoming common challenges threatening their existence and livelihoods (Kolawole, 2004). Therefore, policies and programs by governments and donors are exhorted to consider this, and be informed how such alliances may be harnessed to address negative impacts of climate change, vulnerability and contribute to resilience. This may also be applicable in CSA and its associated ambit for resilience and contributing to sustainable development.

Intersectionality may enrich understanding of gender issues in communities especially given issues of gender-differentiated vulnerability and potential for climate change to transform gender roles in agrarian communities (Nelson and Huyer, 2016). As men and women in agrarian communities experience impacts of climate change, they engage in practices and decision-making to renegotiate complex contexts (Kaijser and Kronsell, 2014, Alston and Whittenbury, 2012). Within the gender binaries both men and women have to contend with socially constructed roles and responsibilities in a changing climate, the linkages with gendered-vulnerability, and potential transformation concurrently as climate changes. Since gender roles are socially constructed and can be transformed, then possibly women's subordination and men's dominance can also be changed as both are neither natural nor perpetual. Climate change may drive deconstruction and reconstruction of gender roles among agrarian communities, nonetheless egalitarian societies where men and women can both fulfil their potentials are possible in developing countries (Parpart et al., 2000). Hence, it is inadequate to state that women are more vulnerable to climate change than men, and researchers and practitioners need be wary of such narrow and simplistic approaches resulting in poorly formulated CSA initiatives. Instead, through an intersectionality lens in CSA there lies an opportunity to incorporate changing gender roles in promoting CSA adoption. Therefore, research and practice need to ensure their adaptation and

resilience policies and programs are pliable to the emerging climate context. Tied closely to intersectionality and fast gaining momentum is yet another contemporary gender approach with more specificity to the African context.

2.2.5.2 African feminisms

The African feminist movement argues that Western feminisms inadequately addressed gender inequality issues, especially for African communities (Chilisa and Ntseane, 2010), including rural smallholder-farmers. Consequently, African feminisms (AFs) emerged between the 1970s and late 1980s, their prominence peaking in the 1990s (Mikell, 1995, Mekgwe, 2006, Coulibaly, 2015a) in resistance to, and defiance of, Western hegemonic feminisms (Kolawole, 2004, Akin-Aina, 2011). AFs are partly grounded on intersectionality within the gender context in Africa as they seek to address the many other oppressions faced by women, including patriarchy (Ahikire, 2014). This Afrocentric type of feminism is applauded for its grounding on the African value systems and cultural ethos, such as pre-colonial egalitarianism, *ubuntu* (humanity towards others), motherhood and value of the family unit (Malunga, 2014). For that reason it has been suggested that AFs are capable of addressing germane gender issues in African communities (Mikell, 1997). The core of AFs is realisation that the African continent, its contexts and realities are altogether essential in discursive gender imperatives (Mekgwe, 2006, Arndt, 2002). This makes it important for the gendered approach to CSA to consider the African feminist imperative. It paves the way for opportunities to address gender equality from within, thus eliminating the imposition of foreign-centric ideals, decried for their detachment from local reality. AFs may have potential to give different outcomes across the continent, and may be preferred for their inclusion of both men and women, probing the women's views and giving them a voice in the relevant context (Akin-Aina, 2011).

AFs are hailed for being inclusive and eclectic, their perspective neither archaic nor monolithic and embracive to the heterogeneity of women (Mekgwe, 2006, Mikell, 1995). There are various AFs namely African womanism, Motherism, *STIWA*-nism (acronym for Social Transformation Including Women in Africa), Nego-Feminism and Snail-Sense feminisms. There are key underlying principles that are common across all these feminisms (Nnaemeka, 2004, Coulibaly, 2015b, Mekgwe, 2006). While a detailed narrative of each type of AF is beyond the scope of this study, it is important to know their key tenets for effective gendered approach to CSA adoption. The acclaim of AFs also lies in their in-depth assessment of African communities and having potential to address real issues affecting the lives of both men and women in Africa. Strength of AFs lies in their ability to enhance understanding of gender issues within the African milieu.

In all AFs patriarchy and women's subordination is acknowledged, though challenged differently (Arndt, 2002). Eminently, all AFs view men and women in African communities as complementary partners who can form alliances to address their developmental challenges (Akin-Aina, 2011, Arnfred, 2004). It is on this basis that scholars such as Kolawole (2004) and Arndt (2002) argue that in African societies, men and women have formed alliances and together confronted such challenges as colonialism and apartheid through active involvement of African women in the liberation struggle. Possibly, application of AFs may encourage conceptual interrogation of development theories and critical analysis of challenges faced by African communities, such as the climate change impacts. In some sectors, such as health, education and governance, they are said to have been able to address challenges of African women across the continent (Akin-Aina, 2011). However, agricultural development although directly concerned with livelihoods of both men and women in rural Africa, has not applied AFs perspectives.

There exists potential to use AFs as an analytic concept for gendered approach in the adoption of CSA technologies. AFs advocate for appraisal of societal values to identify strategies that favour women and need promotion. Concurrently, opportunities to overcome discrimination and oppression and achieve egalitarian communities are identified (Arndt, 2002). The analysis in AFs sees beyond the linear gender binaries to broadly address all other forms of injustices and discrimination within African communities and across genders. AFs view the totality of life, family systems and motherhood, and women are not regarded as an exclusive group (Akin-Aina, 2011). Free engagement on gender issues within AFs also demands gender-just communities through gender equality and equity, and may be relevant in poor smallholder agrarian communities threatened by negative impacts of climate change.

Through application of AFs, gendered approaches can build on pre-existing indigenous knowledge in African communities (Nnaemeka, 2004). African cultures, histories and local contexts which inform AFs are also fluid and dynamic. It is on this basis that African women have been known to rise up and actively participate in issues affecting their societies, such as the role of women in liberation struggles in African countries and in the fight against apartheid in South Africa (Mikell, 1997). This forms the basis of the contention that given that climate change threatens their livelihoods, African women are likely to be rising up and actively engaging in adaptation and resilience strategies. However, their efforts may be missed if only parochial classical approaches to gender are considered.

While AFs and intersectionality could partly offer remedy to deficiencies of Western feminism approach in African communities, there is need to enhance their militancy to ensure that they do not romanticise patriarchy. On the other hand, prescriptive, top-down gender approaches may miss out on opportunities to harness bottom-up active involvement of heterogeneous gender

groups in a community. Taken together, although scholarship on intersectionality and AFs may be considered relatively uncharted, specifically in DRR and CSA adoption (Carr and Thompson, 2014), the merits of the two approaches justify their consideration in the scope of this study. For effective gendered approach in CSA adoption it will be important to strike a balance between the merits and shortcomings of both contemporary and conventional gender approaches for optimal results. Therefore, this feminist theoretical basis for gender mainstreaming in CSA anchored the entirety of this study, and was specifically articulated in Article 1: *'Understanding the gender dimensions of climate-smart agriculture adoption by smallholder-farmers in disaster-prone regions in Malawi and Zambia'.*

2.3 CSA adoption

CSA architecture explains the concept as cross-scalar, transcending from farm-level up to global-level, and as all-encompassing, with focus on policies, technologies, practices, institutions and strategies (Nelson and Huyer, 2016, Sibanda et al., 2017). Such a wide focus of the approach necessitated a deliberate delimitation of this study to the farmer-level, and on technologies and practices. Underpinning the delimitation was a notion that, on matters concerning CSA adoption, it was essential to generate knowledge from the micro-level where adoption of technologies is expected to occur, and is the ultimate hub of policy implementation and strategy execution for the achievement of CSA goals (FAO, 2013). Arguably, for a concept that is still less than a decade in existence, the micro-level is important as a guide to CSA policy formulation, knowledge generation and implementation.

The pith of the study was to investigate the various possible adoption statuses of different farmers hence the import of all defining what was meant by each status. In that regard, in the context of this thesis and its objectives, CSA adoption was defined as when farmers decide to practice any form of CSA, non-adoption as when farmers have never practiced any form of CSA, while dis-adoption defined a scenario of farmers who had decided to discontinue any CSA they had practiced before. On the basis of these definitions it should be noted that there is a dissimilarity with definitions used in most CSA studies with dominant focus on conservation agriculture, such as highlighted in Andersson and D'Souza (2014).

The study diverged from the traditional conservation agriculture definition for adoption for two reasons. Firstly, the adoption definition in conservation agriculture has been criticised for lack of consistency and ambiguity, which some have proposed to be a significant flaw of adoption studies. Secondly, this study acknowledges the variety of forms of CSA, and the conservation agriculture definition was likely to be inappropriate in some cases. Examples of CSA technologies and practices include conservation agriculture, agro-forestry, aquaculture, wood-saving energy

efficient stoves, livestock breed improvement, weather and market information services. However, in this study CSA adoption was assessed broadly, and specific examples drawn from technologies and practices that were established from the farmers are used to explain the findings and discussion. Ultimately, attention was paid to gender-differentiated CSA adoption on the basis of DRR and CCA for smallholder-farmers to be resilient to climate-related disaster risks.

2.4 Disaster risk reduction and climate change adaptation

This study applied a conceptual framing that recognises interlinkage of DRR and CCA. This interconnection can be drawn from the post-2015 global development agenda that is guided by the Sendai Framework for Disaster Risk Reduction (SFDRR), the Paris Agreement and the 2030 Agenda for Sustainable Development. In combination, the three global frameworks seek to address reduction of disaster risks, enhance resilience and adaptation to climate change, while also pursuing sustainable development. Various disaster risk management and adaptation approaches can contribute towards the reduction of disaster risks affecting smallholder farming in a changing climatic context. Such approaches include reduction of exposure, resilience-building, transformation, reduction of gendered-vulnerability, disaster preparedness, response and recovery, as well as risk transfer mechanisms (IPCC, 2012). It is worth mentioning that all these approaches are interlinked and should not be pursued in isolation. Rather, harnessing the synergies that exist between the approaches to adaptation and disaster risk management will be valuable to adaptation, disaster risk reduction and resilience, and sustainable development. As suggested by FAO (2013), at the farmer-level there may be no distinction between operationalisation of adaptation and risk reduction, with farming households' major focus being to address threats to their livelihoods. This also converges with scholarship that accentuates integration of DRR and climate change adaptation (CCA) (Kelman and Gaillard, 2010, Mercer, 2010). Recognition of this interconnection is relevant in assessing gendered approaches to CSA adoption because it underpins the CSA pillar on adaptation and resilience-building.

FAO (2013) highlights that a DRR perspective may contribute towards achievement of CSA objectives, especially through some DRR technologies or practices or policies. At community-level, DRR has some strengths that could be harnessed to make up for the shortcomings of CSA, thereby optimising on the CSA and DRR interconnection. For instance, while CSA critics have cited one of its weaknesses as nominal provision for community participation through bottom-up contributions (Whitfield, 2015), in DRR provision for bottom-up participation has been achieved through community-based disaster risk management (CBDRM). Also, the extent to which indigenous knowledge systems (IKS) have been recognised in CSA is an area which is under scrutiny, whereas DRR is more embracive in that regard and could open up opportunities for consideration of IKS in CSA. Hence, where bottom-up participatory engagement or IKS for

instance is required in CSA, then CBDRM may be a helpful springboard. Furthermore, Birkmann (2006) suggests that adaptation increases resilience, while Mercer (2010) and FAO (2013) state that successful DRR strategies and policies contribute to resilience.

While a DRR approach to CSA should not be seen as a fix-all to CSA gaps, it remains a germane approach worth exploring for some of its strengths. Thus, throughout the study, CSA was viewed from a DRR perspective (FAO, 2013, Khoza et al., 2019c). This helped unravel insights on gendered-vulnerability that was discussed in understanding the gender-differentiated drivers of CSA adoption in Article 2, the socio-psychological behaviour and links to perceptions of climate risk in Article 3, and also laid the groundwork to the resilience-based approach to the development of the gender-sensitive CSA adoption framework proposed in Article 4.

2.4.1 Resilience-based approach to CSA

Various scholars allude to the gender-differentiated vulnerability to climate change, and suggestions have been made that affected smallholder-farmers will either *'hang in'*, *'step up'* or *'step out'* of smallholder farming as a major livelihood (Dorward et al., 2009). In the absence of coping alternatives to 'step up' or 'out' of the sector, many smallholder-farmers will 'hang in', continuing to rely on smallholder agrarian livelihoods. If smallholder-farmers in climate-sensitive and disaster-prone regions will continue depending on smallholder farming as their main livelihood, then CSA is relevant to assist them to adapt and build resilience. Unfortunately, adoption studies that comprehensively explore resilience-building through CSA are currently scanty.

Resilience forms the basis of the second pillar of CSA and unsurprisingly, Africa made this one of its two priority CSA pillars. Resilience has been widely explored as shown by the existence of wide-ranging, multi-disciplinary scholarly literature on the subject (Mayunga, 2007, Bahadur et al., 2010), with some being proponents, while others critique it on the basis of its shortcomings. Resilience is the common element that runs through DRR, CCA, sustainable development and humanitarian aid, and is preferred for its pragmatism for vulnerability reduction. While a detailed espousal of what resilience is in each of the various disciplines is beyond the scope of this study, the theoretical framework of resilience was positioned from the socio-ecological systems perspective, and in relation to DRR and CCA.

Furthermore, DRR discourse conceptualises resilience as the ability to *'build back better'*, instead of outright pursuit of a return to a normal, pre-disaster state (Manyena, 2016). This is grounded upon realisation that disasters are un-natural, emanating from interactions of hazards, exposure and vulnerability. Hence, a consistent desire to return to normalcy may actually perpetuate a

return to the same pre-disaster vulnerabilities that existed, setting up other disasters. However, in seeking to build back better, resilience may actually create opportunities to tackle the 'normal' vulnerability. For instance, if pre-disaster context was that land ownership is along gender lines, a resilience-approach means in seeking to build-back-better measures are taken to address the gender disparities in land ownership. Ultimately, building back better may have a broader approach to achieve gender balanced access to, control or ownership of economic, physical, natural, social or human capital.

A resilience-based approach in CSA ameliorates the myopic focus on technological aspects, embracing a wider focus cognisant of long-term processes of vulnerability reduction and resilience (Birkmann, 2006). Resilience also brings to the fore issues of 'multiple exposure' to other risks beyond climate-related disaster risks which may present within the local context within which CSA adoption is expected to occur. For example, local communities could be simultaneously exposed to poverty, HIV/ AIDS, volatility of food prices, environmental degradation, poor governance among other challenges they may be facing. In addition, resilience-building for smallholder-farmers needs to pay attention to gender-differentiated impacts of climate change on smallholder agriculture which may arise from gendered-vulnerabilities and inequalities.

On that basis, the locus of resilience used in this study makes its departure from the *'building back better'* school of thought, as the climate-related disasters necessitate that with each catastrophic event, smallholder-farmers should be able to build back better. Hence, it is essential that any gender-sensitive CSA adoption framework be anchored by the ambit to build back better in the smallholder-agriculture sector. Furthermore, this study posits that since CSA is also said to contribute to sustainable development, then resilience-building of smallholder-farmers through CSA should aim for *building back better, leaving no-one behind.* Hence, this theoretical framing was essential in the achievement of the overall research aim which was to formulate a proposed new gender-sensitive CSA adoption framework. In addition, the gendered focus of this thesis facilitated the consideration of the various disaster risk management and adaptation approaches already alluded to in the preceding section 2.4. The thesis explored the 'resilience-building and adaptation' pillar of CSA from a much broader perspective that included focus on issues of gendered-vulnerability reduction, transformation, building resilience to changing risks affecting smallholder agriculture sector, DRR components and risk sharing and transfer (IPCC, 2012). This was the basis for Article 4: *'A gender equitable resilience-thinking perspective to climate-smart agriculture adoption by smallholder-farmers in Malawi and Zambia'*. Such an approach will ensure that gender considerations become entrenched in every component of CSA, including implementation, technology development, funding and policies, ensuring inclusivity that is all-

encompassing, while acknowledging the heterogeneity of smallholder-farmers and meeting their needs.

2.5 Technology adoption

Due to the disaster risks associated with negative impacts of climate change on smallholder agriculture, there is already, and there will be in future, emerging CSA technological innovations aimed at improving productivity and resilience-building. Technologies may not presently be available on the market, while some are new in communities, for example energy-saving stoves and aquaculture among traditional fisheries-dependent communities. All this means is, at some point, smallholder-farmers need to decide whether they will adopt, dis-adopt or not-adopt CSA technologies.

For farmers the decision to adopt a new technology is a two-step decision-making process (Neill and Lee, 2001). The first step is deciding whether or not they will adopt a technology. If they decide to adopt the technology, then at some point they also have to decide whether they will continue or discontinue using the technology (dis-adoption). Technology adoption is also described as transitory at any given time, with farmers likely to decide to move from non-adoption to adoption, and then from adoption to dis-adoption (Simtowe and Mausch, 2018). Hence, it is critical to understand the drivers shaping the transitory nature of smallholder-farmers' decisions. Even more essential is the exploration of the dynamics of the decision-making in relation to gender.

2.5.1 Drivers of technology adoption

Various scholars have classified drivers of technology adoption decisions differently. For instance, Pierpaoli et al. (2013) suggest that drivers of technology adoption can be categorised into four; economic, entrepreneurial, environmental and sociological. Akudugu et al. (2012) state that adoption drivers can be grouped into social, economic and institutional, while Ragasa (2012) categorises them as accessibility, liquidity, profitability and suitability, and socio-cultural. Commonalities can be identified from such diversity and on that basis the study adapted the drivers as *social, environmental, economic and institutional.* Economic drivers include cost of technology, farm size, cost of adoption, access to credit, expected economic benefits from the adoption and income-generation activities that farmers may engage in (Akudugu et al., 2012). Social factors have to do with community organisation and personal characteristics, while institutional factors are access to extension services and institutional support that may be available for farmers from various institutions (Akudugu et al., 2012, Ragasa, 2012).

Environmental drivers are those related to the ecosystem, biophysical and geographical contexts (Barnard et al., 2015).

Drivers of adoption mean those conditions or factors that exist, making farmers likely to decide to adopt a technology. Dis-adoption drivers are those which exist, or emerge and may negate the previously identified benefits of a technology (Aleke et al., 2011). This means a farmer may reach a point where they are no longer able to enjoy the optimal benefits of a technology they had decided to adopt at a point in time. Drivers of non-adoption refers to those conditions or challenges with whose existence a farmer is demotivated or constrained from adopting a technology. Also important in understanding drivers of non-adoption and dis-adoption is that it generates engagement and may help bring the farmers who are constrained in adopting to articulate their demands and needs (Ragasa, 2012). In addition, value may also be derived from an understanding of adoption prediction, which may shed insights to decision-making processes at farmer-level from a socio-psychological perspective on behaviour and attitudes towards new CSA technologies.

2.5.2 Socio-psychological behaviour in CSA adoption

While knowledge already exists on socio-cultural factors and gender-differentiated vulnerability that drives CSA adoption by different categories of smallholder-farmers (Van Hulst and Posthumus, 2016, Khoza et al., 2019c, Asfaw et al., 2012, Zeweld et al., 2017, Mbow et al., 2014), there is a critical need to understand how behavioural and attitudinal patterns along gender lines influence CSA technology adoption decisions at micro-level. There is nominal existence of gender-sensitive CSA adoption theories (Van Hulst and Posthumus, 2016, Beuchelt and Badstue, 2013, Nyasimi et al., 2017). Consequently, this denies both research and practice a detailed understanding of CSA adoption dynamics among different groups of farmers before technologies are introduced. It goes without saying that research, extension methodologies, implementation strategies and policies in CSA would benefit from a clear comprehension of such perceptions from smallholder-farmers. Actually, authors such as Van Hulst and Posthumus (2016) and (Khoza et al., 2019b), suggest that socio-psychological behaviour and attitudes towards technology adoption could be driven by background factors of *gendered*-vulnerability, and their consideration may enrich knowledge on CSA technology adoption in research and practice.

Some of the studies that have used the socio-psychological theories approach include Van Hulst and Posthumus (2016) who used the Used the Reason Action Approach theory, Lalani et al. (2016) used the Theory of Planned Behaviour (TPB) approach on conservation farming in Mozambique, and Martínez-García et al. (2013) used TPB in livestock technology adoption in Mexico. Similarly, in Brazil, behavioural theories have also been used in studies exploring farmers'

intention in diversification of agricultural production. However, Gupta et al. (2012), suggest that there is need for studies on socio-psychological behaviour in technology adoption in developing regions so as to establish how societies in these developing regions respond to *new technologies*. Unfortunately, to date within CSA adoption there are few studies that explore adoption using socio-psychological theories to predict adoption. Specifically, developing regions suffer a deficiency of CSA adoption studies that consider how cognitive and socio-psychological factors shape adoption decisions. Actually, some scholars have speculated that, for Southern Africa focus seems to be on *'farmer-free'* adoption theories, that generally lack being informed by farmer perspectives and are marked by simplistic focus on technology characteristics (Martínez-García et al., 2013, Price and Leviston, 2014). Also, a lacuna exists among scholars on how socio-psychological behaviour interplays with gender among smallholder-farmers whose livelihoods are threatened by climate-related disaster risks. In the conclusion of their study, Zeweld et al. (2017) propose that further application of socio-psychological behaviour theories should also consider gender. In synthesis, such assertions give currency to application of socio-psychological lens in understanding adoption dynamics of new CSA technologies.

This study argues that in the context of climate-related disaster risks, a more holistic understanding of technology adoption is urgently required to inform DRR and CCA research, policies and implementation strategies concerning CSA. Therefore, there is compelling need for a concept that will ground empirical research on the cognitive and socio-psychological drivers of CSA adoption. This will be significant given the demand for gender-sensitive CSA technology generation and innovation, governments are resource constrained, and that coupled with disasters affecting smallholder agriculture calls for more efficiency, effectiveness and value for money in CSA projects (Glover et al., 2016). It is on that basis that this study also assessed the socio-psychological behaviour of different farmers to gain understanding on key constructs for CSA adoption that may influence adoption of CSA technologies across the heterogeneity of men and women smallholder-farmers. This could be a useful approach in enriching insights into CSA adoption theoretical perspectives. Therefore, Articles 2: *'Vulnerability and inequality: understanding drivers of climate-smart agriculture adoption among smallholder-farmers in Malawi and Zambia'*, and 3: *'A gender-differentiated analysis of climate smart agriculture adoption by smallholder-farmers: Application of the Extended Technology Acceptance Model'*, were used to discuss the gender-differentiated drivers of CSA adoption, and the gender-differentiated socio-psychological behaviour that ultimately underlies each individual's smallholder-farmer's decision to adopt, dis-adopt or not-adopt CSA. To that end, the Extended Technology Acceptance Model was preferred in this study because of its strength in prediction of user acceptance of CSA technologies at individual level, ease of application and flexibility, and its ability to explore relationships between the different external variables and behaviour, attitudes and intentions (Al-

Mamary et al., 2016, Ducey, 2013). The value of such knowledge for research and practice is that it helps better understand the totality of the CSA adoption context, beyond the traditional technical econometrics that have often been the core of CSA adoption investigations.

2.6 Chapter Conclusion

The preceding sub-sections highlighted the theoretical framings underpinning this study, which were drawn across a variety of disciplines, viz., feminism and gender, technology development, socio-psychology, agriculture, climate change and DRR. Such a theoretical lens was necessary for a gendered approach to CSA adoption in order to tackle the exigencies of gender disparity among smallholder-farmers. Notably, key tenets of gender mainstreaming were explored, its critique and contemporary gender mainstreaming approaches drawn from other disciplines were introduced. This was essential for a thesis that used gender as a major analytical unit, where the importance of including local perspectives on gender was recognised as essential in order to appreciate the real-life experiences of smallholder farmers in CSA adoption. On that basis, the feminist and gender mainstreaming theories were applied in understanding the gender-differentiated profiles of smallholder-farmers who adopt, dis-adopt or do-not-adopt CSA in Article 1, which was the cornerstone of the thesis. Theories on CSA technology adoption were applied in Articles 2 and 3 which sought to understand the gender-differentiated drivers of CSA adoption, dis-adoption and non-adoption, as well as appreciating the micro-level decision-making dynamics from a socio-psychological perspective, respectively. Lastly, Article 4 specifically applied a DRR theoretical lens in the development of the gender-sensitive CSA adoption framework. Each of the articles developed during the course of the study, culminating to the overall thesis, is presented in the individual Articles in Chapters 3-6.

CHAPTER 3: Gender-differentiated profiles of smallholder-farmers who adopt, dis-adopt and do-not-adopt CSA and theoretical imperatives on gender mainstreaming in CSA adoption

Article 1 Understanding gender dimensions of climate-smart agriculture adoption in disaster-prone smallholder farming communities in Malawi and Zambia

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Understanding gender dimensions of climate-smart agriculture adoption in disaster-prone smallholder farming communities in Malawi and Zambia

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Abstract

Purpose – Through the application of traditional and contemporary feminist theories in gender mainstreaming, the purpose of this paper is to contribute to emergent debate on gender dimensions in climate-smart agriculture (CSA) adoption by smallholder farmers in disaster-prone regions. This is important to ensure that CSA strategies are tailored to farmer-specific gender equality goals.

Design/methodology/approach – An exploratory-sequential mixed methods research design which is qualitatively biased was applied. Key informant interviews and farmer focus group discussions in two study sites formed initial qualitative phase whose findings were explored in a quantitative cross-sectional household survey.

Findings – Findings shared in this paper indicate the predominant application of traditional gender mainstreaming approaches in CSA focusing on parochial gender dichotomy. Qualitative findings highlight perceptions that western gender approaches are not fully applicable to local contexts and realities, with gender mainstreaming in CSA seemingly to fulfil donor requirements, and ignorant of the heterogeneous nature of social groups. Quantitative findings establish that married men are majority adopters and non-adopters of CSA, while dis-adopters are predominantly *de jure* female household heads. The latter are more likely to adopt CSA than married women whose main role in CSA is implementers of spouse's decisions. Access to education, intra-household power relations, productive asset and land ownership are socio-cultural dynamics shaping farmer profiles.

Originality/value – By incorporating African feminisms and intersectionality in CSA, value of this study lies in recommending gender policy reforms incorporating local gender contexts within the African socio-cultural milieu. This paper accentuates potential benefits of innovative blend of both contemporary and classic gender mainstreaming approaches in CSA research, practice and technology development in disaster-prone regions.

Keywords Agriculture, Climate change adaptation, DRR, Climate-smart agriculture adoption, Gender and DRRM, Gender policy

Paper type Research paper

1. Introduction

As disasters linked to climatic change are projected to increase in frequency and magnitude, efforts should be directed to building resilience and adaptation for smallholder farmers (Joshua *et al.*, 2016). In 2010, climate-smart agriculture (CSA) was introduced, whose pillars are: increased productivity and incomes, building resilience and adaptation to climate-related extreme-weather events, and mitigation achieved through reduced greenhouse gas emissions (FAO, 2013). Therefore, based on these pillars, CSA is considered a disaster risk reduction (DRR) strategy (Lei, 2014; Mathews *et al.*, 2018).

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DRR involves policies, strategies and practices systematically developed and applied for the minimisation of vulnerabilities, hazards and anticipated disasters in communities, ultimately contributing to sustainable development (UNISDR, 2004). However, CSA adoption by women smallholder farmers in Africa remains low, yet they are in majority and more vulnerable to climate change impacts (Asfaw *et al.*, 2015).

CSA adoption studies in general and gender-focused specifically have been conducted (Van Hulst and Posthumus, 2016; Farnworth *et al.*, 2016; Manda *et al.*, 2016). Dominance of quantitative econometric analyses to generate understanding on factors influencing adoption cannot go unchallenged (Mango *et al.*, 2017; Murage *et al.*, 2015). Descriptive statistics remain void of rich detail of real-life experiences of qualitative findings (Andersson and D'Souza, 2014; Glover *et al.*, 2016). Recently, a similar study was conducted in East Africa (Nyasimi *et al.*, 2017), but for Southern Africa, no such study has ever been conducted. Although giving gender some consideration, study by Nyasimi *et al.* (2017) suffers dearth of gender-focused adoption studies focusing solely on male/female gender binaries. The traditional gender dichotomy that often characterises gender mainstreaming in the development sector in Africa has been criticised for its parochial nature that sees men and women as homogeneous groups. Furthermore, emphasis on traditional gender binaries may be biased towards addressing mainly practical gender needs that may fail to challenge disenfranchising structural bottle-necks that disadvantage different types of women.

Thus, this study was conducted to examine heterogeneous gender-differentiated profiles of smallholder farmers who adopt, dis-adopt or do not adopt CSA in Malawi and Zambia. For purposes of this study, adopters were taken as farmers who indicated the current use of identified CSA technologies. Dis-adopters were farmers who had discontinued use and non-adopters were those who had never used any CSA technologies. The study also aims to explore the socio-cultural milieu shaping decision making for men and women in CSA adoption. Nyasimi *et al.* (2017) stated that local socio-cultural practices influence CSA adoption. To this end, this study applied contemporary feminist theories, such as African Feminisms (AFs), and traditional feminist theories to explore gender perspectives in CSA adoption. Through the application of contemporary feminist theories to understand gender dynamics in CSA adoption by SHFs, this study accentuates that the promotion of CSA in disaster-prone regions may necessitate gender policy reforms. Gender policy reforms relevant for CSA adoption need to be driven by local contexts to address relevant structural gender needs to empower especially the disenfranchised women whose agrarian livelihoods are threatened by inclement climatic change.

2. Theoretical underpinnings of gender mainstreaming in CSA

Understanding contemporary gender discourse in CSA adoption by SHFs in disaster-prone regions remains important for policy makers and programme designers in Africa. Emergent gender discourse suggests need for the local contextualisation of gender, recognising heterogeneity of both men and women (Jost *et al.*, 2016), and going beyond just adding women to make up targeted figures (Asfaw *et al.*, 2015). Critical to gender in CSA adoption is understanding interactions of socio-cultural factors with adoption (Nyasimi *et al.*, 2017), and men and women's common but differentiated realities (Perch and Byrd, 2015) influencing CSA adoption decisions.

Furthermore, contemporary gender dialogue requires that gender mainstreaming considers contextualised African realities where women face many other oppressions in addition to patriarchy (Arndt, 2002; Mekgwe, 2006). Thus, based on the African context, AFs which resist western hegemony underlying traditional feminist theories in gender mainstreaming in African development have emerged. There are various types of AFs, namely African womanism, motherism, STIWA-nism (acronym for social transformation including women in Africa), Nego-feminism and Snail-Sense feminisms.

While detailed narrative of AFs types is beyond the scope of this paper, knowledge of their key tenets is essential for gendered approaches to CSA adoption. Merits of AFs lie in enhancing the appreciation of gender issues within the African context (Coulibaly, 2015; Nnaemeka, 2004; Arndt, 2002). They are inclusive and diverse, accentuating possible heterogeneity of women (Akin-Aina, 2011; Arnfred, 2004). In all AFs, patriarchy and women's subordination is acknowledged and challenged differently. Notably, all AFs view men and women in African communities as complimentary partners who can form alliances to address their developmental challenges. Thus, in relevance to understanding gender tensions in CSA, AFs offer alternative cross-examination of the gender mainstreaming schema.

Apart from AFs, this study also considered intersectionality, which also emerged to address dissentions over perceived western-hegemonic feminist theories. Intersectionality acknowledges the existence of interactions between different categories such as gender, race, wealth and education. These interactions determine individual experiences, socio-cultural ideologies and power dynamics (Davis, 2008). More so, intersectionality acknowledges that social groups are heterogeneous and unequal power dynamics result from existing social structures rendering one group privileged or disempowered. Intersectionality states that while individuals may identify with more than one social groups, unique and mutually exclusive effects often result (Stewart and McDermott, 2004).

In addition, two prominent classic approaches: women in development (WID) and gender and development (GAD) (Lorber, 2010; Okali, 2012; Parpart *et al.*, 2000), still applied in some projects in developing countries (Wilson, 2015), were considered in this study. WID and GAD are criticised for failing to address gender issues, women's disempowerment and marginalisation in developing regions (Davis, 2008; Singh, 2007). These two approaches anchored by traditional feminist theories inform current gender mainstreaming in CSA (Arora-Jonsson, 2011; Collins, 2017).

Relevance of gender in CSA for smallholder farmers is gaining traction as new contributions emerge in the discourse (Beuchelt and Badstue, 2013; Nelson and Huyer, 2016; Twyman *et al.*, 2015). Evidence base for this is the inclusion of a stand-alone Module 18: Gender and CSA in the *Gender in Agriculture Sourcebook* (Collins, 2017). Additionally, the Consultative Group on International Agricultural Research Program on Climate Change, Agriculture and Food Security implemented in parts of Africa also had gender as one of its focus areas. In Southern Africa, Perch and Byrd (2015) have also explored gender in CSA at the policy level. Although literature study indicates progress towards understanding gender in CSA, this subject has neither been adequately nor appropriately addressed. Ultimately, all three pillars of CSA need to be gender smart as well, by being gender transformative and gender responsive (Collins, 2017).

Additionally, CSA adoption by smallholder farmers in a changing climate needs to be considered within DRR. This is important given that DRR is the first line of defence in climate change adaptation (CCA) (Ban, 2008). Furthermore, FAO (2013) highlighted that at the implementation level, smallholder farmers may not distinctively delineate between DRR and CCA. Thus, the interconnectedness of DRR and CCA in disaster-prone regions lies in building resilience and adaptation of livelihoods in a changing climate. Such association may be harnessed to create synergies for DRR and CSA in smallholder farming.

3. Methods and materials

3.1 Study areas

The study was conducted in two disaster-prone districts, namely Chikwawa in Malawi and Gwembe in Zambia. Chikwawa district (Figure 1) is found in Southern province, in the Lower-Shire valley's Ngabu Agricultural Development Division. The region is

characterised by a high prevalence of poverty and vulnerability to climate change (Coulibaly, 2015).

Agriculture is dominantly rain-fed smallholder agriculture and irrigation. Projected negative climate change impacts include increased disasters, such as floods, droughts, pests and diseases (Mudege *et al.*, 2017). Erratic rainfall ranges from a low of 170 mm to high of 970 mm, and mean monthly temperature exceeds 20°C (Joshua *et al.*, 2016).

Gwembe district (Figure 2) is situated in Zambia's middle-Zambezi Valley region in Southern province in Agro-ecological Region 1, with 800 mm annual rainfall and most vulnerable to droughts. Rain-fed smallholder agriculture and fisheries are the major livelihood activities (GRZ, 2005). Thus, selection of these two disaster-prone districts was because smallholder farmers are already experiencing climate-related disasters and CSA has been promoted in both.

3.2 Research design

The gender focus of the study necessitated an exploratory-sequential mixed methods research design where both qualitative and quantitative data were collected sequentially within the same study (Creswell, 2014; Johnson and Onwuegbuzie, 2004). The first phase of qualitative data collection provided themes with subsequent inquisition of identified themes through quantitative data collection.

3.3 Data collection and instrumentation

Data collection in both study sites enlisted help from trained local research teams. Qualitative data were collected from a total of 16 key informants at the district level in Malawi and Zambia. A total of six FGDs, each with an average of nine people, were conducted, three per country (one women only, one men only and one mixed group). FGDs are in-depth discussions among people of similar backgrounds which give understanding of their social issues and are facilitated by skilled moderators (Hennink, 2013). From both key

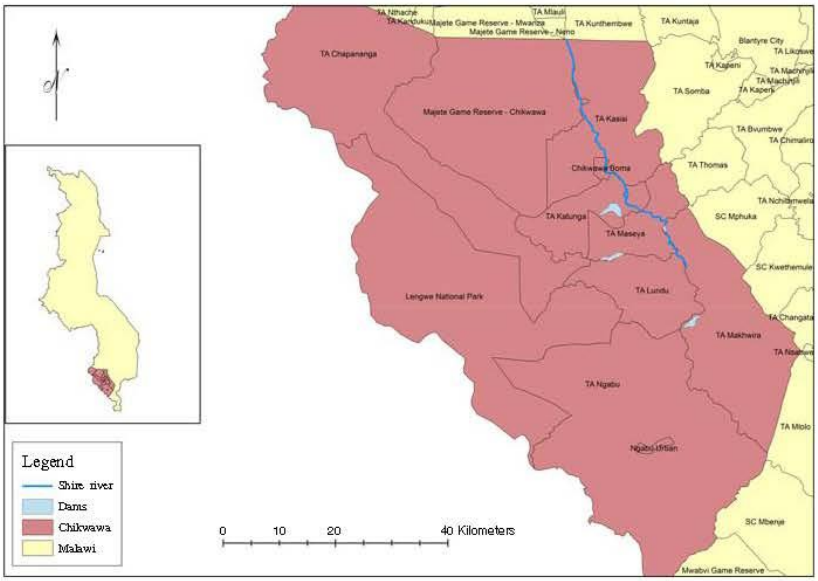

Figure 1.
Map of Chikwawa district

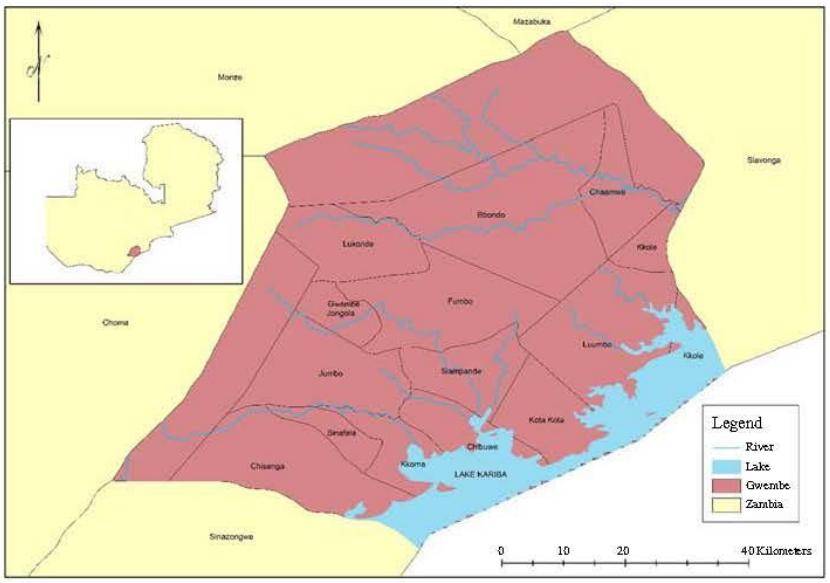

Figure 2.
Map of Gwembe district

informant interviews (KIIs) and FGDs, the quantitative household cross-sectional survey was developed. A questionnaire was designed and pilot tested in both study sites. Subsequently, information on household demographics, CSA adoption status and supporting explanations were collected from households.

3.4 Sampling

Sequential mixed methods sampling strategies were used in the study where purposive sampling and probability sampling were sequentially employed for qualitative and quantitative data collection, respectively (Creswell, 2014). Different respondents were used in each phase of data collection, enabling the triangulation of perspectives on CSA adoption.

3.5 Data analysis

Sequential mixed data analysis was conducted where thematic analysis (Teddlie and Tashakkori, 2009) of qualitative data was conducted first. Thematic analysis ensured that dominant characteristics typifying farmer profiles in each adoption category were pervasively described. Descriptive analysis was conducted on quantitative data to establish frequencies and patterns of relationships between dependent and independent variables (Creswell and Creswell, 2017).

4. Findings

In both countries, characteristics of different farmer typologies in each CSA adoption category were established. CSA technologies common between both sites included conservation agriculture (CA) (mainly basin in Chikwawa and both basin and mechanised in Gwembe), improved seed varieties and livestock improvement. Irrigation schemes were unique to Chikwawa, while unique to Gwembe were energy-saving stoves and aquaculture, although the implementation of the latter was not fully underway.

4.1 Gender dimensions in CSA

Findings of gender dimensions in CSA highlighted three major themes: local contextualisation, institutional provisions and gender-differentiated participation in CSA.

4.1.1 Local contextualisation of gender. Perspectives emerging during interviews of the wide spectrum of practitioners in both countries displayed mixed understanding on gender in CSA adoption. In all six FGDs, both men and women articulated their understanding of gender as cooperation between men and women. In Malawi, in both women only and mixed FGDs, women stated that they needed to work with men because some of the CSA technologies required physical strength. An example of men and women working together was shared in the management of a Fall armyworm *Spodoptera frugiperda* infestation in Chikwawa from December 2016 and was still being controlled at time of data collection in February 2018. In FGDs in Gwembe, women shared how drinking beer was affecting gender roles in farming, as men spent a lot of their time drinking beer and were unavailable to work together with women. Thus, although drinking beer is a non-agricultural activity *per se*, it may have a bearing on agricultural decision making and cannot be dismissed lightly. The significance of beer in Gwembe has been studied before (Bennett, 1990; Cliggett, 2007). In previous studies, the gender context was framed around beer brewing as an income source for women with men being consumers. The emerging concern raised by women in this study is relatively new in the gender and CSA context in Gwembe. Imperatively, the case of drinking beer in Gwembe presents opportunity for future studies to explore other emerging non-agricultural activities that could be affecting CSA adoption by smallholder farmers in disaster-prone regions.

4.1.2 Institutional provisions for gender mainstreaming. In both countries, the study established that there were government personnel under respective line ministries at district level mandated with mainstreaming gender in development projects. In Malawi, the Ministry of Agriculture, Irrigation and Water Development has an Agricultural Gender Roles Extension Support Services Officer and a District Gender Officer under the Ministry of Gender, Children, Disability and Social Welfare. In Zambia, the Ministry of Gender and Community Development has staff members who also work in CSA projects. Various non-governmental organisations (NGOs) interviewed also highlighted that they mainstream gender in their programmes. Both government and NGO institutions in the two sites indicated that ensuring gender mainstreaming in agriculture was one of their core functions. However, while this may indicate commitment for gender mainstreaming at institutional level in the respective governments, extent to which gender mainstreaming activities are implemented at smallholder farmer level in CSA still needs further exploration.

4.1.3 Gender-differentiated participation and CSA adoption status. Qualitative findings indicated that a majority of CSA adopters were men. However, there were deliberate strategies by government departments and NGOs to specifically target women in both countries in order to increase their participation. There were views that women were not fully exploiting opportunities presented to them. Quantitative findings indicated that in both Chikwawa and Gwembe districts, a majority of CSA adopters were married men (Figure 3), with less than 15 per cent women adopters in Chikwawa and less than 30 per cent in Gwembe. Widows, divorced and single women adopted CSA technologies in both sites. In Gwembe, there were few cases of married women who were stand-alone CSA adopters. These were women who practiced CSA on land apportioned by their husbands. In other cases, married women received energy-saving stoves distributed by an NGO. Although a fish-farming project targeting at least 50 per cent women was underway in Gwembe, the survey established that women had not registered at that time. In Chikwawa, men were the only non-adopters, while more women were likely to dis-adopt CSA.

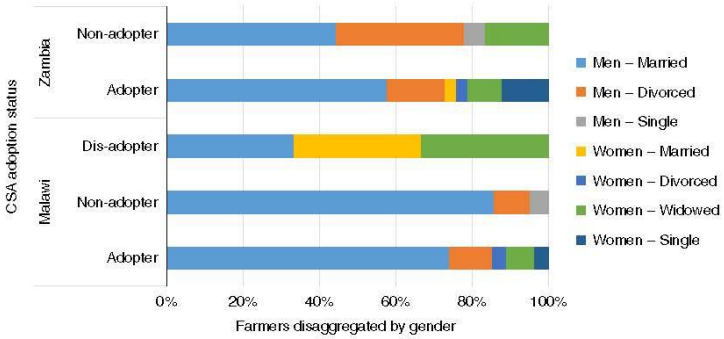

Figure 3.
CSA adoption status in different farmer categories

This can be attributed to the NGO targeting criteria which focuses on vulnerable women to adopt any given CSA technology.

Thus, quantitative findings substantiated the qualitative findings which stated that men were the major adopters and less women were participating in CSA. These findings established that regardless of marital status, generally more men were likely to adopt CSA than women, thus, consistent with existing literature (Doss and Morris, 2000; Murage *et al.*, 2015).

4.2 Underlying factors in CSA adoption

An assessment of gender in CSA adoption would be insufficient without the further exploration of underlying socio-cultural issues shaping gender.

4.2.1 Lack of education as a disadvantage to women adopting CSA. During KIIs and FGDs, education level emerged as a key characteristic influencing CSA adoption. In both sites, women were said to be less educated than men because they had less opportunities to access education in comparison to men. The extent to which education was likely to affect women's adoption of CSA was explained by some respondents as captured below:

> Men are better educated and more literate […] (KII Zambia).

> Literate people […] men can better adopt CSA (FGD mixed Malawi).

Farmer profiles showed that CSA adoption occurred across education backgrounds, although the majority of adopters in both sites were married men with primary school level education. Due to deliberate targeting by NGO projects, women of various education backgrounds were adopters, although majority had either never been to school or attained education up to primary school level. Other adoption studies carried out in similar regions have highlighted how education level influences adoption (Manda *et al.*, 2016).

4.2.2 Intra-household decision making. In both KIIs and FGDs, respondents reiterated that intra-household dynamics of decision making influenced who was likely to adopt CSA. Men were generally main decision makers on being CSA adopters, dis-adopters or non-adopters. Women could only make decision in cases of *de jure* female household heads (HHHs) with the outright absence of an adult man to lead decision making. Where an adult male relative was present within household (such as brother, son or grandson), the woman consulted him and would likely to adopt his opinion on adoption. While men were main decision makers, women were said to be primary implementers of men's decisions. The following responses highlight some of the common views:

> Men are dominant in discussions and engagements as decision makers, women are primary actors and implementers of the decisions made by men (KII Malawi).

> Man is the primary decision-maker [...] his choice to consult and involve his wife [...] may decide not to adopt CSA. Decision-making is easier for female-headed households, although they may have challenges in putting together the adequate resources required (KII Zambia).

> The men decide [...] leaving women to cope with even the unfavorable decisions (KII Zambia).

Quantitative findings as shown in the different farmer profiles substantiated views from qualitative findings as they indicated that different groups of men, regardless of marital status, were decision makers where household adopted (total of 85 and 73 per cent in Chikwawa and Gwembe, respectively) or did not adopt (total of 100 and 83 per cent in Chikwawa and Gwembe, respectively) CSA. *de jure* female HHHs were primary decision makers in adoption, discontinuing or non-adoption. In discontinuing or non-adoption of CSA, *de jure* female HHHs stated that they consider the availability of resources and assets required in CSA.

4.2.3 Wealth status. Respondents from both KIIs and FGDs stated that CSA adoption was also influenced by one's wealth status. FGDs participants indicated that factors considered in wealth classification were livestock, food security, income sources and productive assets. The following statements indicate some of the perspectives on wealth:

> Women are poor and don't have large tools (KII Zambia).

> Some CSA technologies require someone who is better off (KII Malawi).

> We target the very poor widows who are most vulnerable (KII Malawi).

Qualitative findings indicated that generally very poor *de jure* female HHHs were primary target of CSA projects. However, quantitative findings as presented in Section 4.3 were divergent. The household survey established that these groups of women often face challenges that hinder adoption, such as lack of productive assets. These findings are consistent with similar findings made by Makate *et al.* (2018) in their quantitative study conducted in Mozambique.

4.2.4 Land tenure and ownership. In both study sites, qualitative findings indicated that land ownership was determined by customary provisions. In patrilineal societies, men owned land, while in matrilineal, the converse was true. Although matrilineal communities exist in both countries, patrilineal system was dominant in both sites (Mwambene, 2010; GRZ, 2005). Thus, men owned land and had general oversight of decision making on its utilisation, including for CSA. In cases where women owned land, it was widows whose in-laws had not dispossessed her of the late husband's land. In FGDs in Zambia, men explained issues considered in handling property inheritance rights for widows:

> The land is owned by the men [...] our main field will always take priority for inputs and labour then after she can go and do as she pleases on her piece [...] (Men only FGD Zambia).

> Land is owned by men, women are taken on board [...] when a man dies the woman may be sent back to her village and her husband's land taken away [...] this leaves her vulnerable [...] (KII Zambia).

In Zambia, it was common that husbands allocate their wives a piece of land for farming and this is similar to study findings by GRZ (2005). The land still remained of the husband, but the wife could exercise general oversight of agricultural activities. As such, although married women could claim land ownership, it was actually access to land through usufructuary rights. Land ownership for married women is seem to be different from women who are *de jure* HHHs. A woman could own land if she was single and had children, then her father or brother apportioned a piece so she could farm on it. Where a marriage ceased to exist, the woman lost out on the land she would have been farming on while married. She could, however, be allocated land by either her brother or father upon

return to her father's home. Land ownership patterns established in the qualitative phase were consistent with other similar studies (Mango *et al.*, 2017) and quantitative findings illustrated in Section 4.3 corroborated.

4.2.5 Ownership of production assets. Qualitative findings indicated that generally men owned productive assets. In some cases, productive assets owned could be used in CSA, for example, oxen for draught-power in mechanised CSA. Some of the responses gathered during KIIs and FGDs are shared as follows:

> We need to strive for fair distribution of resources (KII Malawi).
>
> Men own almost everything (FGD mixed Zambia).

Married men owned major productive assets, such as large farm equipment, livestock and in the case of Zambia, men also owned fishing equipment. Women could only own major productive assets if they were *de jure* female HHHs and had inherited assets from the late husband. Major productive assets required huge investment; hence, men were likely to lead such an investment decision.

Quantitative findings outlined in Section 4.3 were consistent with responses from KIIs and FGDs. Findings showed that generally women were likely to own small farming tools, indicating consistency with findings from a similar study by Murray *et al.* (2016). For example, in Chikwawa, married women did not own any productive assets and this may be suggested as reason that divorced women only own small livestock and small farming equipment acquired post-marriage. This is evidence of unfair distribution of resources that need addressing, as stated by one interviewee. Thus, consistent with studies conducted elsewhere (Murage *et al.*, 2015; Farnworth *et al.*, 2016) in terms of productive assets ownership in both study sites, women across marital statuses owned fewer and lower quality productive assets compared to men.

4.3 Profiles of farmers in CSA adoption status

In both study sites, KIIs and FGDs revealed farmer characteristics in each CSA adoption category were determined by gender, marital status, education, wealth, decision-making power, ownership of productive assets and land tenure systems. This corroborates with similar adoption studies (Manda *et al.*, 2016; Mango *et al.*, 2017) that highlight the same as factors influencing adoption decision, although these studies were not looking at gender specifically.

4.3.1 Adopters profiles. The tree-map charts (Figures 4 and 5) illustrate characteristics of majority of CSA adopters in Chikwawa and Gwembe, respectively. In both sites, these were predominantly married men, 74 per cent in Chikwawa and 58 per cent in Gwembe. In Chikwawa, these adopters own land, hand-hoes, livestock including a few goats and cattle. These married men were decision makers in CSA and were said to rarely consult or consider their wives' views.

In all, 44 per cent adopters in Chikwawa attained primary education, 22 per cent secondary education, and a total of 6 per cent had either tertiary education or had never been to school. CSA adopters who had tertiary education were male locals who were formally employed and were middle class in terms of local wealth classification indicated during FGDs. Middle-class married men were CSA adopters in small-scale irrigation schemes where they rented plots from very poor plot-holders. In all, 11 per cent of adopters in Chikwawa were very poor *de jure* female HHHs who had never been to school. These women owned land, hand-hoes, chickens and decided on their own to adopt CSA. Additionally, a majority of adopters in Gwembe owned large farm implements, such as ox-drawn ploughs, and in fishing communities, they also owned fishing equipment. CSA adopters in Gwembe included those farmers described by the community as better off/rich, owning many cattle and large farming equipment and could practice mechanised CA. Only a

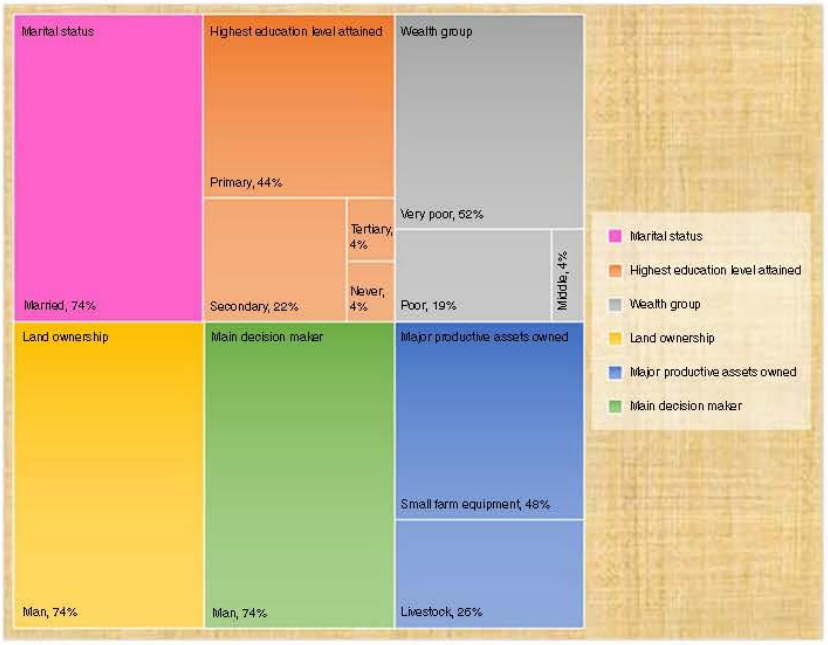

Figure 4.
Adopters' profile, Chikwawa

small proportion of CSA adopters in Gwembe had never been to school and these were either married or divorced men.

Majority of *de jure* female HHHs CSA adopters had attained secondary education, although there were some who attained tertiary education. These were mainly retired government employees. Notably, in Gwembe, there were married women who made decision to adopt CSA. This was the case concerning energy-saving stoves which improved their reproductive role of cooking, and CA in cases where a woman was apportioned land by the husband. Cultures in both sites place decision making as a men's function and such findings corroborated with similar study conducted by Murray *et al.* (2016) and GRZ (2005).

4.3.2 Non-adopters' and dis-adopters' profiles. Figure 6 illustrates the composition of non-adopters in Chikwawa, 86 per cent of whom were married men, and there were no *de jure* female HHHs in this group. These married men were major decision makers on the non-adoption of CSA, although they owned land on which they could practice technologies such as CA. A lack of adequate resources was cited as their major challenge as majority of them were very poor (67 per cent) and owned small farming equipment and small livestock. These married men had either attained primary education or had never been to school at all, thus they felt they did not possess required education levels for CSA adoption.

The composition of Gwembe non-adopters (Figure 7) was slightly different as it included 44 per cent married and 33 per cent divorced men, as well as 17 per cent widows. In all, 11 per cent of widows had never been to school and thus felt they did not possess background education that could be applied in CSA practice. Another challenge faced by widows was the lack of adequate farming tools and they all belonged to the poor category as defined by community during FGDs. Although 17 per cent actually indicated

Figure 5.
Adopters' profile, Gwembe

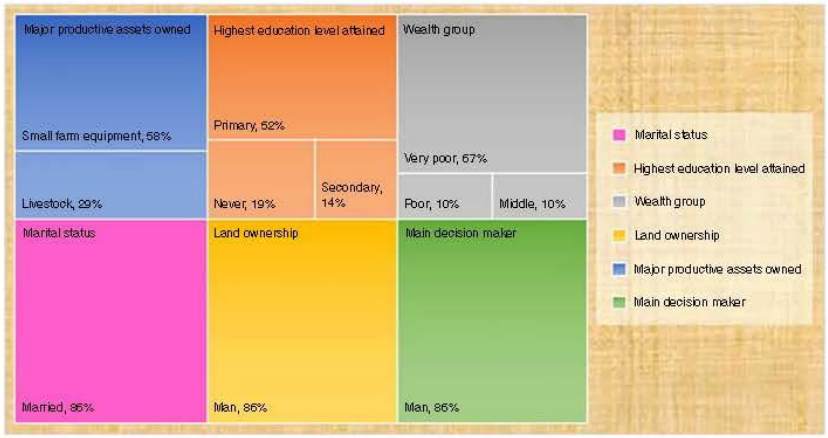

Figure 6.
Profile of non-adopters, Chikwawa

Figure 7.
Profile of non-adopters, Gwembe

ownership of land, only 9 per cent of them owned productive assets that could be used in CSA.

The men non-adopters in Gwembe were essentially equipped to adopt any of the CSA technologies. Almost 12 per cent owned fishing equipment and felt CSA technologies currently promoted were not relevant for them as their livelihoods were more dependent on the fish value chain. Interestingly, while a project is underway that seeks to promote women's participation in aquaculture, this study showed that ownership of fishing equipment was not typical for women. Hence, findings from the men only FGD were that women only owned small fishing rods for catching small fish in the lake's shallow peripheral waters were substantiated. For women, fishing was mainly for household consumption, although for married women, their spouses could decide to involve them in fish trading.

Dis-adoption was only encountered in Chikwawa (Figure 8), where 66 per cent of dis-adopters were women, 33 per cent married and 33 per cent widowed. These women were very poor, had either attained primary education or had never been to school. In case of married women, decision making on dis-adoption was taken by the husband, while widows made the decision in consultation with adult male relatives. Women dis-adopters who were married did not own the land, thus even if they saw benefits of CSA if the husband decided to stop practicing the technology they had to comply with his decision.

These findings converged with findings from KIIs and FGDs that stated women were the primary target of CSA interventions by NGOs and because of resource constraints were likely to stop practicing CSA once project support ended.

5. Discussion

Findings provide critical insights into gender-differentiated profiles of adopters, dis-adopters and non-adopters of CSA. Heterogeneity exists among men and women; thus, this paper submits that approaches focusing only on male/female gender binaries are both passé and insufficient to address gender issues in CSA adoption. Men and women smallholder farmers exist in complex local realities marked by socio-cultural factors which interact to influence adoption as established by the study. Theoretically, the study was underpinned by feminist theories of gender mainstreaming. Findings shared in the paper indicate the

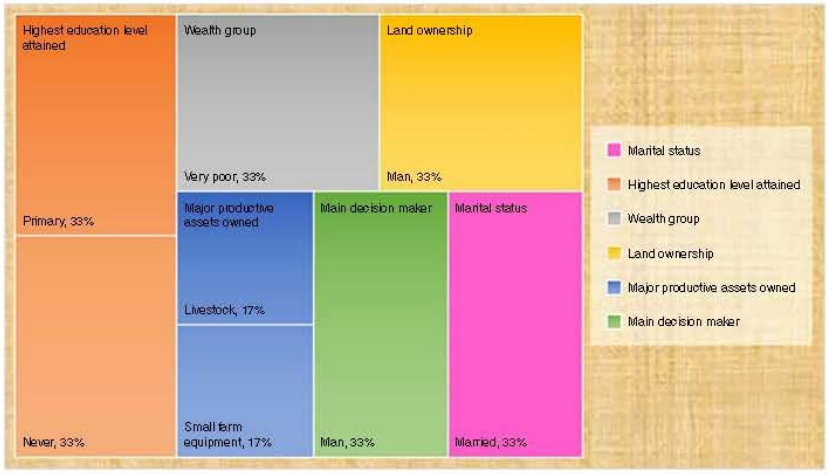

Figure 8.
Dis-adopters' profile, Chikwawa

application of WID and GAD to eliminate patriarchal privilege and women's subordination,; for example, when energy-savings stoves distribution specifically targets women only. However, this also may be an indication of bias towards addressing practical gender needs. Qualitative findings at local district level highlight perceptions that gender issues have fizzled out (Davis, 2008) and gender mainstreaming in CSA simply fulfils donor requirements. Sentiments that Western gender approaches were not fully applicable to local contexts were echoed throughout the study. This paper argues that while there is progress in women's empowerment through traditional gender frameworks, gaps still remain especially in addressing strategic gender needs.

Traditional gender mainstreaming has been criticised for its paradoxical failure to give voice to the women it purports to give voice to (Chilisa and Ntseane, 2010). In the study, this was observed in contrast between local perceptions of gender and its classical definition applied in CSA. Communities, including women who were given a voice in this study, while acknowledging patriarchal dominance and women's disadvantaged position, view gender as men and women working collaboratively. This corroborates with literature (Kolawole, 2004; Nnaemeka, 2004). Thus, this paper submits that for farmer profiles to be understood in CSA adoption, the contextualisation of gender must consider local realities. Subsequently, gender mainstreaming approaches will be tailored to address relevant practical and strategic gender needs. This paper argues that when local realities are considered, CSA will respond to issues of a non-agricultural nature which affect intra-household decision making. For example, how treadle pumps in Chikwawa and beer drinking in Gwembe affect matrimonial relations and adoption decision making.

Local contextualisation of gender draws attention to socio-cultural factors such as patriarchy and women's disadvantaged position, and how this compromises CSA adoption. For example, customary marriages place ownership of most of productive assets required in resilience and adaptation under men. Women have limited asset ownership, with access to land and productive assets predominantly through usufructuary rights in marriage (GRZ, 2005; Murray *et al.*, 2016). Based on study findings women are likely to lose major productive assets upon death of husband or collapse of marriage, and similar findings have been made by studies on land ownership and women (Brown and Siamwiza, 2002). However, as established in the study, divorced men retained assets from the marriage, evidence of

gender disparity. Although customary laws govern property ownership, even existing legal framework has gaps, further magnifying women's plight (Keller, 2000).

Findings from the study also showed that productive asset base determined decision making by different types of farmers. At the core of decision making were intra-household power relations. Women in either *de facto* female-headed or male-headed households have limited decision making in CSA adoption. While *de jure* female HHHs may independently make decisions, the implementation of adoption decisions is constrained by lack of ownership, access to and control of land and other productive assets (Farnworth *et al.*, 2016). Therefore, this paper posits that the empowerment of women in decision making should be supported with substantial strategies to improve ownership of land and other productive assets to improve CSA adoption.

The study also established that adoption decisions were also influenced by farmers' literacy and education levels. Majority of women in the study were less educated that men thus did not adopt CSA. CSA is knowledge intensive (WBG *et al.*, 2015); thus, this papers suggests that to improve CSA adoption, capacity-building strategies should be inclusive to people of all education and literacy levels. Accordingly, CSA may tap into local capacities; for example, in Zambia, findings showed that within adopters' category, there were a few *de jure* female HHHs who were also retired professionals. Such women could be used as lead farmers, and CSA trainings custom made to suit specific women needs according to farmer profiles.

Intersectionality and AFs may enrich understanding of gender in CSA as they recognise heterogeneity of social groups, unequal power relations within groups, individuals belonging to more than one social group, consideration of local contexts and realities (Arndt, 2002; Arora-Jonsson, 2011; Carr and Thompson, 2014), all of which were established by this study. As men and women farmers experience climate change, they engage in practices and decision making to renegotiate complex contexts (Kaijser and Kronsell, 2014). This is key in understanding complexities of African smallholder farmers, as not all men or women by simply falling into same gender group will have same adaptation and resilience-building requirements. Other factors may intersect with gender; for example, empirical evidence from the study showed gender intersecting with marital status, education, asset ownership, wealth and cultural norms. Therefore, this paper accentuates potential benefits of innovative blend of both contemporary and classic gender approaches to address underlying socio-cultural issues to improve CSA adoption for DRR. Furthermore, by incorporating AFs and intersectionality in CSA adoption by SHFs, this study proposes gender policy reforms informed by local gender contexts within the African socio-cultural milieu. This may be achieved by harnessing strengths of contemporary gender paradigms to mitigate weaknesses of traditional gender approaches as espoused in this paper.

6. Conclusions

The study examined gender-differentiated profiles of smallholder farmers who are adopters, dis-adopters and non-adopters of CSA. Furthermore, underlying socio-cultural factors shaping real-life experiences of farmers thereby influencing their adoption decisions were explored. The heterogeneity of farmer profiles and complexity of socio-cultural milieu within which CSA adoption should occur demand more inclusive and diversified strategies and policies tailor made for farmers. While contemporary gender paradigm cannot single-handedly address pervasive gender issues in CSA, this paper proposes an integrated approach. Integrating traditional and contemporary gender approaches paves a way for the inclusion and consideration of multifaceted local contextual realities that frame farmer profiles. Thus, CSA adoption can be improved by a holistic approach and future gender-focused CSA adoption studies should explore engendering DRR models and formulation of context-specific, gender-sensitive adoption framework.

Acknowledgements

This paper forms part of her PhD research on gendered approaches to disaster risk reduction, with focus on climate-smart agriculture adoption by small-holder farmers in disaster-prone regions. This research was supported by the Department of Science and Technology-National Research Foundation (DST-NRF) Centre for Excellence in Food Security. Appreciation goes to the research assistants, farmers, non-government organisations and government departments in Chikwawa and Gwembe who played different roles during the data collection stage of this study.

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Chapter 4: Gender-Differentiated Drivers of Climate-Smart Agriculture Adoption

Article 2 Vulnerability and inequality: understanding drivers of climate-smart agriculture adoption among smallholder-farmers in Malawi and Zambia

Article Submitted to The Journal of Peasant Studies

Vulnerability and inequality: A gendered approach to understanding drivers of climate-smart agriculture technology adoption among smallholder-farmers in Malawi and Zambia

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Abstract

This study explores gender-differentiated drivers of adoption, dis-adoption and non-adoption of climate-smart agriculture (CSA) technologies among smallholder-farmers facing increasing climate-related disaster risk. Through an exploratory-sequential mixed methods study conducted in Malawi and Zambia, we establish that CSA outcomes of improved agricultural productivity and resilience-building may not be equitably achieved owing to gender inequalities that demotivate diverse women household-heads from adopting climate-smart technologies. We suggest that application of a disaster risk reduction lens in understanding CSA adoption dynamics unravels underlying gendered-vulnerability, dynamic pressures and risk factors that require gender-sensitive policies and implementation strategies to reduce vulnerability and facilitate improved CSA adoption.

Keywords: climate-smart agriculture; gendered-vulnerability; technology adoption; smallholder-farmers, risk reduction

1. Introduction

At a time when rain-fed smallholder agriculture is increasingly under threat from inclement climate-related hazards, governments and non-governmental organisations (NGOs) are promoting various climate-smart agriculture (CSA) technologies at farmer-level in developing regions. Benefits of these CSA technologies over conventional agriculture are said to include improved food and income security, adaptation and resilience, with possible mitigation, in the face of climate change (FAO, 2013). Smallholder-farmers' decision to adopt new technologies is determined by whether adoption of that new technology offers greater benefit or profitability than not adopting it (Pierpaoli et al., 2013, Ragasa, 2012, Simtowe and Mausch, 2018). Despite the stated benefits of CSA, low adoption by smallholder-farmers remains a concern (Andersson and D'Souza, 2014, Glover et al., 2016). Other studies also highlight need in both research and

practice to fully understand tensions between gender and CSA adoption, non-adoption and dis-adoption (Collins, 2017, Fisher and Kandiwa, 2014).

Gender remains an important social construct in adaptation and resilience-building to reduce climate-related risks among smallholder-farmers (Neumayer and Plümper, 2007). In developing countries, gender mainstreaming has focused on empowering women and improving their participation (Debusscher and Hulse, 2014, Morna and Dube, 2014). Yet, there are growing concerns that promotion of CSA adoption could be within the context of pre-existing gender disparities in disaster-prone smallholder farming communities. There is a gap in existing literature probing into understanding gender-differentiated drivers of CSA adoption, dis-adoption and non-adoption. Previous CSA adoption studies have a general focus on adoption, in some instances with little attention on gender-differentiated drivers of diverse adoption positions taken by smallholder-farmers (Asfaw and Maggio, 2016). Taken together, investigation into gender issues in CSA adoption is based on the conception that social inequalities create different vulnerabilities (Neumayer and Plümper, 2007, Huyer et al., 2017), which could affect adoption. Therefore, understanding gender-differentiated drivers of CSA adoption, dis-adoption and non-adoption creates opportunity to explore ways of how CSA may be inclusive of marginalised social groups who often exist at the peripherals of any society. That said, there is need to deviate from common parochial focus on climatic-hazards towards an inquisition aimed at exploring links between gendered-vulnerabilities and CSA adoption decisions (Birkmann et al., 2013, Brandt et al., 2017).

It is important to consider diverse gender-differentiated drivers shaping adoption decisions because they contribute to the sustainability of the adoption process. Knowledge of drivers of CSA dis-adoption is critical to inform strategies on winning back different categories of dis-adopters (Simtowe and Mausch, 2018). It will guide steps and adjustments that need to be made in CSA implementation to ensure challenges encountered by farmers which resulted in abandonment of CSA are addressed. When gender-differentiated drivers are known it helps identify actors and responsibilities on corrective measures to be taken. Also, investigating gender-differentiated drivers of non-adoption illuminates constraints faced by different farmers that hinder CSA adoption (Barnard et al., 2015).

In this study CSA adoption status was categorised as any of three options: adoption (those using any form of CSA technology); non-adoption (those who have never used any form of CSA technology); and dis-adoption (those who had decided to discontinue use of any CSA technology they had practiced before). Also, although CSA is said to include technologies, practices, policies and strategies (FAO, 2013); for purposes of understanding adoption decisions at local farmer-level this study focused on CSA practices and technologies, using the two interchangeably. This is essential in comprehension of local-level adoption dynamics shaping uptake of CSA technology

by smallholder-farmers, and may guide CSA technology development, policies and implementation. The study applied concepts from mainstream technology adoption field. Ultimately, this paper contributes towards a gender-transformative and gender-responsive paradigm in CSA adoption in climate-sensitive regions. Additionally, the paper makes germane contribution in the under-researched 'gender-CSA-DRR' nexus.

1.1 Study sites

The study was conducted in two Southern African countries, Malawi and Zambia. In Malawi the study site was Chikwawa district (Figure 1), in Southern Province, while in Zambia it was Gwembe district (Figure 2) in Southern province. The major commonality between these two sites is that both are situated within major river valley systems whose communities are already being affected by severe weather events and changing climatic conditions such as droughts and floods, consequently rendering them vulnerable (Arslan et al., 2018). In the two districts Smallholder-farmers' livelihoods are mainly shaped around rain-fed crop production.

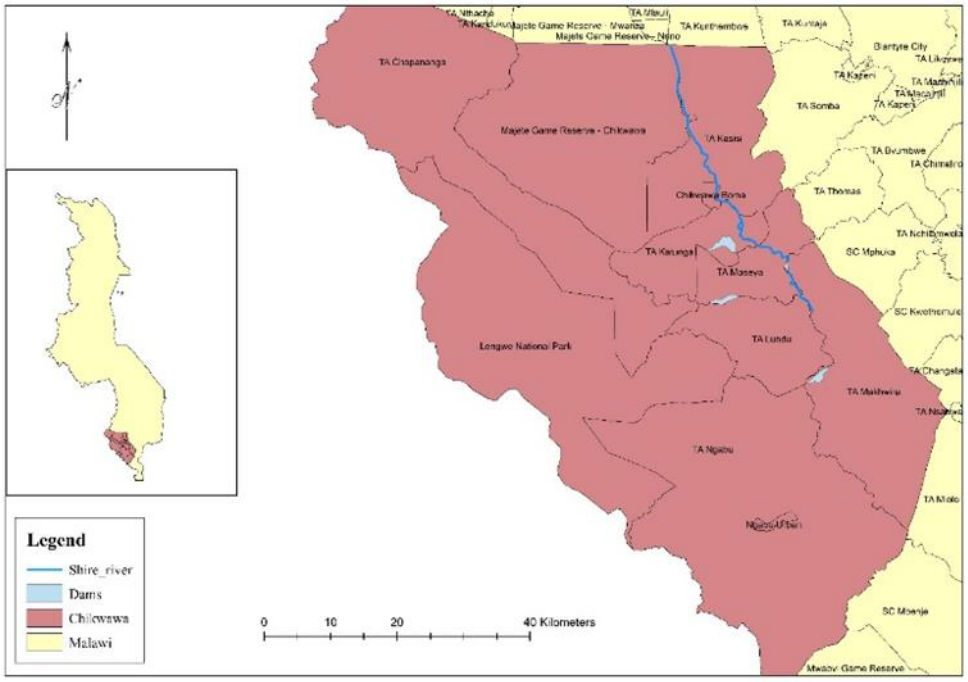

Figure 1: Map of Chikwawa District (Khoza et al., 2019c)

Chikwawa is located in the Lower-Shire Valley. With an elevation below 150mm above sea level, Chikwawa is located on the Great East-African rift valley (Lumumba Mijoni and Izadkhah, 2009). The district is one of Malawi's most vulnerable regions in the context of climate change, with Smallholder-farmers' livelihoods also dependent on natural resources (Malcomb et al., 2014). The

rainfall season supporting subsistence agriculture lies between November and April, with low annual rainfall between 600 to 750mm during this peak rainfall period (Jayanthi et al., 2013).

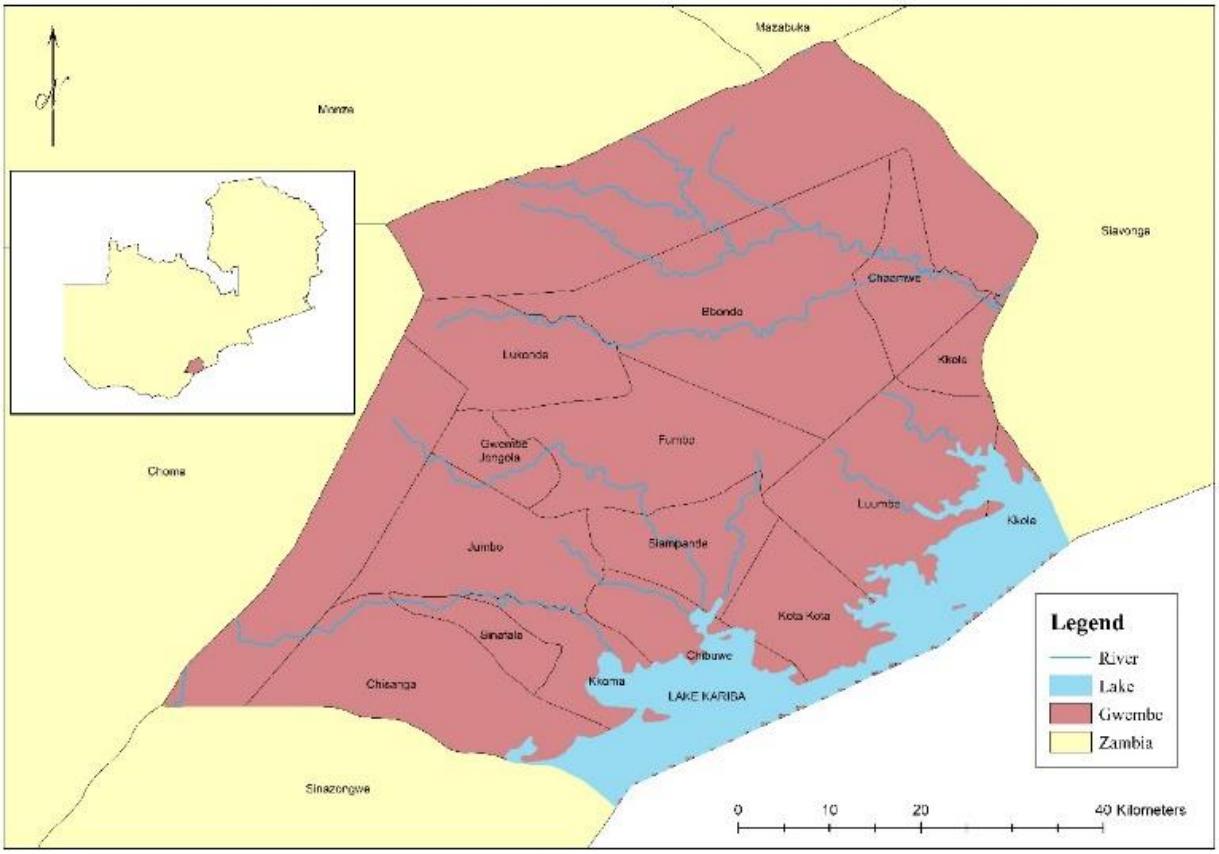

Figure 2: Map of Gwembe District, Zambia (Khoza et al., 2019c)

Gwembe district is located on the Zambezi rift valley, sharing a watercourse with Zimbabwe's Binga and Kariba districts. The district lies in Zambia's semi-arid agro-ecological zone 1, and is one of Zambia's most vulnerable regions where average annual rainfall is less than 800mm (GRZ, 2005).

2. Conceptual framework of CSA adoption

For farmers, adoption of a new technology is a two-step decision-making process (Neill and Lee, 2001). The initial step is deciding whether or not to adopt a technology. If they decide to adopt, then at some point they also have to decide whether they will continue or discontinue using the technology (dis-adoption). Authors such as Simtowe and Mausch (Simtowe and Mausch, 2018) describe technology adoption as transitory at any given time, with farmers likely to decide to move from non-adoption to adoption, and then from adoption to dis-adoption. It is critical to understand the drivers shaping the transitory nature of smallholder-farmers' decisions.

Various scholars have classified drivers of technology adoption decisions differently. Drivers of technology adoption can be categorised into four; economic, entrepreneurial, environmental and sociological Pierpaoli et al. (2013), into social, economic and institutional (Akudugu et al., 2012), or as accessibility, liquidity, profitability and suitability, and socio-cultural (Ragasa, 2012). Commonalities can be identified from such diversity and on that basis the study adapted the drivers as *social, environmental, economic and institutional.* Economic drivers include cost of technology, farm size, cost of adoption, access to credit, expected economic benefits from the adoption and income-generation activities that farmers may engage in (Akudugu et al., 2012). Social factors have to do with community organisation and personal characteristics, while institutional factors are access to extension services and institutional support that may be available for farmers from various institutions (Akudugu et al., 2012, Ragasa, 2012). Environmental drivers are those related to the ecosystem, biophysical and geographical contexts (Barnard et al., 2015).

Drivers of adoption mean those conditions or factors that exist, making farmers predisposed towards adopting a technology. Dis-adoption drivers are those which exist, or emerge and may negate previously identified benefits of a technology (Aleke et al., 2011). This means a farmer may reach a point where they are no longer able to enjoy optimal benefits of a technology they had decided to adopt at a point in time. Drivers of non-adoption refer to those conditions or challenges with whose existence a farmer is demotivated or constrained from adopting a technology. It is important to understand drivers of non-adoption and dis-adoption to stimulate engagement with farmers who are constrained in adopting to articulate their demands and needs (Ragasa, 2012). This is even more important given the changing climatic context that necessitates the need for the reduction of disaster risks affecting smallholder agriculture and building the resilience of smallholder farmers. As such there is need to consider CSA adoption for DRR.

2.1 CSA adoption for DRR

The link between CSA and DRR lies in the focus of on adaptation and resilience-building in affected communities (FAO, 2013, Lei, 2014, Mathews et al., 2018), hence this study focused on CSA adoption through a DRR lens. In regions where rain-fed smallholder agriculture is under threat from climatic-hazards, researchers have called for need to direct efforts towards DRR (Jayanthi et al., 2013). Subsequently, an emergent discourse on the interconnectedness of CSA and DRR is gaining momentum in research (Mathews et al., 2018, FAO, 2013), and is expected to direct practice as well. Essentially, a DRR approach in CSA diverts from a narrow focus on the nature of *climate-related* hazards by encouraging a wider focus into *gendered*-vulnerability and risk arising from interactions between the two (Hai and Smyth, 2012, UNISDR, 2015, Vermaak and Van Niekerk, 2004).

As part of on-going DRR efforts in disaster-prone regions affected by negative climate-change impacts, diverse CSA technologies are promoted for adoption by smallholder-farmers (McCarthy et al., 2011, Morgan et al., 2016, Morton, 2007). This paper theorises that the same conceptualisation of technology adoption can be applied in understanding CSA adoption drivers in smallholder agriculture. Smallholder-farmers have to decide on whether to adopt, dis-adopt or not-to-adopt any form of CSA already introduced in their areas. In some countries, such as Malawi and Zambia, government and NGO programmes have introduced CSA technologies such as mechanised and basin conservation farming (CF), improved seed varieties (ISVs), small-scale irrigation schemes, aquaculture, improved livestock breeds and agroforestry (Khoza et al., 2019c)
.

2.2 Gender gaps, CSA adoption and DRR

While it is important to understand the drivers of CSA adoption, non-adoption and dis-adoption as conceptualised in the preceding sections, there is value in understanding these drivers from a gender perspective. CSA adoption is driven by decision-making, and previous studies have provided empirical evidence socially-constructions of decision-making (Khoza et al., 2019c). Gender gaps affect adoption of, and access to, climate-smart agricultural technologies (Ragasa, 2012, Huyer et al., 2017). Therefore, it is critical that any efforts aimed at improving CSA adoption by different farmers should be anchored on an understanding of gender inequality and gendered-vulnerability (Hai and Smyth, 2012).

Econometric studies, mainly using Tobit, Logit and Probit models, have concluded that gender is not a significant factor in technology adoption, but rather issues of differentiated access to resources and institutions drive men and women's different adoption decisions (Akudugu et al., 2012, Doss and Morris, 2000, Kpadonou et al., 2017). However, it remains unexplained how these different adoption decisions arise, with (Ragasa, 2012) alluding to a lack of analysis on root causes of gender-differentiated adoption challenges. This study theorises that with imminent climate vagaries threatening smallholder agrarian livelihoods, investigation of smallholder-farmers' adoption decisions is essential. Hence, this study used gender as an analytical unit to explore the different drivers of CSA adoption.

3. Materials and methods

3.1 Research design and sampling techniques

An exploratory-sequential mixed-methods study design (Creswell and Creswell, 2017) was applied, with a deliberate bias towards qualitative data (Johnson and Onwuegbuzie, 2004). This study seeks to contribute towards a transformative paradigm in CSA adoption hence it was also essential to capture the textual narration of the experiences of those directly involved in CSA adoption.

Sequential mixed-methods sampling strategies were used (Tashakkori and Teddlie, 2010). For qualitative phase, in both key informant interviews (KIIs) and focus group discussions (FGDs), purposive sampling was used. Respondents were selected based on their knowledge of gender and/ or CSA to provide data that could answer the research questions. For quantitative cross-sectional survey at household level, random sampling was used.

3.2 Data collection and analysis

Data was collected from a total of 172 study participants from the two study sites and analysed separately. First set of qualitative data was collected at district level where a total of 16 KIIs were conducted with district-level government and non-governmental organisation (NGO) officials, as well as local leaders in the two sites. Three FGDs, each with an average of nine people, were held per district at traditional authority or ward level, one for women only, one for men only and one mixed group. FGDs comprised CSA adopters and non-adopters and in total 54 farmers participated, with at least 50% being women as the study deliberately sought to engage women. Preliminary thematic analysis of qualitative findings from KIIs and FGDs was conducted in the field to establish themes to be explored in the quantitative survey. Established themes were used to design the survey questionnaire, in both sites pilot tests were conducted before being administered to sample households at village level. Descriptive statistical analysis of quantitative data was done to establish distribution trends and patterns, followed by integration with qualitative findings.

4. Findings

Qualitative findings from KIIs and FGDs in Chikwawa and Gwembe established that drivers of adoption, dis-adoption and non-adoption were similar between the two sites. However, differences were encountered upon exploration of these drivers in the quantitative cross-sectional household survey in the two sites. Table 4-1 presents a summary of the identified drivers of CSA adoption, non-adoption and dis-adoption. These drivers were further explored to establish how

they differed across the different social groups of men and women smallholder-farmers and in-depth findings are explained in the following sections.

4.1 Drivers of CSA adoption

As presented in Table 1, in both study sites major CSA adoption drivers were identified as tangible benefits, government or NGO projects, social networks, concern about climate risks, food security goals and income-earning opportunities. Qualitative findings established that smallholder-farmers were likely to adopt any CSA technology promoted in their areas upon seeing tangible benefits. Tangible benefits were indicated as mainly improved food security and income earned from sale of surplus produce from different CSA technologies. This was said apply especially in conservation farming (CF). However, income from crop sales or livestock

Table 1: Summary of identified drivers of CSA adoption, non-adoption and dis-adoption

Drivers of adoption	• *Tangible benefits* • *Government or NGO projects* • *Social networks* • *Concern about climate risks* • *Improve family's food security* • *Income-earning opportunities*
Drivers of non-adoption	• *Lack of viable markets* • *Lack of tangible benefits* • *CSA affordability* • *Inadequate technical support* • *Limited access to information* • *NGO projects* • *Lack of CSA-relevant resources*
Drivers of dis-adoption	• *Lack of CSA-relevant resources* • *Discontinuation of NGO CSA projects* • *Lack of tangible benefits* • *CSA affordability*

sales from specifically CSA was said to be minimal at present. Low income-earning opportunities were attributed to lack of viable markets where farmers could trade their produce, and also buy required inputs for CSA technologies. For example, in Gwembe farmers in FGDs stated that they often had to travel to neighbouring districts and bigger towns to buy inputs, or sell produce. In a FGD for men only, it was established that because of the traveling distances involved, mobility for different groups of women was constrained. Married men stated that they were not usually comfortable with sending the wives to trade because *'when you get in the habit of sending her, eventually she will see other men and leave you*.*'*

In both study sites both government and NGOs supported CSA projects, such as CF, subsidised agricultural inputs, small-scale irrigation schemes and aquaculture (in Gwembe only). Thus, although tangible benefits from CSA were not apparent to smallholder-farmers, they were likely

to adopt CSA because it was promoted by government and NGOs. These CSA projects often required minimal financial contribution from the smallholder-farmers, with either the NGOs or government bearing the major capital costs, for example in the aquaculture project in Gwembe, and the small-scale irrigation schemes in Chikwawa. Further investigation into the gender issues at the qualitative phase revealed that indeed CSA adoption drivers could be gender-differentiated as exemplified in the following statements;

> *'We deliberately target women to adopt CSA because we know they often face challenges that would limit them in taking up CSA if there is no help'*

Study findings also showed that smallholder-farmers were likely to decide to adopt CSA if there was encouragement from other farmers within their social networks. Respondents stated that this was usually the case if other farmers who were already CSA adopters shared with non-adopters about tangible benefits they were realising from CSA. In addition, evidence showed that concern for climate risks also influenced CSA adoption by smallholder-farmers, especially for crop production, where in both sites farmers and district-level key informants highlighted climate-related risks such as droughts, floods and pests (Fall Armyworm cited in Chikwawa only at time of data collection- February 2018). Respondents highlighted that smallholder-farmers adopted CSA technologies that had tangible benefits of improved crop production in the face of climate-related risks, or offered them income-earning opportunities. Where farmers perceived climate-related risks threatened their agrarian livelihoods then adoption was likely in an effort to ensure food security for their families. Taken together, based on qualitative findings of this study drivers of CSA adoption do fall into economic, social, environmental and institutional categories as previous technology adoption studies established (Ragasa, 2012, Simtowe and Mausch, 2018, Pierpaoli et al., 2013).

Further exploration of CSA adoption drivers at quantitative phase established same adoption drivers as identified in the qualitative phase (Figure 3). In Chikwawa, 33% of adopters indicated that *'seeing benefits from those who were already practicing'* was the major driver for them to adopt various CSA technologies they were involved in. All respondents who stated this reason were involved in CF. Farmers who were realising tangible benefits motivated others to adopt (24%) through social networks. Those who adopted through this process also indicated their aspiration for improvement in their family's food security (20%), and expected to improve income earned by households from sale of proceeds from the technology practiced, for example crop sales from CF. A proportion of farmers (13%) did show concern for climate risks threatening their agrarian livelihoods hence decision to adopt CSA. Institutional support was seen to drive adoption in a small proportion of farmers (8%) who expressed that motivation to adopt was desire to benefit from government or NGO support (usually in form of agricultural input support schemes or

livestock distribution). However, only 2% of the farmers cited adoption motivation as income-earning opportunities derived from use of various CSA technologies. Such a low proportion was consistent with qualitative findings where it was established that income-earning opportunities from CSA were minimal, due to lack of viable markets.

Further gender-disaggreged analysis of adoption drivers revealed that in Chikwawa none of the identified drivers were captured from married women (Figure 4), although they participated in the household interviews. This could be an indication of disparate intra-household power dynamics in decision-making on CSA adoption or unequal access to resources required for CSA (Fisher and Kandiwa, 2014).

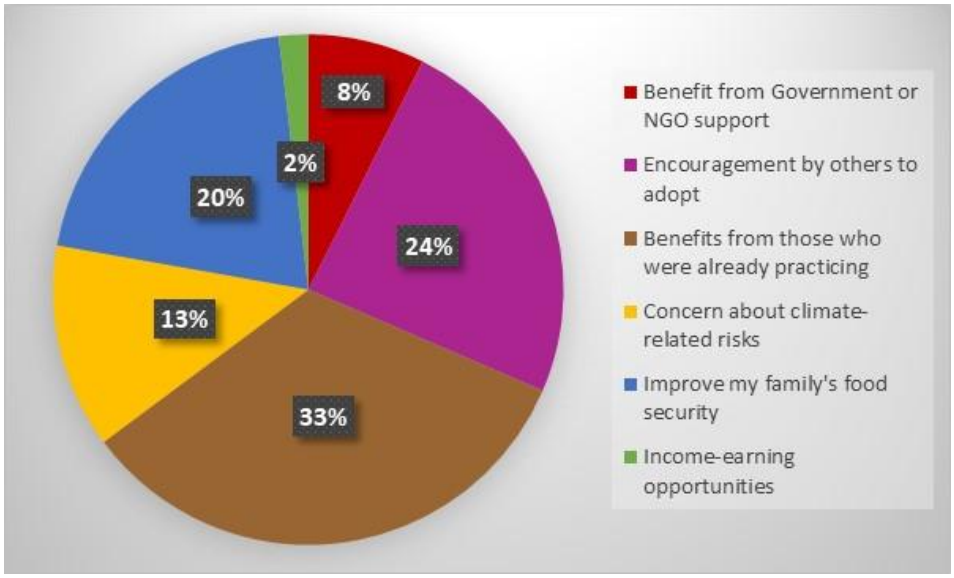

Figure 3: Drivers of CSA adoption, Chikwawa

Among women CSA adopters, single women household-heads cited motivation to adopt through encouragement by other farmers who had already adopted CSA (social networks). Additionally, seeing tangible benefits of food security was identified as a driver among single and divorced women while for widows, drivers were identified as concerns about climate risks and desire to improve family's food security, ultimately improving quality of life. Unlike their married counterparts, *de jure* women household-heads single-handedly bear the role of food provision for their households, whereas for married couples this is either the husband's role or shared.

In Gwembe quantitative findings established main drivers of CSA adoption (Figure 5) as seeing benefits from those who were already practicing CSA (23%) and aspirations to improve family's food security. Adopters also indicated benefit from government or NGO support (20%) as another

motivation for CSA adoption. This substantiated qualitative findings stating that farmers adopt CSA to comply with requirements of various input subsidy programmes in the two study sites. Encouragement by others to adopt CSA was cited as a driver by 17% of the adopters, while 16% indicated that concern for climate risks was their motivation for CSA adoption.

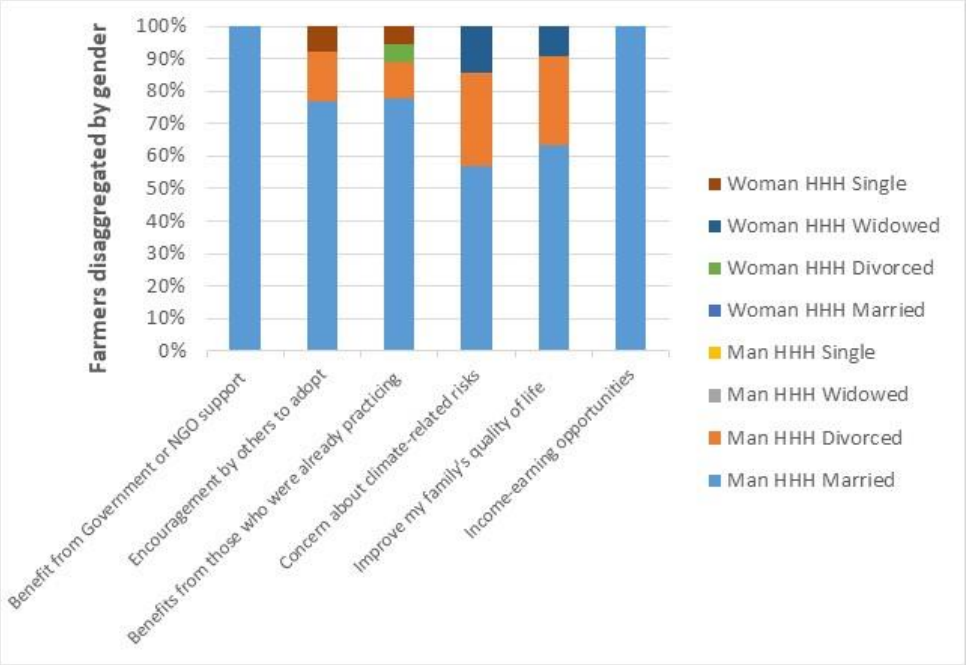

Figure 4: CSA adoption drivers dis-aggregated by gender, Chikwawa

Income-earning opportunities were indicated as an economic driver in a mere 1% of the adopters. This confirmed qualitative findings that there were little economic opportunities in the different CSA technologies adopted by farmers.

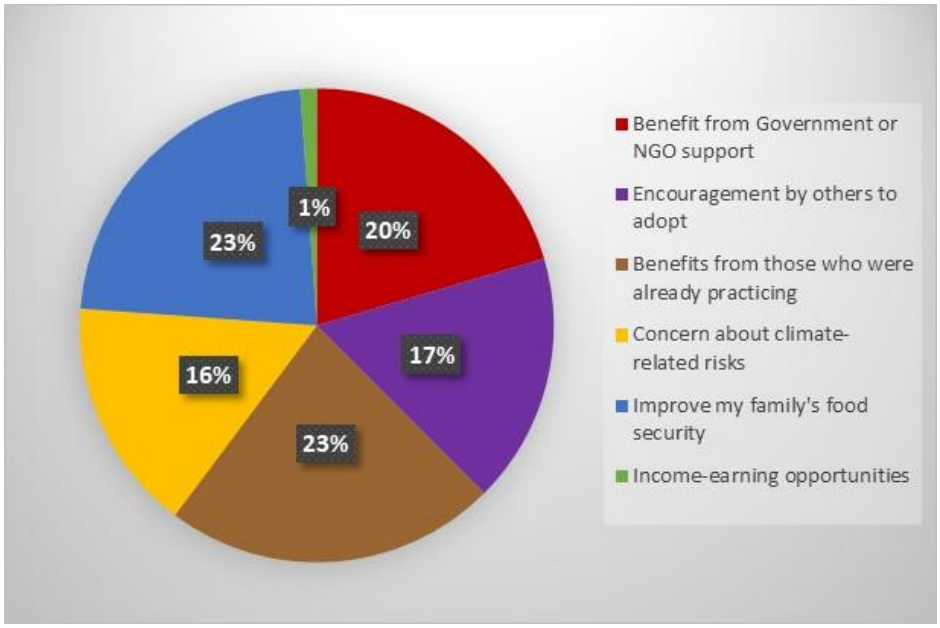

Figure 5: Drivers of CSA adoption from quantitative phase, Gwembe

Further gender-disaggregated analysis showed some differences across different farmer categories (Figure 6). For example, no category of women mentioned economic-earning opportunities, which when taken together with qualitative findings that indicated lack of viable local markets for CSA produce, could be an indication of mobility constraints especially for *de jure* women headed-households. Furthermore, in 5% divorced women only one driver was identified; *'seeing benefits from those who were already practicing'*. These were women who had returned to their father's or brother's homesteads upon collapse of their marriage. They were not directly benefiting from NGO or government CSA interventions, but had land apportioned to them by their male relatives who were in CSA programmes, and from who they could see CSA benefits.

In Gwembe, married women who were stand-alone adopters on land apportioned by their husbands were able to cite drivers that made them adopt CSA. Although these were a few women, this scenario gives insights into intra-household gendered agricultural roles, especially given that while citing all other adoption drivers such as benefit from government or NGO support, concern for climate risks and encouragement by others, these women did not mention any economic drivers of CSA adoption. This may be consistent with suggestions that married women have little control of family economic decisions in the household (Khoza et al., 2019c).

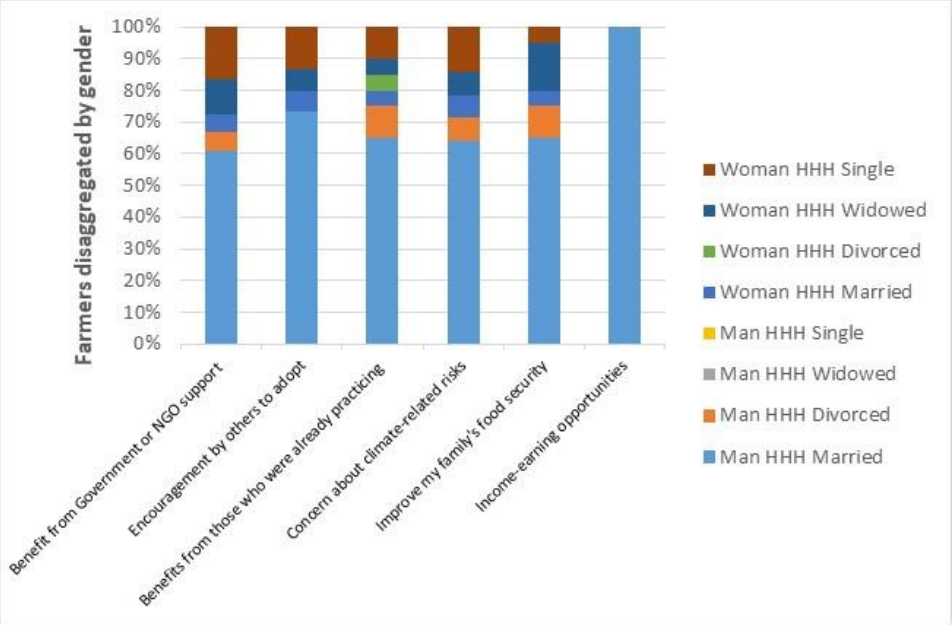

Figure 6: CSA adoption drivers dis-aggregated by gender, Gwembe

On the other hand, divorced men did not cite income-earning opportunities and encouragement by others as drivers for CSA adoption. This could be an indication of their roles in the absence of a wife, which could mean they were also constrained to move in search of better markets for agricultural inputs or outputs. However, in literature there is paucity of gender roles of unmarried men household-heads. This paper recommends that in the face of climate hazards affecting agrarian livelihoods, and as DRR initiatives such as CSA are embarked on, it is important to comprehend socially constructed roles of all types of household-heads.

4.2 Drivers of CSA non-adoption

In both study sites non-adoption of CSA was driven by constraints that could be categorised as economic, social and institutional (Table 1). Identified economic constraints include lack of viable markets, lack of tangible benefits which made non-adopters perceive their conventional practices were better than adopting CSA, CSA affordability and lack of CSA-relevant resources (also social). CSA-relevant resources were identified as labour and appropriate farm-implements. For example, in Gwembe, government-distributed equipment for mechanised CF was insufficient to reach a wider number of farmers. The equipment package distributed to 64 lead farmers comprised one ripper and five sprayers, and was supposed to support more than 400 follower CSA adopters. The following statements highlight the existing situation regarding different drivers of non-adoption of CSA technologies;

> *'Our impact is minimal because our projects require huge investments such as irrigation schemes, which farmers cannot afford'*

'Without input subsidy programs, most of our farmers would not afford to purchase these varieties…they have to contribute an amount for co-payment towards the inputs package.'

Institutional drivers of CSA non-adoption were identified as inadequate technical support, limited access to CSA information and humanitarian NGO projects. Inadequate technical support and limited access to CSA information were said to be closely connected. Extension officers were mentioned as one major source of CSA information, alongside lead farmers who are especially trained on CSA so that they can train and support other farmers in their communities. However, in both KIIs and FGDs insufficient coverage of farmers by government and NGOs was lamented. Although viewed as better resourced by government departments, NGOs also stated their projects were unable to reach more farmers. One NGO worker summarised the situation as follows;

'Our project target is to reach more than 9000 farmers, and for that we have 72 lead farmers…clearly this is not enough to reach more farmers with CSA'

In addition, humanitarian NGO projects were also identified to fall under social drivers. This was because it was said to be dependent on farmers' mind-sets and ideologies especially around food-aid distribution by NGOs, as it was established that statements such as *'we know that even if we do not harvest much from our fields, NGOs will come and give us food, so why work so hard in these practices yet we know we will not starve'*, were common among some farmers.

Qualitative findings established that non-adopters had limited access to CSA information, such as benefits and demerits of CSA, and specific CSA options for farmers. According to technology adoption concepts (Neill and Lee, 2001, Pierpaoli et al., 2013), farmers' decision to adopt a technology is driven by whether benefits of the new technology surpass those of their traditional approaches. Hence, in the absence of such CSA information being readily available and disseminated to farmers, non-adoption was likely.

No environmental drivers were shared in terms of non-adoption of CSA. However, a close relationship between social and economic drivers was emphasised by respondents, which was consistent with previous studies (Barnard et al., 2015) that highlighted how socio-economic constraints negatively affect CSA adoption.

In Chikwawa quantitative findings (Figure 7) corroborated qualitative findings that non-adoption resulted from lack of CSA-relevant resources (67% respondents). Also, 11% of non-adopters indicated that their conventional practices seemed more beneficial (lack of tangible benefits of CSA), while another 11% stated that lack of access to information was a constraint they faced. Some respondents cited that there are no tangible benefits (7%) while 4% indicated that humanitarian food assistance by NGOs demotivated them to adopt CSA.

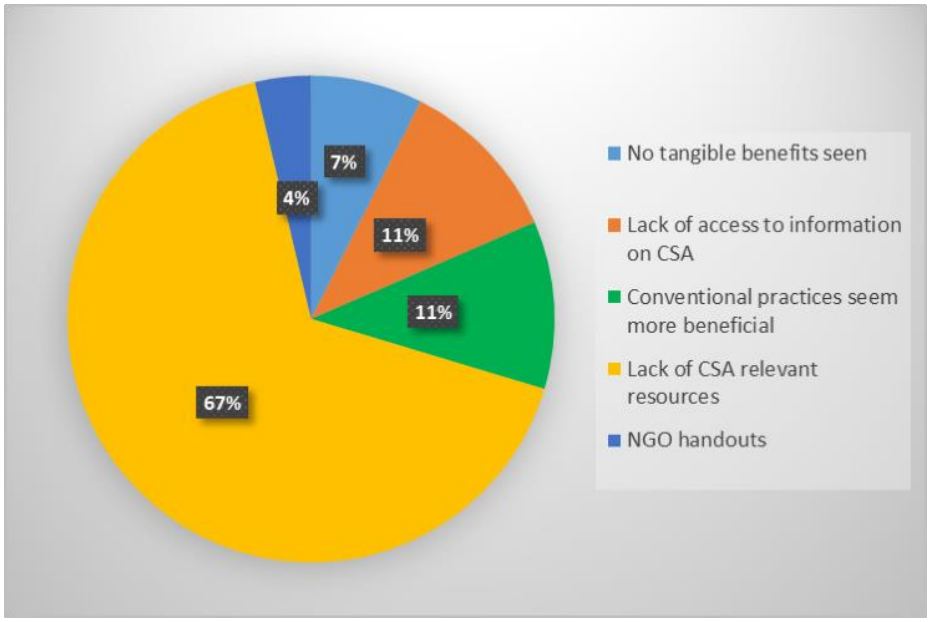

Figure 7: Drivers of CSA non-adoption from quantitative phase, Chikwawa

In the study, all non-adopters encountered in Chikwawa were married, divorced or single men (Figure 8). This could be attributed to the fact that there was a deliberate drive to have women adopt CSA especially by NGOs in the district. Drivers for non-adoption were identified as no tangible benefits seen, hence conventional practices were perceived as more beneficial, and lack of access to information on CSA. Furthermore, above 80% of married men also cited lack of CSA-relevant resources as a driver to non-adoption of CSA. Divorced and single men (approximately 12% and 5% respectively) cited lack of CSA relevant tools as their major constraint. Single men were the only category of non-adopters who cited NGO handouts as their reason for not adopting any CSA technology, as humanitarian food assistance tended to focus on all food insecure households.

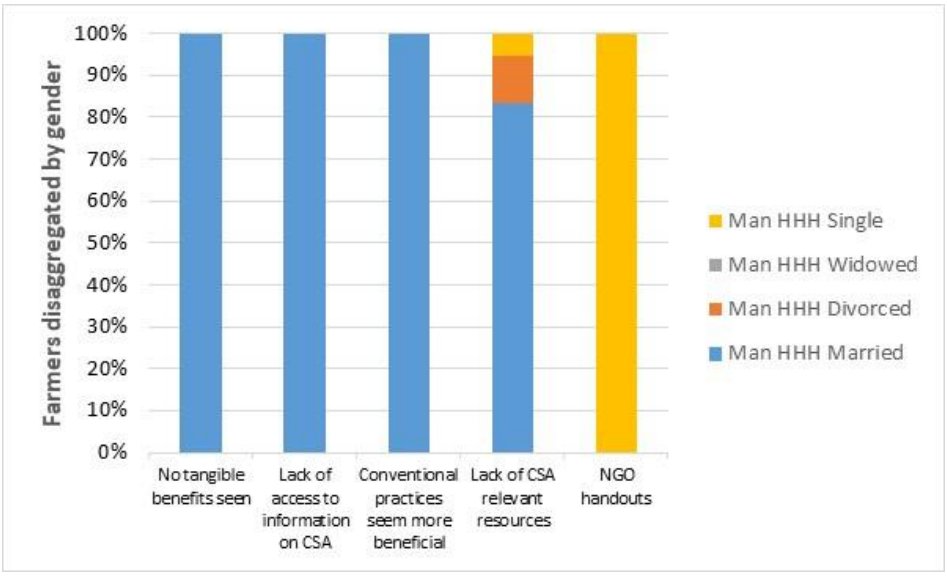

Figure 8: Drivers of CSA non-adoption disaggregated by gender, Chikwawa

In Gwembe, 31% of farmers cited a lack of access to CSA information as their main driver for non-adoption of CSA (Figure 9). Lack of CSA-relevant resources was cited as a constraint by 23% of the farmers, while 21% stated their conventional practices seemed more beneficial. Twenty percent of the farmers attributed non-adoption of CSA to a lack of tangible benefits of CSA. A small proportion attributed non-adoption to NGO handouts (5%) that they received, as they stated they knew that even if they had poor harvests they would receive food assistance from NGOs.

Figure 10 shows that widows were the only category of women found among non-adopters in Gwembe district. Lack of access to CSA information was cited as a driver for non-adoption by almost 25% of the widows, while 22% highlighted lack of CSA-relevant resources as a constraint they faced. A smaller proportion (approximately 11%) stated that they did not see any tangible benefits of CSA, and they found their conventional practices more beneficial.

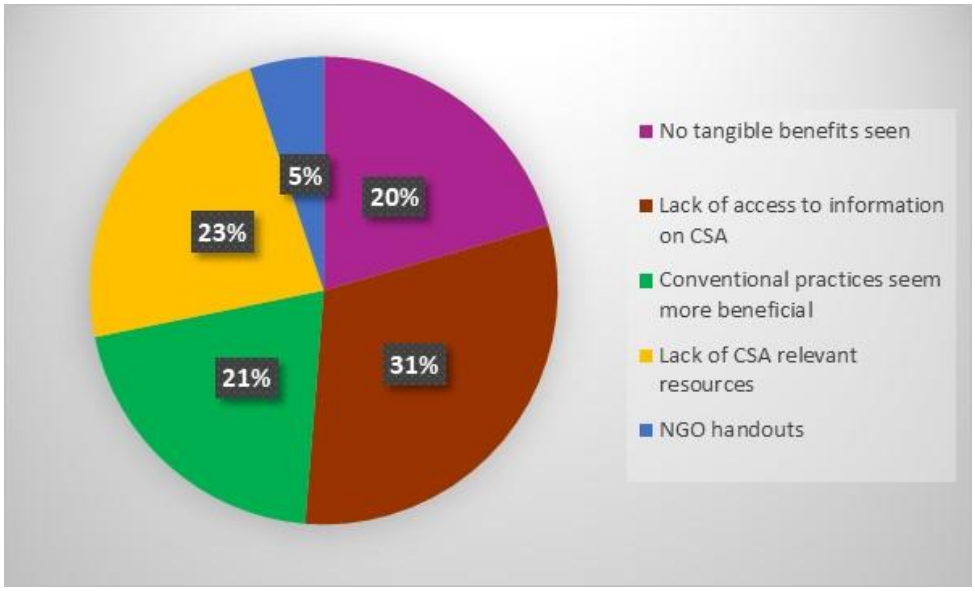

Figure 9: Drivers of CSA non-adoption, Gwembe

Among married men, almost 90% said that they found conventional practices more beneficial, with 72% stating they did not see any tangible benefits from CSA. Lack of access to information was cited as a driver for non-adoption by 59% of the married men, while 22% cited a lack of CSA-relevant resources. There was a proportion of divorced men (40%) who cited lack of CSA-relevant resources, while almost 15% indicated lack of CSA information, as a constraint. All single men household-heads in the study mentioned NGO handouts received as food aid as their main reason for not adopting CSA.

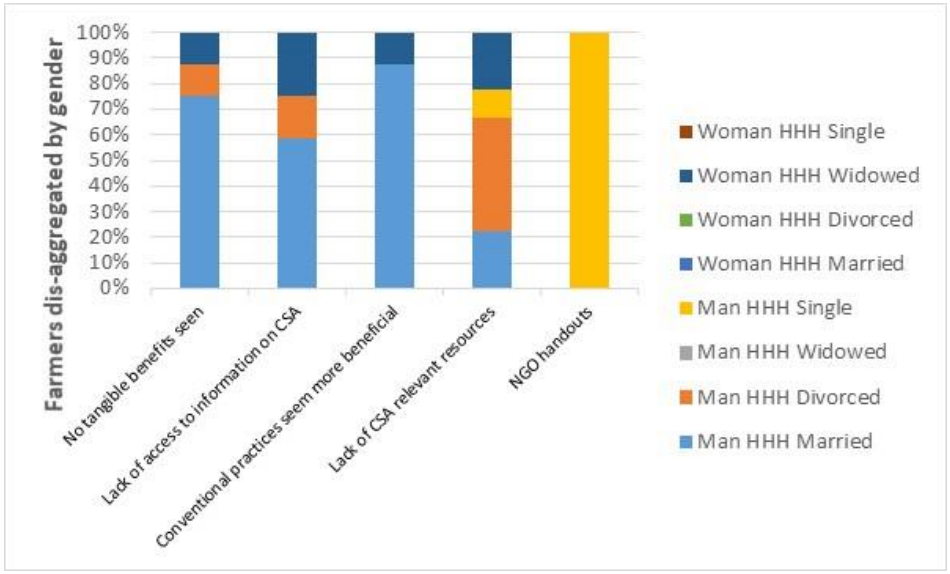

Figure 10: Drivers of CSA non-adoption disaggregated by gender, Gwembe

While quantitative findings generally confirmed qualitative findings, further exploration of identified drivers of CSA non-adoption established that the drivers were gender-differentiated. Although

gender-differentiated drivers of CSA non-adoption have not been looked into by many studies, the broad drivers identified in this study show consistency with what previous studies have alluded to (Barnard et al., 2015, Fisher and Kandiwa, 2014).

4.3 Drivers of CSA dis-adoption

Dis-adoption of CSA was only encountered in Chikwawa. In Gwembe farmers stated there was no outright dis-adoption, although there was possibility that this was masked by farmers who moved from one project to another as different CSA projects ended and new ones commenced. In Chikwawa dis-adoption was said to be driven by lack of CSA-relevant tools (economic and social driver), lack of tangible benefits and unaffordability of CSA (both economic drivers), health problems (social drivers), and the ending of NGO projects (institutional).

Qualitative findings established that women household-heads were most likely to encounter challenges that forced them to abandon CSA, and this is exemplified by the following statement;

> *'Women are more likely than men to dis-adopt CSA when they face problems in their homes…when they fall sick and cannot work in the fields or when they do not have enough money to pay towards subsidised inputs…'*

Related to lack of tangible benefits qualitative findings also established that abandonment was likely when farmers' expectations on CSA were not met. In the case of CF, dis-adoption was also said to result when NGO projects that would have been distributing free inputs packages ended, or farmers were required to make contribution towards payment of the inputs. It was highlighted that there were farmers who could not raise the required contribution, often opting to discontinue instead.

Exploring identified drivers through quantitative survey revealed some divergences from qualitative findings. KIIs and FGDs did not identify time constraints as a driver of dis-adoption, yet at the quantitative phase 13% of the dis-adopters mentioned it as a driver (Figure 11). Health status was cited by 25% of dis-adopters, because it affected availability of household labour to engage in CSA activities, especially CF.

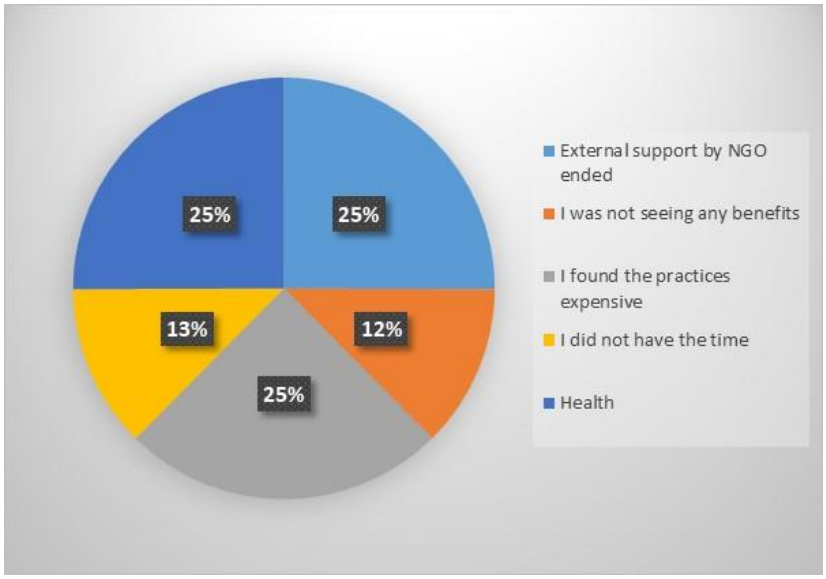

Figure 11: Drivers of CSA dis-adoption, Chikwawa

When NGO-supported CSA projects ended dis-adoption was likely as dis-adopters explained that they could not afford expensive CSA technologies (Figure 11). Dis-adopters also stated they had not realised any tangible benefits in the CSA technologies they had been engaged in (14%), mainly because they had been unable to earn income that could have changed their lives.

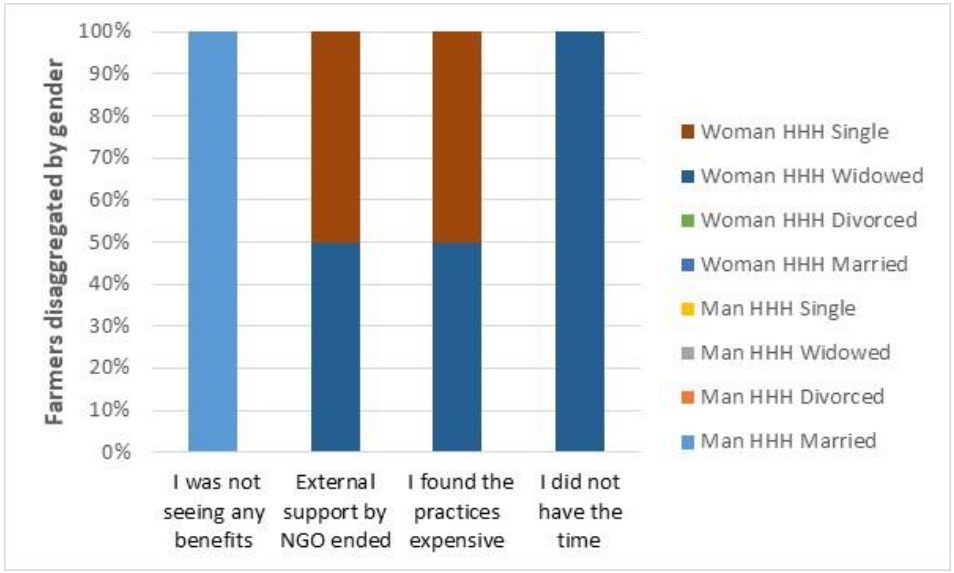

Figure 12: Drivers of CSA dis-adoption disaggregated by gender, Chikwawa

All dis-adopters who stated lack of tangible benefits were married men, and this was the only driver of dis-adoption cited by this category of farmers (Figure 12). *De jure* women household-heads indicated time-constraints, unaffordability of CSA and ending of NGO projects. This is

empirical evidence that *de jure* women household-heads face more challenges that demotivate them from continuing CSA.

Taken together, this study confirmed that CSA drivers of adoption, non-adoption and dis-adoption fall within economic, social and institutional categories (Fisher and Kandiwa, 2014, Neill and Lee, 2001, Pierpaoli et al., 2013, Ragasa, 2012). Environmental drivers were only encountered among CSA adopters. A gender lens applied to further analysis of these drivers indicates that there exist different contexts for the different farmer typologies (Khoza et al., 2019c) which influences their opinions on benefits of CSA adoption or lack of. A critical juncture is to make further inferences on gender-differentiated drivers of CSA adoption, non-adoption and dis-adoption within the framings of DRR. This forms the basis of the discussion of these findings in the ensuing section.

5. Discussion

Conceptual framings of understanding drivers of CSA adoption, non-adoption and dis-adoption were based on technology adoption and DRR. The study applied a DRR lens in looking into identified gender-differentiated drivers of CSA adoption, non-adoption and dis-adoption which were established to fall into social, environmental, economic and institutional categories. This was critical given suggestions from literature on interconnectedness of CSA and DRR (FAO, 2013, Lei, 2014, Mathews et al., 2018). From a DRR perspective, these findings gave insights into existing gendered-vulnerability, and are aligned with work by Wisner, *et al* (Wisner et al., 2012) and the components of the Pressure and Release Model (PAR), which was later modified into a gendered PAR model (Hai and Smyth, 2012).

Given that inclement climatic hazards are not expected to relent (Barnard et al., 2015), this paper asserts that for countries in developing regions such as Malawi and Zambia, resilience-building and adaptation remain critical. More importantly is adaptation and resilience-building among vulnerable social groups, which based on findings are predominantly *de jure* women household-heads, either single, divorced or widowed. This paper submits that to ensure adaptation and resilience-building across the diversity of men and women smallholder-farmers, there is need for a paradigm shift from promoting CSA as a technical remedy to climatic-hazards, towards local-level CSA implementation tackling influence of progression of gendered-vulnerability on adoption dynamics among smallholder-farmers. The crux of this paper is that a revolution is required in CSA policies and implementation where traditionally gender-blind or neutral CSA projects transform into gender-sensitive and transformative CSA projects that recognise specific gendered-vulnerabilities that hinder CSA adoption.

In line with the gendered PAR model this paper accentuates that attention should be paid to gender-differentiated drivers of CSA adoption, non-adoption and dis-adoption if CSA is to

contribute to adaptation and resilience-building. The paper underscores need for creation of enabling conditions to achieve CSA goals. Similarly, release of *gender-differentiated* pressure (Hai and Smyth, 2012) and addressing underlying root causes to create equal opportunities for all groups of men and women in vulnerable communities cannot be overemphasized. The following sub-sections give deeper insights into this.

5.1 Creating enabling conditions

This study provided evidence that gender inequalities created unconducive conditions that discouraged CSA adoption especially by vulnerable women smallholder-farmers. This paper contends that enabling conditions may be created for vulnerable women which may motivate them to adopt various CSA options. Based on study findings that highlighted that vulnerable women, such as married, widows, single and divorced, lack access to CSA information, this paper proposes that equal opportunities for training and skills development be afforded all groups of men and women smallholder-farmers. Access to information for women may also be improved by strengthening their social networking platforms where CSA information can be disseminated and peer encouragement to adopt strengthened. When armed with information, decision-making becomes easier. In order to improve information access for women especially, other social networks and community platforms may be used as well. This paper recommends deviation from traditional silo-syndrome towards holistic, multi-sectoral partnerships even at local-level. The CSA space may be opened up to other community channels for information dissemination. Furthermore, creation of enabling conditions requires public action that will bring together various stakeholders to collectively tackle existing gendered-vulnerabilities faced by farmers and hindering CSA adoption.

Enabling conditions can also be created by diversification of rural income opportunities for vulnerable men and women, especially *de jure* women household-heads with limited income options. When income earning opportunities from CSA options are lucrative for smallholder-farmers, they may be more likely to adopt CSA. While there has been massive promotion of CF, evidence from this study shows that the same cannot be said about other CSA options, such as climate-smart livestock production, aquaculture, market development and small-scale irrigation. This paper argues that when gender-responsive diversified CSA options move beyond CF to include other CSA options, income earning opportunities for the farmers may be widened.

5.2 Reducing dynamic pressures

The study identified gender-differentiated drivers which hindered CSA adoption by smallholder-farmers. Using the gendered PAR model for DRR, some of these drivers of non-adoption and dis-

adoption can be interpreted as dynamic pressures. For example, evidence showed that without viable markets, there was little income earned from CSA to translate to any meaningful change in quality of life, especially for *de jure* women household-heads. Consequently, CSA non-adoption and dis-adoption are likely, hence there is need for CSA to innovatively promote gender-responsive economic empowerment through meaningful value-chain development. This should consider different farmer typologies, especially women whose mobility for market services is often constrained by their domestic and community roles, whether they are married or not as findings show. Also, value-chain development may contribute to rural development which ultimately should service all farmers equally. Therefore, this paper advocates for women's economic empowerment through CSA because increased income may reduce gendered-vulnerability and poverty.

Improved economic empowerment through CSA should be buttressed by adequate technical support provided by various institutions involved in CSA projects. Study findings showed that institutional drivers, such as inadequate technical extension support from both government departments and NGOs, encourages non-adoption of CSA. Conversely, it may be true that provision of adequate technical extension support may improve CSA adoption as these may effectively serve as CSA information dissemination hubs. This paper argues that when extension support is concentrated on convenient locales, marginalised women in remote villages whose mobility to attend trainings and meetings is constrained by their reproductive roles are deprived of much-needed CSA information to inform decision-making. This contributes to skewed access to information and knowledge, with women in this study indicating they had no access to CSA information. Equally concerning is evidence that in some cases even married men indicated they lacked CSA information. While it may be understandable that resources for CSA implementation in both government and NGOs are limited, this paper contends that CSA implementation needs to resourcefully utilise existing community structures, such as community-based DRR committees.

5.3 Addressing the root causes

Evidence from the study shows that institutional, economic and social drivers including availability of CSA-relevant tools, affordability, tangible results and ideologies around NGO projects and dependency syndrome formed gender-differentiated drivers of adoption, non-adoption or dis-adoption of CSA. This paper contends that it is important to address these root causes, which anchor identified social, economic and institutional drivers influencing decisions made on whether to adopt, not adopt or discontinue CSA. This paper proposes that addressing root causes should aim to create enabling conditions providing equal opportunities that enhance CSA adoption by different groups of men and women smallholder-farmers. For example, when using the gendered

PAR model, it can be seen that although governments provided subsidised input support programmes (ISPs), these were gender-neutral and viewed men and women as homogeneous hence requiring the same amount of monetary contribution to access inputs. For *de jure* women household-heads who have been shown to have limited ownership and access to CSA-relevant resources, this could mean the monetary contributions required in ISPs could be prohibitive. Farmers will adopt CSA if it will have affordable and low associated running costs, and if any of these conditions are not met, then farmers are unlikely to adopt. As seen in the findings among dis-adoption drivers, in the event that a subsidy programme ended, some women farmers could discontinue CSA. Therefore, this paper contends that in understanding gender-differentiated vulnerabilities, gender-neutral policy and implementation gaps are identified and transformed to adequately cater for all genders. For example, concerning ISPs, policies may need to be amended to address the gender-neutral contribution requirements.

Simultaneously, reducing dynamic pressures through economic empowerment and viable local markets may create tangible benefits of CSA adoption, ultimately addressing root causes. Tangible benefits in the form of food security, improved quality of life and poverty alleviation among CSA adopters may drive other farmers to adopt CSA as well. Also, tangible benefits drive investment decisions on time, money and labour. Failure to demonstrate a distinctive competitive edge of CSA adopters may demotivate CSA adoption, or encourage dis-adoption. Therefore, it is also important that addressing root causes that drive CSA adoption, non-adoption and dis-adoption also focuses on NGO projects. Evidence gathered by this study suggest a paradox of NGO projects in CSA adoption, where on one hand CSA adopters indicated that their motivation to adopt was driven by existing NGO support. Conversely, non-adopters and dis-adopters were said to depend on food-aid distribution hence they were not motivated to adopt CSA. Program harmonisation between humanitarian food-aid distribution and longer-term resilience projects such as CSA (Béné et al., 2016) is also required. Furthermore, this paper submits that CSA needs to bridge humanitarian and resilience-building efforts. One possible way would be to diversify CSA options available to farmers, and increase income security, ultimately providing evidence of tangible improvements in quality of life for heterogeneous groups of smallholder farmers and poverty alleviation through CSA.

5.4 Reducing disaster risks through CSA adoption

This paper posits that in addressing the identified gender-differentiated drivers of CSA adoption, non-adoption and dis-adoption, it is possible to reduce gender-differentiated climate-related disaster risks affecting smallholder agriculture. Through adoption of CSA, different groups of men and women household-heads may attain food security, and loss of livelihoods alleviated through adaptation and resilience-building. Conversely, non-adopters and dis-adopters may remain food

insecure and lack resilience in the face of climatic change, and be perpetually dependent on food-aid.

This paper argues that within the context of gendered negative impacts of climate change on smallholder agriculture (Alston and Whittenbury, 2012, Huyer et al., 2017), it is insufficient to frame understanding of CSA adoption decision-making purely on econometric analyses. Thus, evidence provided by findings shows that combined application of technology adoption and DRR concepts to generate understanding of CSA adoption dynamics among heterogeneous men and women smallholder-farmers helps identify areas where transformation of pre-existing gender inequalities is required. When interactions of social, economic, institutional and environmental drivers shaping CSA adoption decisions are understood, researchers, practitioners and policy-makers may be able to collectively formulate strategies and policies that will curtail impediments, and harness opportunities, to optimise CSA adoption by different groups of smallholder-farmers.

6. Conclusions and policy implications

This paper provides an evidence-base on how underlying gender-differentiated vulnerabilities affect decision-making and shape CSA adoption dynamics among smallholder-farmers in climate-sensitive regions. Findings show that CSA is being introduced within the context, and seems to maintain the status quo, of pre-existing gender-disparities in climate-sensitive smallholder farming communities, hence the identified gender-differentiated drivers of CSA adoption, non-adoption and dis-adoption. This paper magnifies need for transformation of CSA policy-framework and implementation strategies to become inclusive, equitable, locally appropriate and sustainable. Understanding of gender-differentiated drivers of CSA adoption, dis-adoption and non-adoption creates opportunity to explore ways of pursuing inclusion of marginalised and heterogeneous social groups of farmers in CSA. Ability of smallholder-farmers to identify climate-related hazards affecting them indicates their awareness of the problem, hence their contributions should form part of efforts to improve CSA adoption.

This paper emphasises that it is important for CSA technology innovators, policy-makers, implementers and researchers to realise that gender-differentiated drivers for adoption, dis-adoption and non-adoption may be mutually reinforcing, and interacting in such ways that addressing one driver could actually have potential knock-on effects on other drivers. Thus, through identification of gender-differentiated drivers of CSA adoption, dis-adoption and non-adoption, various players and sectors critical in contributing to improved CSA adoption can be identified. This paper recommends that domesticating CSA within DRR creates opportunities for more collective action that will address complexity of gendered-vulnerability that otherwise tends to inhibit CSA adoption. This cannot be left solely in the agriculture domain hence,

transdisciplinary collective action that enhances collaborations and partnerships is required in research and practice to improve CSA delivery at farmer-level. Taken together, with less than a decade in existence, CSA work done thus far presents researchers, practitioners and policy-makers opportunity to critically review the concept and identify what works, and what does not, for vulnerable smallholder-farmers threatened by worsening climate-related hazards. Ultimately, such holistic efforts to address gender inequalities that hinder CSA adoption, especially by the different groups of women, may enable CSA to be delivered with precision and efficiency to adequately enable smallholder-farmers to be food and income secure, resilient as well as adapt to climate change. To further enhance precision and efficiency of CSA in meeting adaptation and resilience needs of smallholder-farmers in climate-sensitive regions, especially women, future research needs to explore gender-differentiated adoption using technology adoption models.

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Chapter 5: Theoretical Perspectives of Climate-Smart Agriculture Adoption

Article 3 A gender-differentiated analysis of climate smart agriculture adoption by smallholder farmers: Application of the Extended Technology Acceptance Model

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A gender-differentiated analysis of climate smart agriculture adoption by smallholder farmers: Application of the Extended Technology Acceptance Model

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Abstract

Low adoption of climate-smart agriculture (CSA) technologies by smallholder-farmers in regions where negative impacts of climate-related hazards already threaten agrarian livelihoods remains a concerning enigma. Adoption patterns are not commensurate with merits of CSA on food security and climate resilience. Attention to gender in relation to behavioural and attitudinal patterns in CSA adoption remains underexplored. An exploratory- sequential mixed methods study was conducted, using a socio-psychological theoretical lens to test applicability of the extended technology acceptance model in predicting CSA adoption among at-risk smallholder farming communities in Malawi and Zambia. Correlation results from Spearman's Rho show relationship strengths between socio-psychological factors; perceptions on ease of use, usefulness and climate risk, differed between men and women household-heads. Results also show that social processes are central in influencing decision-making on CSA adoption. For practitioners and policy-makers these findings reflect critical need for gender-specific behavioural change communication strategies and inclusive participatory engagement. This will promote dialogue with diverse groups of smallholder-farmers aimed at changing negative, and leveraging on positive, behaviour and attitudes towards CSA technologies. CSA technology development for smallholder-farmers needs to appreciate role of socio-psychological factors in adoption decisions. Further scientific research is required to establish causality between related socio-psychological factors.

Keywords: gender-differentiated, climate-smart agriculture, technology acceptance model, resilience-building, socio-psychological behaviour

1. Introduction

In the 21st century one of the greatest priorities for most governments in sub-Saharan Africa is to ensure climate change adaptation and resilience-building for rural smallholder-farmers. This is important given the risk of gender-differentiated negative impacts of disasters associated with climatic change on agriculture (IPCC, 2014). Thus, the impetus for sub-Saharan Africa and other developing regions is to increase efforts towards reduction of disaster risks, more-so those associated with climatic change (Alexander, 2013, Gaillard and Mercer, 2013, Kelman, 2015). This is more critical for the rural smallholder farming sector which supports the main livelihoods of the majority of the population in many developing countries.

Accordingly, across the African continent climate-smart agriculture (CSA) is being promoted on the basis of its aptitude to increase agricultural productivity ensuring food security and income, adaptation and resilience, while also reducing greenhouse gas emissions (FAO, 2013). This paper is underpinned by an understanding that given the projected negative climatic changes in developing regions, such as in Southern Africa, there will likely be demands for more, new, unfamiliar and innovative CSA technologies that smallholder-farmers will need to take up (Glover et al., 2019). Furthermore, CSA technologies aimed at improving food productivity and resilience-building among smallholder-farmers will also contribute to disaster risk reduction (DRR) (FAO, 2013).

In Africa a deliberate position has been taken to prioritise CSA for food security, adaptation and resilience-building, with less attention paid to mitigation (Williams et al., 2015). This was the first contextualisation of CSA to give it more relevance for Africa, where its merits offer solutions to the various developmental whammies faced by the continent, such as food insecurity, food provision for a growing population and protracted poverty (FAO, 2010, Nelson and Huyer, 2016).

Notwithstanding the macro-level efforts promoting CSA and its value in resilience and adaptation to climate change challenges in smallholder agriculture, response to policy at farmer-level shows a concerning paradox of low adoption. At-risk communities seem less embracive to CSA, yet their agrarian livelihoods are susceptible to climate-related hazards whose frequency and magnitude is likely to worsen (Gebrehiwot and Van Der Veen, 2015). Eiser et al. (2012) aver that technology adoption decisions of individuals are not purely on cost-benefit analysis of alternatives as parsimoniously portrayed in econometric studies, sentiments similarly echoed by other scholars (Akudugu et al., 2012, Andersson and D'Souza, 2014, Glover et al., 2016). Decision-making is more multi-faceted than just the linear, single-step process often advanced in adoption lexicon (Van Hulst and Posthumus, 2016, Glover et al., 2019). Hall and Khan (2003) assert that when adoption is low, new technologies are less likely to improve people's well-being and contribute towards resilience-building.

Even more concerning is low CSA adoption by women smallholder-farmers, given the corollaries of common-but-gender-differentiated impacts of climate change (Arora-Jonsson, 2011, Carr and Thompson, 2014, Doss, 2001, Perch and Byrd, 2015). Any efforts to improve CSA adoption across heterogeneity of smallholder-farmers should be informed by holistic comprehension of the farmers' decision-making process. While previous studies have been conducted to understand the socio-cultural, econometric and technological facets of CSA adoption (Andersson and D'Souza, 2014, Khoza et al., 2019c), assessment of CSA adoption on a micro-level decision-making perspective is scanty. Application of socio-psychological theories in CSA adoption may possibly provide insights into this.

Across the world, various scholars have assessed adoption of a diversity of agricultural technologies using socio-psychological theories. For instance, Van Hulst and Posthumus (2016) applied the Reason Action Approach theory, Lalani et al. (2016) applied the Theory of Perceived Behaviour (TPB) approach on conservation farming in Mozambique, and Martínez-García et al. (2013) used TPB in livestock technology adoption in Mexico. However, Gupta et al. (2012), suggest that there is need for more studies on socio-psychological behaviour in technology adoption in developing regions so as to establish their response to new technologies. Developing regions suffer a deficiency of CSA adoption studies that consider socio-psychological determinants shaping adoption decisions (Martínez-García et al., 2013, Price and Leviston, 2014).

In addition, research focus on socio-psychological behaviour has paid little attention to gender, which has been identified as a gap in scholarship (Lalani et al., 2016, Ngigi et al., 2018). Some authors have suggested , that socio-psychological behaviour and attitudes towards technology adoption could be linked to background factors of gendered-vulnerability (Van Hulst and Posthumus, 2016, Khoza et al., 2019c). Importantly, understanding of gender as a concept needs to include gender perspectives drawn from respective communities. This study theorised that socio-psychological determinants of CSA adoption may be gender-differentiated, hence there is value in examining gender tensions that could exist and interact with adoption decisions.

The existing empirical gap in comprehension of socio-psychological factors in agricultural technology adoption among communities at-risk of climate hazards is also identified (Martínez-García et al., 2013, Zeweld et al., 2018). Gebrehiwot and Van Der Veen (2015) highlight a similar gap in the DRR field. Some scholars have suggested need to examine farmers' decisions from a socio-psychological, rather than socio-econometric, theories in prediction of farmers' behavioural intentions than socio-economic variables perspective (Zeweld et al., 2017). Taken together, such assertions give currency to need for increased application of socio-psychological theoretical lens in understanding gendered nuances of adoption dynamics of new CSA technologies. To bridge the research gap, this paper tests applicability of a socio-psychological theory in ascertaining intricacies of gender-differentiated behaviour and attitudes shaping farmers' decision-making.

Accordingly, the aim of this paper is to share empirical evidence on the gender-differentiated socio-psychological determinants of CSA adoption among at-risk communities faced with increasing climate risk. Thus, this study applied a theoretical model known as the Extended Technology Acceptance Model (TAM2) to assess the socio-psychological behaviour of diverse smallholder-farmers to gain understanding on key determinant constructs for CSA adoption among men and women smallholder-farmers.

This could be a useful model in providing insights into CSA adoption theoretical perspectives. Empirical evidence from the study contributes to literature and practice on role of socio-psychological behaviour and attitudes in adoption of climate-smart technologies. More specifically, this study contributes to the nascent discourse on gender and CSA within DRR framings by sharing insights on gender-differentiated socio-psychological issues in CSA adoption decision-making in communities facing climate risk. In synthesis, the paper conceptualises significance of micro-level socio-psychological perspectives in CSA adoption in enhancing sustainability, effectiveness and people-centredness of CSA, with the ultimate goal of building resilience and enhancing food productivity for smallholder-farmers. Findings unravel need for gender-specific approaches in addressing behaviour and attitudes of diverse smallholder-farmers to inform adoption decisions. Extension methodologies, implementation strategies and policies in CSA would benefit from a clear comprehension of such perceptions from smallholder-farmers. Notably, the study makes a clarion call for governments and donors to formulate transformative and gender-sensitive CSA and DRR policy architecture to tackle dis- and non- adoption.

1.1 Study sites

The study was conducted in two countries, Malawi and Zambia, where smallholder-farmers are facing increasing risk of climate-related hazards. For both countries, smallholder agriculture is significant, contributing at least 70% of agricultural production, and is mostly rain-fed (Arslan et al., 2018). Hence, it is critical for farmers to adapt and be resilient to climate change. This study focused on Chikwawa district, Malawi and Gwembe district, Zambia. Chikwawa lies in the Lower-Shire Valley and Gwembe is on the Middle-Zambezi valley. In terms of rainfall received during the peak farming season, Chikwawa receives between 600-750mm while for Gwembe it is less than 800mm. For the two districts, droughts and floods are typical hazards affecting smallholder agriculture, hence making these areas vulnerable to climate change. In both sites, episodes of floods and droughts have been linked to climate change, for example the devastating El-Nino induced drought in 2016/2017 agricultural season (Nhamo et al., 2019). In the 2017/ 18 season, the two study sites were affected by the Fall Armyworm pest infestation, with Malawi declaring a state of emergency in December 2017. Climatic change was attributed as the causal factor to migration of the pest from Western America to Africa where conditions for its proliferation were increasingly getting favourable (Stokstad, 2017).

2. Extended Technology Acceptance Model (TAM2)

The TAM2 (Figure 1) is touted as one of the influential models in mainstream technology due to its pliability that permits inclusion of various constructs and easily adapted across a variety of disciplines, such as information technology, banking, health and education (Alkhaldi and Al-Sa'di,

2016, Chismar and Wiley-Patton, 2003). According to TAM2, there are two major determinants shaping an individual's beliefs, behaviour and attitude in technology adoption; *perceived usefulness* (PU) and *perceived ease of use* (PEOU) (Dutot, 2015). When an individual's perceptions are that a particular technology will enhance their job performance it is referred to as PU (Chismar and Wiley-Patton, 2003) and when they believe that use of a specific technology will be free from effort, it is referred to as PEOU. According to TAM2, the PEOU of a technology directly influences its PU (Dutot, 2015), and ultimately, based on the PEOU and PU, an individual may have or not have *intention to use* the technology and adopt it, which in itself leads to *actual usage behaviour*.

TAM2 further states that four cognitive factors; job relevance, output quality, result demonstrability and PEOU all determine PU (Tarhini et al., 2014). By extension in CSA adoption this paper theorises that PU will be extent to which smallholder-farmers believe CSA technologies and practices enhance performance of their farming activities. Whilst it may almost seem impossible to think of CSA technology being void of smallholder-farmers' efforts, in this case PEOU was theorised as a farmer's beliefs that CSA technology will not bring additional drudgery (Farnworth et al., 2013).

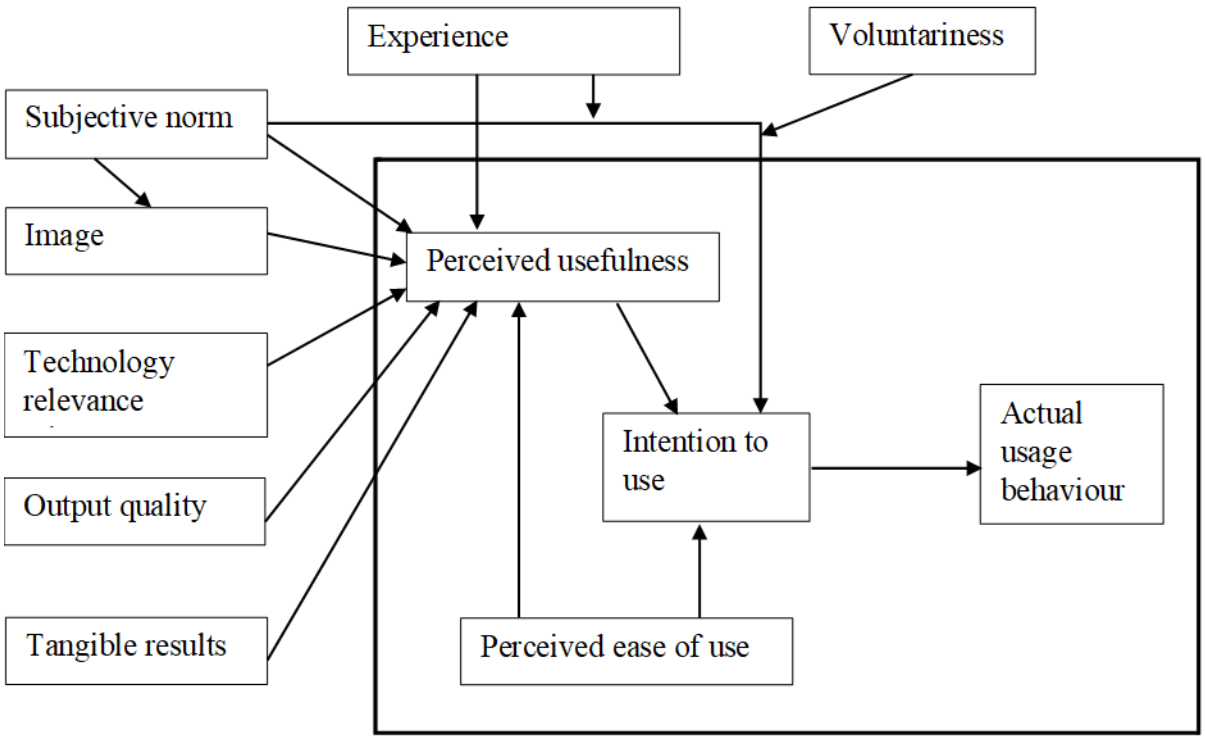

Figure 1 : Extended technology acceptance model (Chismar and Wiley-Patton, 2003)

Job relevance is described as an individual's perception on technology's relevance to their objectives (Dutot, 2015). For purposes of this study and to provide clarity to smallholder-farmers, job relevance was replaced with *technology relevance*, and for purposes of this study this was taken as smallholder-farmers' perceptions on relevance of a particular CSA technology to their farming and livelihood objectives. TAM2 also considers the *output quality* where individuals form perceptions about a technology based on its execution of certain tasks to do with their functions (Chismar and Wiley-Patton, 2003). In this study output quality was considered as farmers' perception on ability of CSA technology to execute desired farming tasks. The model also recognises that an individual's behaviour or attitude towards a particular technology may also be determined by perceived *tangible benefits* derived from use of a particular technology. This is the result demonstrability component of the TAM2 (Tarhini et al., 2014). In CSA adoption this is substantial for smallholder-farmers as they would consider the tangible benefits they stand to gain with adoption and use of CSA. This is critical, given that predictions on climate change impacts are that smallholder agrarian livelihoods will most likely be negatively impacted and there may be significant losses in productivity and incomes. Smallholder-farmers may likely adopt and use technologies that give them tangible benefits, enhancing their adaptation and resilience, ultimately improving their livelihoods.

In addition, three social factors influence PU; subjective norm, image and voluntariness. The basis of social determinants is that adoption decisions are made within the context of existing social influences (Lalani et al., 2016). *Subjective norm* is when an individual's perception and decision to adopt a technology is informed by other people whose opinion on use of the particular technology is important (Chismar and Wiley-Patton, 2003). Chismar and Wiley-Patton (2003) also state the *image* construct as when an individual perceives that use of a technology will raise their status within their social groups. Such a scenario of perceptions may prevail in CSA adoption where some smallholder-farmers could think that use of CSA technology could raise their status. *Voluntariness* is defined as degree to which a person will perceive decision to use a technology as non-mandatory. To smallholder-farmers this is extent to which they decide to use CSA on their own, without any mandatory requirements to be fulfilled. Lastly, the *experience* construct considers an individual's prior interaction with the technology, for example if the smallholder-farmer has used any CSA technology before.

3. Methodology

3.1 Data collection procedure

An exploratory-sequential mixed methods research design (Tashakkori and Teddlie, 2010) was used, which allowed collection of qualitative data through key informant interviews (KIIs) and

focus group discussions (FGDs) in the preliminary phase, subsequently followed by a quantitative phase. The qualitative phase was significant because through it a better understanding of the real-life context and perspectives, which could not be captured statistically, were identified and explored quantitatively for generalisability.

3.2 Sampling, data collection and instruments

Mixed methods sampling (Teddlie and Tashakkori, 2009, Creswell, 2014) was used where for qualitative phase, key informants and focus group discussants were purposively sampled based on their knowledge of gender, CSA and climate-related issues in agriculture. In the quantitative phase random sampling was used to select households to participate in the study.

Qualitative data was collected from a total of 16 KIIs and six FGDs in the two study sites. KIIs were conducted at district level with government department officials, traditional leaders and NGOs in Chikwawa and Gwembe, while FGDs were conducted at traditional authority and ward levels in Chikwawa and Gwembe respectively. In each site three FGDs were held, men only, women only and one mixed gender, with participation from at least 54 individuals. For quantitative data collection an instrument was developed based on findings from qualitative data analysis, and administered to a total of 102 households between the two study sites. The study developed its own set of questions in the tool, and conventional questions used in the TAM2 were not included. In both sites the instrument was pre-tested to ensure that identified socio-psychological constructs were sufficiently explored.

3.3 Measurement of variables

Themes identified in qualitative phase were explored as variables of the TAM2 in the quantitative phase. Identified variables were all measured using a 5-point Likert scale, from 1 (strongly disagree) to 5 (strongly agree). Beliefs were assessed through questions exploring farmers' PU, PEOU and PCR. PU was assessed through questions asking whether CSA technologies were better than conventional practices, whether they thought CSA could enable them to produce more food for their families, and for sale to earn income, and whether they thought CSA could improve their yields or productivity in bad seasons. To establish PEOU farmers were asked questions on whether they thought CSA technologies were easy to use, whether they constantly had to depend on extension support to be able to use CSA and whether they found CSA technologies difficult to implement in comparison to their conventional ways. PCR was explored through questions that asked whether farmers thought there was need to adopt CSA, or they thought frequency and magnitude of climate related hazards was increasing, if they thought there was need for them to adopt CSA to help them adapt to climate change and to help them improve food security.

Cognitive processes were explored through questions on experience (EXP), technology relevance (TECH) and tangible benefits (TANG). EXP was established through asking questions on whether farmers found it easy to adopt new CSA technologies, that they would be confident in practising new CSA and that they thought CSA concepts were easy to understand. Questions on TECH explored whether CSA was able to meet farmers' farming and livelihood goals, and whether farmers were satisfied with CSA technology options that were available. TANG was assessed through questions on whether farmers were deriving more benefits from CSA than from conventional practices and whether they were seeing or would see any improvements in their lives through practising CSA.

Social processes were explored through questions on subjective norm (SUB) and voluntariness (VOL). Questions for SUB sought to identify whether adoption decisions were influenced by family members, friends, neighbours, extension staff from either government or NGOs, there was no influence from anyone, and whether farmers would influence others to adopt CSA. VOL was explored through questions on whether farmers' adoption decisions were influenced by conditions to benefit from government or NGO CSA projects, or motivation was because they wanted to improve their livelihoods.

Intention (INT) to use CSA was established through questions that assessed whether farmers intended to continue using CSA even when there was no existing government or NGO funded project, and whether they were open to adopt CSA technologies that may be promoted in future. Actual use behaviour (ACT) explored whether farmers would practice CSA without external support from NGOs or government CSA projects. These variables were explored in the two sites with a total of 102 farmers. Since this was a component of a larger study, demographics and socio-economic characteristics were not addressed in this particular paper. Both qualitative and quantitative findings are presented in the following section.

3.4 Quantitative data analysis

The data analyses were performed with the open-source freeware software suite jamovi 1.0.7.0 (Jamovi, 2019). Specifically, correlations (r) were generated between the scores of all of the variables. The values of correlations were considered in terms of statistical significance and the effect size rule of thumb where correlations of 0.30 and above are considered a medium effect size and 0.50 and above considered a large effect size (Cohen, 1992). Furthermore, to explore potential gender-difference in mean scores of the variables, Mann-Whitney U-tests were conducted. For Mann-Whitney U-tests, significance of the results as well as the effect size for the difference in median were considered. The effect size was Cohen's d which indicates small ($d \geq 0.20$), medium ($d \geq 0.50$) and large effect ($d \geq 0.80$) sizes for the difference (Cohen, 1992). For

both techniques, the data were considered to be non-normally distributed and the cut-off for statistical significance was set at the 95% level that is $p < 0.05$.

4. Findings

Tables 1 and 2 present results from the correlation analysis for men and women household-heads respectively, to establish relationships between constructs. Tables 3 and 4 present results from the Mann-Whitney U tests conducted by household-head and by country respectively.

4.1 Beliefs determining CSA adoption

4.1.1 Perceived ease of use

Results showed similarities for women and men household-heads in the relationship between PEOU and PCR (Women: r=-0.731, p<0.001 Men: r=-0.497, p<0.001). This means that for both, their perceptions for climate risk negatively affected their views that CSA technology would be easy to use free from additional labour requirements. Relationship between PEOU and technology relevance for women and men (r=0.581, p=0.011 r=0.300, p=0.006 respectively) means for both their perceptions that a technology is easy to use with minimum additional labour requirements, are likely to positively influence their perceptions that the particular technology actually helps them achieve their farming and livelihoods objectives. In contrast to women, for men a relationship was also observed between PEOU and tangible benefits (Men: r=0.467, p<0.001) showing that for men their views towards ease of use of CSA technology were determined by tangible benefits they saw from practising CSA. This confirms qualitative findings which established that farmers needed CSA technologies that would not bring additional labour requirements as was summarised by women who participated in a mixed gender FGD in Malawi;

> *'Conservation agriculture is difficult to do, especially for those of us without men to help us because it involves a lot of work'*

In Zambia women added that conservation agriculture labour requirement was *'too much, when we already have so much more to do'*.

4.1.2 Perceived usefulness

For this construct a contrast was observed between women and men. For women a strong positive relationship was shown to exist between PU and intention to use (r=0.648, p=0.017). These results which also corroborate with original TAM2, show that when women view CSA technology as enhancing the performance of their farming activities, they were likely to want to continue using it in future. The relationship with PCR (r=0.584, p=0.036) also shows that for

women usefulness was considered in relation to contribution of CSA in reducing climate risk impacts on their livelihoods. Results also showed a strong negative relationship between PU and voluntariness for women (r=-0.689, p=0.009), in divergence from TAM2 which states that PU positively influenced voluntary adoption of a technology. The contrast of our findings could be indicative of limited decision-making power of women farmers where even when they thought CSA could enhance farming activities they could not voluntarily decide as men were likely to make the adoption decision. For men all relationships for this construct were statistically not significant. The statistical results colluded with qualitative findings that highlighted importance that farmers place on PU.

4.1.3 Perceived climate risk

Another contrast was observed between men and women HHHs here, where for the latter all relationships were not statistically significant. However, for men results showed both positive and negative relationships, between PCR and voluntariness (r=0.357, p<0.001), subjective norm (r=0.242, p=0.026), actual usage behaviour (r=-0.311, p=0.004) and intention to use (r=-0.224, p=0.041). Climate risk seems more significant to men than women. PCR was a new construct not found in the original TAM2, yet in this study this emerged as a key determinant due to climate-related risks that farmers are exposed to. The results also suggest that men could be more likely to share and influence each other to adopt CSA based on PCR. This could also be related to the skewed access to climate change and risk information which is more accessible for men than women. In their study, (Belay et al., 2017) also established the role of risk perceptions in adoption decisions.

4.2 Cognitive processes determining CSA adoption

4.2.1 Experience

Among men a positive relationship exists between experience and voluntariness (r=0.307, p=0.004) and subjective norm (r=0.334, p=0.002), while a negative relationship was observed with actual use (r=-0. 423, p<0.001). These results show that having prior good experience with other CSA technologies is likely to make men more predisposed to voluntarily adopt new CSA and make them advocate for others to adopt, while any bad experiences were likely to demotivate them from CSA adoption. This confirmed qualitative findings that previous experience with CSA mattered in CSA adoption, and farmers could serve as influencers to others based on their own experiences, which included tangible benefits derived from CSA. These findings are similar to Ainembabazi and Mugisha (2014) who established that experience was key in adoption of new agricultural technologies, and consistent with TAM2 applied in Chismar and Wiley-Patton (2003).

Table 1: Correlation Matrix Households headed by Men

		expTOT	actTOT	intTOT	volunTOT	subTOT	pcrTOT	techTOT	tangTot	useTOT	easeTOT
expTOT	Spearman's rho	—	-0.423	-0.091	0.307	0.334	-0.006	-0.120	-0.132	-0.067	-0.130
	p-value	—	< .001	0.413	0.004	0.002	0.957	0.278	0.231	0.657	0.238
actTOT	Spearman's rho		—	0.442	-0.783	-0.795	-0.311	-0.061	0.307	NaN	0.126
	p-value		—	< .001	< .001	< .001	0.004	0.582	0.004	NaN	0.255
intTOT	Spearman's rho			—	-0.457	-0.474	-0.224	-0.219	0.172	-0.205	0.006
	p-value			—	< .001	< .001	0.041	0.045	0.117	0.172	0.953
volunTOT	Spearman's rho				—	0.922	0.357	0.174	-0.403	-0.001	0.010
	p-value				—	< .001	< .001	0.113	< .001	0.994	0.930
subTOT	Spearman's rho					—	0.242	0.036	-0.416	0.162	-0.038
	p-value					—	0.026	0.748	< .001	0.281	0.730
pcrTOT	Spearman's rho						—	0.443	0.266	0.096	0.497
	p-value						—	< .001	0.014	0.525	< .001
techTOT	Spearman's rho							—	0.318	0.132	0.300
	p-value							—	0.003	0.383	0.006
tangTot	Spearman's rho								—	0.160	0.467
	p-value								—	0.288	< .001
useTOT	Spearman's rho									—	0.150
	p-value									—	0.318
easeTOT	Spearman's rho										—
	p-value										—

Table 2: Correlation Matrix for Households headed by Women

		actTOT	intTOT	volunTOT	subTOT	pcrTOT	techTOT	tangTot	useTOT	easeTOT
actTOT	Spearman's rho	—	0.044	-0.831	-0.759	0.076	-0.229	0.080	NaN	0.102
	p-value	—	0.864	< .001	< .001	0.765	0.361	0.751	NaN	0.687
intTOT	Spearman's rho		—	-0.275	-0.348	0.423	0.326	0.263	0.648	0.305
	p-value		—	0.270	0.157	0.080	0.187	0.292	0.017	0.218
volunTOT	Spearman's rho			—	0.733	-0.298	-0.024	-0.132	-0.689	-0.235
	p-value			—	< .001	0.230	0.926	0.603	0.009	0.347
subTOT	Spearman's rho				—	-0.421	0.146	-0.131	-0.408	-0.383
	p-value				—	0.082	0.564	0.605	0.166	0.117
pcrTOT	Spearman's rho					—	0.442	0.623	0.584	0.731
	p-value					—	0.066	0.006	0.036	< .001
techTOT	Spearman's rho						—	0.344	0.440	0.581
	p-value						—	0.163	0.132	0.011
tangTot	Spearman's rho							—	0.278	0.438
	p-value							—	0.357	0.069
useTOT	Spearman's rho								—	0.452
	p-value								—	0.121
easeTOT	Spearman's rho									—
	p-value									—

4.2.2 Technology relevance

Correlation results showed that among men a positive relationship was observed between CSA technology relevance and PCR (r=0.443, p<0.001), suggesting men were likely to adopt CSA when they viewed technologies as relevant to their farming aspirations, helping them meet their livelihood goals. A negative correlation observed with intention to use (r=-0.219, p=0.045) is indicative of likelihood that men farmers would not continue to use CSA if they thought it was irrelevant for their livelihoods. For women all the relationships were not statistically significant. These results substantiated qualitative findings that had established that in their decisions to adopt or not, farmers considered whether a particular CSA technology was useful and applicable to their situations and contexts. Consideration of CSA technologies that were introduced to farmers to help them adapt to drier conditions for instance, needed to go beyond the agricultural scope. For instance, in Chikwawa in an irrigation scheme it emerged that treadle pumps were not a preferred technology for married women firstly because the pumping routine was physically exhausting and *'by the time we get home we are too tired to fulfil our conjugal role to our husbands resulting in fights'* (Women only FGD, Chikwawa). Secondly, the pumping was seen to be culturally inappropriate by the women who wear skirts and dresses beneath a *chitenge* (a cloth wrapped over the skirts) and felt the up-and-down treadling motion exposed their legs, which was culturally inappropriate. These findings extend assertions by (Doss, 2001) and (Sumberg et al., 2003) on need to ensure participation of farmers, especially women in technology development.

4.2.3 Tangible benefits

Correlation results showed a similarity on relationship with PCR (women r=0.623, p=0.006 Men: r=0.266, p=0.014), meaning for both men and women when PCR was high farmers were likely to desire more tangible benefits derived from CSA. In contrast other relationships were established for men which were not significant for women. There was positive correlation with actual usage behaviour (r=0.307, p=0.004) and technology relevance (r=0.218, p=0.003), and negative correlations with subjective norm (r=-0.416, p<0.001) and voluntariness (r=-0.403, p<0.001). These results all emphasise importance placed by farmers on need to see tangible benefits from CSA for them to adopt, and that in the absence of tangible benefits then farmers could be dissuaded from adopting by influencers around them. This substantiated qualitative findings stating that farmers, irrespective of gender, needed *'to be introduced to a technology, use it and appreciate the benefits of adoption'* (KII, Gwembe). While these findings contrast the original TAM2, which states influence of results demonstrability through tangible benefits (Chismar and Wiley-Patton, 2003), there is value in the results that show demand for tangible benefits where climate risk is perceived.

4.3 Social processes determining CSA adoption

4.3.1 Voluntariness

Similar results for women and men showing a significant strong negative correlation with actual usage behaviour (Women: r=-0.831, p<0.001 Men: r=-0.783, p<0.001). Another negative relationship was observed for men with voluntariness and intention to use (r=-0.457, p<0.001). However, a positive correlation with experience was seen for men (r=0.307, p=0.004). These results show that actual usage behaviour and intention to use CSA was involuntary, and this could be linked to sentiments of CSA adoption being driven by NGOs and government project where it was mandatory for farmers to adopt CSA in order to benefit from CSA projects. Actually, authors such as Glover et al. (2016) and Andersson and D'Souza (2014) do suggest that farmers' volitions on CSA could be masked by 'conditional' adoption where farmers uptake of CSA is on the basis of project-based support.

4.3.2 Subjective Norm

Correlation results were similar for both women and men between subjective norm and voluntariness (Women: r=0.733, p<0.001 Men: r=0.922, p<0.001) and actual usage behaviour (Women: r=-0.759, p<0.001 Men: r=-0.795, p<0.001). Different results for men were also noted for relationship with experience (r=0.334, p=0.002) and intention to use (r=-0.474, p<0.001). These results show that social influence by others has potential to drive farmers to voluntarily adopt CSA, while at the same time there is potential for farmers' intention to use and actual usage behaviour in CSA to be negatively influenced by social referents. Qualitative findings emphasised role played by influencers, mainly extension workers and lead farmers, in driving CSA adoption. These findings are consistent with other studies that applied a socio-psychological theoretical lens to adoption (Al-Mamary et al., 2016, Ashraf et al., 2014).

4.4 Intention and CSA actual usage behaviour

Results suggest that among men a relationship exists between intention to use and actual usage behaviour (r=0.442, p<0.001). This is consistent with original TAM2 that states behavioural intention will actually lead to adoption and use of CSA. For women, this relationship was not statistically significant. Among men a negative relationship between actual usage behaviour and previous experience in CSA was also established (r=-0.423; p<0.001), while for women correlation results for actual usage behaviour were not statistically significant. This means where men had previously had a bad experience with CSA, this negatively affected their behaviour to actually adopt and use CSA in future, which was also highlighted in qualitative findings where respondents stated;

'when farmers have bad experience, such as loss of surplus yields because of lack of viable markets, they are likely not to adopt CSA in future to guard against losses unless the issue of markets is addressed' (mixed gender FGD, Gwembe).

Findings of Mann-Whitney U tests by household-head gender (Table 3) show that from the two sites men scored experience and intention to use more highly than women (*expTOT*: Mann-Whitney U=501, *p*=0.024, Mean difference 1.000; *intTOT*: Mann-Whitney U=488, *p*=0.010, Mean difference=1.000). This suggests that for men experience is most likely to influence CSA adoption, and their intention to use could be higher than women. For women voluntariness and subjective norm seem to be more key in determining CSA adoption as they ranked it higher than men (*volunTOT*: Mann-Whitney U=454, *p*=0.005, Mean difference -2.000; *subTOT*: Mann-Whitney U=430, *p*=0.004, Mean difference=-4.000). These results indicate that for women, social processes were more likely to determine CSA adoption, especially subjective norm. These results collude with qualitative findings where it emerged that some NGO projects specifically targeted women.

Given that the findings so far were a universal presentation of the two study sites, further analysis with Mann-Whitney U test established that by study site (Table 4), Gwembe scored PCR, technology relevance, tangible benefits and PEOU, more highly than Chikwawa (*pcrTOT*: Mann-Whitney U=456, *p*<0.001 Mean difference 1.000; *techTOT*: Mann-Whitney U=460, *p*<0.001, Mean difference=1.000; *tangTOT*: Mann-Whitney U=196, *p*<0.001, Mean

Table 3: Independent Samples T-Test for Household-heads

		statistic	p	Mean difference	SE difference	Cohen's d
expTOT	Mann-Whitney U	501	0.024	1.000		0.5673
actTOT	Mann-Whitney U	684	0.455	4.81e-5		0.1891
intTOT	Mann-Whitney U	488	0.010	1.000		0.6984
volunTOT	Mann-Whitney U	454	0.005	-2.000		-0.4907
subTOT	Mann-Whitney U	430	0.004	-4.000		-0.6535
pcrTOT	Mann-Whitney U	651	0.295	-1.31e−5		-0.2757
techTOT	Mann-Whitney U	612	0.177	-5.50e−5		-0.4255
tangTot	Mann-Whitney U	594	0.147	-1.000		-0.3830
easeTOT	Mann-Whitney U	736	0.855	-2.54e−5		-0.0149
useTOT	Mann-Whitney U	290	0.868	-5.40e−5		0.1809

difference =3.000; *PEOU*: Mann-Whitney U=354, p<0.001, Mean difference=2.000). These results suggest a possibility that for Gwembe, a combination of both beliefs and cognitive processes could be more key in determining decision to adopt CSA, than for Chikwawa. However, this test only provides differences between the groups, it remains a very big assumption whether it was a combination or a determinant.

Table 4: Independent Samples T-Test for Study Sites

		statistic	p	Mean difference	SE difference	Cohen's d
expTOT	Mann-Whitney U	1243	0.700	-4.79e−5		-0.0529
actTOT	Mann-Whitney U	1292	0.946	5.80e-5		0.0316
intTOT	Mann-Whitney U	1219	0.550	9.77e-6		0.1306
volunTOT	Mann-Whitney U	1283	0.901	-4.45e−6		0.1540
subTOT	Mann-Whitney U	1133	0.259	-2.000		-0.1464
pcrTOT	Mann-Whitney U	456	< .001	1.000		1.4881
techTOT	Mann-Whitney U	460	< .001	1.000		1.2364
tangTot	Mann-Whitney U	196	< .001	3.000		2.1453
ease4	Mann-Whitney U	354	< .001	2.000		1.6998
useTOT	Mann-Whitney U	241	0.004	3.000		0.6806

5. Discussion

The study tested applicability of socio-psychological theory in understanding gender dynamics in CSA technology adoption among smallholder-farmers facing increasing climate risk, using the TAM2. Findings show that through application of socio-psychological theories in CSA adoption, behavioural and attitudinal differences between men and women household-heads, which shape their adoption decisions, are unravelled. Belief processes shaping smallholder-farmers' decisions on CSA were identified as PU, PEOU and PCR. The original TAM2 model identifies just the PU and PEOU (Chismar and Wiley-Patton, 2003), but from study findings the model was extended to include PCR. The pliability of the TAM2 model allows for such extension. When juxtaposed with other studies applying socio-psychological theories, study findings concur with assertions made by Yazdanpanah et al. (2014). Their case study assessment of farmers' behaviour and intentions in adoption of water conservation technologies states that risk perceptions do influence behaviour and actual use of new technology. Findings of this study also concur with Belay et al. (2017) who highlight that in the context of climate change farmers' perceptions of climate risk may lead them to pursue resilience and adaptation options. This study reifies the importance of understanding men and

women farmers' perceptions of climate risk as it plays an important factor in decision-making as shown in the results.

Findings show the central role of social influences in CSA adoption for both men and women where some of the strongest relationships were identified between social constructs such as subjective norm and voluntariness, and their influence on actual usage behaviour. This shows gender-wide critical role of social influences in shaping attitudes and behaviour for CSA adoption. Findings highlighting negative influence of subjective norm and voluntariness on actual usage behaviour should be a cause for concern to both policy-makers and practitioners. Additionally, strong positive relationship between subjective norm and voluntariness indicates power of influential role of significant others. Subjective norm plays an important role in driving decisions by farmers to voluntarily adopt CSA, hence need for strategies to harness the power of social mobilisation in CSA. Subjective norm, through negative peer pressure where farmers may discourage each other from use of CSA based on negative experience, may also affect voluntariness. Taken together, these findings show power of social influence in ability to mobilise for or against CSA adoption decisions in both men and women. Ngigi et al. (2018) refer to this as the potential for collective action in adaptation.

There is need to identify more social referents, who can be used especially at community level to disseminate information and drive behavioural change. From study findings, in families, neighbourhoods or as friends, farmers were not influencing each other to adopt CSA. This could be a gap that everyone involved in CSA needs to address. This paper submits that strategies to improve CSA adoption need to leverage on other existing social influencers in communities who could also be used as a vehicle to disseminate CSA information. Social influencers, such as traditional leaders, religious leaders, and ordinary CSA adopters and community-based disaster-risk management committees, can be used to drive behaviour change among farmers regardless of gender. The impetus is upon policy-makers and practitioners to ensure optimisation of benefits of social collection and curtail the negatives. More importantly, social influence needs to be anchored on inclusive participation, multi-directional farmer-engagement processes, and empowerment and tackle entrenched gender inequality.

This study accentuates need for both practitioners and policy-makers to refrain from unidirectional top-down CSA approaches that may actually perpetuate inequality and skewed power dynamics. In being multi-directional and inclusive, CSA technology development can allow farmers to give input in the technology development process, engendering considerations for culture, power, inequality that shape socio-psychological behaviour. This paper extends assertions by Doss (2001) on the critical need for involvement of farmers in

technological development process which may improve adoption. Further assertions that involvement and engagement needs to be participatory and provide space for perspectives from heterogeneous farmers, especially women are made. For instance, had all farmers, including women been engaged in use of the treadle pump as a water extraction device in the irrigation schemes, then some of the cultural concerns they raised would have been considered and solutions identified. This paper argues that farmers' participation in CSA should not be limited to trainings and field days where they generally remain recipients of CSA information, and underscore need for active participation of men and women in CSA technology development, or development of any other DRR technologies for that matter.

Active participation in social influence processes needs to be supported by a multi-directional flow of information. Qualitative findings in this study show dominance of uni-directional top-down communication approaches, with minimum space for bottom-up feedback and engagement. This paper posits that there is need for promotion of multi-directional flow of CSA relevant information such as tangible benefits, climate risks, and feedback especially on negative experiences with CSA technologies or failures. Importantly, a DRR focus on CSA may bring to the fore critical issues of risk-informed decision-making in CSA adoption. There needs to be information flow that enables farmers to voluntarily engage in CSA, without specific attachment to NGO or government projects.

Facilitation of multi-directional flow of information among farmers and practitioners should aim to achieve behavioural change that will see more farmers decide to adopt CSA. Based on empirical evidence the paper asserts importance of behavioural change communication targeted at transforming negative behaviour likely to shape decisions against CSA adoption. Behavioural change and farmer engagement processes will facilitate meaningful farmer participation (Gebrehiwot and Van Der Veen, 2015). Accordingly, behaviour change communication (BCC) needs to be gender-specific to meet communication and information needs across heterogeneity of smallholder-farmers. Evidence showed that for women perceptions of climate risk also shaped their adoption decisions. Therefore, this paper makes submission that BCC needs to also incorporate essential climate risk information with elaborations on how smallholder livelihoods are likely to be negatively affected, and possibility of CSA options as a panacea. To further enhance information access that is likely to dismantle negative attitudes towards CSA adoption, information also needs to be packaged to cater for different literacy levels of farmers. An oversight on this may mean behavioural and attitudinal barriers to CSA adoption may persist.

In synthesis, this study substantiates a notion by Yazdanpanah et al. (2014) who caution against a tendency of 'smearing farmers out across a behavioural and attitudinal spectrum'.

This paper reifies importance of consideration of diversity of farmers, contexts, attitudes and behaviour, which should all be considered in technology development. A universal approach to CSA that is devoid of socio-psychological dimensions may proliferate low adoption, especially among women. At the same time, a singular focus on just the socio-psychology around decision-making in CSA is not advised. Rather, there is need for an equitable approach to CSA anchored on multi-faceted decision-making landscape for smallholder-farmers. A holistic and inclusive approach may bolster CSA adoption especially by women smallholder-farmers.

6. Conclusions

The paper shares critical insights on gender-differentiated socio-psychological issues that can be harnessed as a vehicle to steer improvements in CSA adoption by smallholder-farmers, whilst at the same time drawing attention to those entrenched obstacles that need to be tackled to improve policy response at farmer-level. While the study itself focused specifically on CSA, the DRR lens applied in CSA allows us to also make contribution to DRR scholarship where application of socio-psychological theories in adaptation and resilience-building of farmers remains scanty. Governments in developing regions need to articulate requirements for participatory and inclusive farmer engagement processes in introduction of novel or unfamiliar CSA or DRR technologies to smallholder-farmers. Taken together, this study contributes to policy design with regards to generation and dissemination of gender-sensitive CSA and DRR technologies. Additionally, the study also informs future research and development on gender-sensitive CSA technologies which will ensure that production, adaptation and resilience needs of all types of smallholder-farmers can be met in cost-effective, efficient and sustainable technology development and innovation pathways. Lastly, the paper reiterates that gender still matters and remains a critical analytical unit in developing societies, especially in the face of global environmental challenges such as climate change. Gender-focused research needs to build an essential evidence base for gender-sensitive policy direction and implementation.

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Chapter 6: Gender-Sensitive Climate-Smart Agriculture Adoption Framework

Article 4 Rethinking climate-smart agriculture adoption by smallholder-farmers: A proposed new gender-sensitive adoption framework

Article accepted for inclusion as book chapter in in the upcoming African Handbook of Climate Change Adaptation: Learning, Sharing and Advancing Efforts to Promote Climate Change Adaptation in Africa.

Rethinking CSA adoption by smallholder farmers: A proposed new gender-sensitive adoption framework in a changing climate

Sizwile Khoza, Dewald van Niekerk and Livhuwani Nemakonde[1]

Abstract

This paper identifies need for holistic comprehension of gender-differentiated climate-smart agriculture (CSA) adoption by smallholder-farmers who are at the frontline of climate-related hazards and disasters in Africa. CSA adoption is dominantly informed by a parochial linear approach to farmers' decision-making process. Notably, the second CSA pillar on resilience-building and adaptation, which can offer a broader understanding of the CSA adoption nuances, receives less attention in adoption investigations at farmer-level. To appreciate CSA adoption from a resilience perspective, this paper situates resilience-building within the interconnection of CSA and disaster risk reduction, and applies a resilience perspective in a gendered approach to CSA adoption by smallholder-farmers. Through literature and primary data collected in an exploratory-sequential mixed methods design, this paper presents a proposed normative gender-sensitive CSA adoption framework to guide CSA implementation strategies and policies. The framework is anchored on resilience-thinking, and some of its key components include; gender-sensitive CSA technology development, risk-informed decision-making by heterogeneous smallholder-farmers, gender-sensitive enabling factors, resilience strategies, gender equitable and equal ownership, control of, and access to, resilience capitals. The proposed framework can be used to improve CSA adoption by smallholder-farmers by addressing gendered-vulnerability and inequality that influences low adoption.

Keywords climate smart agriculture • disaster risk reduction • gender • adoption • resilience • framework

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1. Introduction

The developmental challenges presented by increasing climate risk in Africa are undeniable, with sub-regions such as Southern Africa categorised as climate change hotspots (Müller et al., 2014). The impetus is to find solutions to the whammies presented by climate change-related disasters affecting smallholder-farmers. In the five most recent agricultural seasons, Southern Africa has faced some of the most devastating, unprecedented climate change related disasters, such as the floods in the 2014/ 2015 that affected Malawi (Murray et al., 2016), El-Nino Southern Oscillation-induced drought of 2015/2016 (Nhamo et al., 2019), the Fall Armyworm infestation of 2017/2018 (Banson et al., 2019) and Cyclone Idai and Kenneth in 2018/2019 season. Even more concerning are the disaster impacts on the smallholder farming sector, which in most African countries is estimated to constitute at least 70 percent of the population (Morton, 2007). In Africa the agricultural sector accounts for at least a third of gross domestic product (GDP) (Diao et al., 2010). Furthermore, women seem to be the primary actors in smallholder farming, producing at least 60 percent of food crops (Mehra and Rojas, 2008).

Thus, it is unsurprising that current development discourse in Africa is seized with exploring resilience-building strategies for smallholder farming households to climate-related disasters (Bernier and Meinzen-Dick, 2014, Speranza et al., 2014). With each climate-related disaster, there is growing need to transform from conventional agricultural farming towards new, unfamiliar and uncommon farming technologies that are perceived to contribute towards resilience-building. It is for this reason that climate-smart agriculture (CSA) has gained eminence as a possible panacea to the developmental challenges presented by climate change specifically in smallholder farming in Africa (Arslan et al., 2018, Asfaw et al., 2015, FAO, 2013). CSA recognises that climate change amplifies developmental challenges, hence its conceptualisation based on the three pillars, viz., 1). improved food and agricultural productivity, 2). resilience-building and adaptation, 3). mitigation through reduction of greenhouse gas emissions from agricultural activities (Asfaw et al., 2015, Chandra et al., 2017a, FAO, 2013). Therefore, CSA is a livelihoods oriented integration of the triple wins of sustainable intensification, resilience-building and climate mitigation (Taylor, 2018) and adoption of CSA technologies and strategies provides one option for resilience-building.

Consequently, there is growing focus of research on adoption of CSA technologies by smallholder-farmers (Barnard et al., 2015, Kpadonou et al., 2017, Mango et al., 2018, McCarthy et al., 2011, Nyasimi et al., 2017), although there still exists some gaps in the understanding of CSA adoption. The study sought to gain an in-depth understanding of the tensions between gender inequality and CSA adoption, and existing limitations to achieving

resilience through CSA. A resilience perspective entrenched on the CSA pillar to build resilience and adaptation of smallholder-farmers was applied in this study which was conducted in two regions sharing almost similar disaster profiles in Malawi and Zambia. Study findings show that low CSA adoption can be attributed to gender-disparities in ownership of resilience capitals, inadequate provision for equal participation of smallholder-farmers in CSA technology development, lack of diverse CSA options that farmers could adopt and the failure to sustain household food security, income generation and improved quality of life through CSA. This paper accentuates that increasing climate risk compels exploration of measures to address identified shortcomings of CSA. Furthermore, the paper emphasises heightened need to pursue alternative gender-sensitive pathways that may help address gender-disparities whose prevalence in smallholder-farming societies continues to be a barrier not only to CSA adoption, but to resilience-building in the face of climate change as well. Hence, in pursuit of alternative approaches to address the barriers to CSA adoption and increase its uptake by smallholder-farmers, this study presents a normative gender-sensitive CSA adoption framework that can be adapted and used in developing regions, ultimately contributing towards resilience-building.

The ingenuity of the proposed framework is its framing on a resilience perspective to understand and transform gender imbalances constraining CSA adoption, and its people-centredness that suits it for operationalisation at the local levels. The proposed framework advocates for gender-sensitive engagement of smallholder-farmers in CSA technology development, in generation and access to risk information to assist farmers to make risk-informed decisions. This requires enabling factors and strategies to be put in place to address gender inequality and vulnerability, as well as gender disparities in ownership and access to resilience capitals. More-over, the paper submits that gender-equitable resilience should be pursued within CSA, and prominence of gender mainstreaming, CSA and resilience in development lexicon (Bahadur et al., 2010, Béné et al., 2016, Dixon and Stringer, 2015, Speranza et al., 2014) give currency to such undertakings. Ultimately, in taking a resilience perspective to CSA, this paper contributes to the under-explored inter-connection between CSA and DRR which may better inform CSA implementation, policies and research in future. The proposed framework also seeks to fill a theoretical gap in the gender-CSA-DRR nexus. While other scholars have not specifically acknowledged the challenges of an atheoretical disjuncture, it remains essential that any attempt to improve CSA adoption be informed by an appreciation of its shortcomings.

2. Critiques of CSA

Conceptualisation of CSA envisioned that humanity could tackle some of its developmental challenges such as negative impacts of climate change, population growth with corresponding increases in food demand, poverty and sustainable development (Williams et al., 2015). Unfortunately, despite its positive attributes CSA has also been met with some scepticism that cannot be ignored in a gendered approach to CSA adoption. Chief among some of its criticisms is insufficient consideration of power relations and inequalities (Chandra et al., 2017b). While Taylor (2018) also considers power and disparities at a global level between countries of the North and the South, this paper considers these aspects at farmer-level. Further dissentions over CSA emanate from its failure to promote participation of local communities, with technologies and research dominantly uni-directional and top-down (Chandra et al., 2017a). Other scholars caution that when CSA fails to pay attention to social issues then its implementation may actually magnify pre-existing social imbalances such as gender inequality (Collins, 2017, Murray et al., 2016). When considered within the context of the pivotal role played by women in smallholder farming, current CSA scholarship has insufficiencies when it comes to appreciation of gender dimensions in the CSA adoption decision-making process. Yet, for many African societies the gender composition in the smallholder farming sector validates relevance of gender as an investigative element.

Previous work by Khoza et al. (2019c), Khoza et al. (2019b) and Khoza et al. (2019a) has also shown that underlying gender inequality, patriarchy and other social imbalances manifest as gender-differentiated socio-cultural, socio-psychological and gendered-vulnerability drivers that shape decisions on whether to adopt, dis-adopt or not adopt CSA technologies. This emanates from a focus on CSA as solving the dilemma of climate change through technical fixes to increase food production. Provision of technological solutions for resilience requires consideration of their social implications, absence of which has resulted in growing concern over the observed adoption paradox. Failure to address underlying gender inequalities and vulnerabilities may have ramifications on resilience-building for smallholder-farmers. Additionally, existing understanding of CSA adoption is framed within a simplistic linear approach, which is insufficient when gender and resilience-building dimensions are brought into consideration. Thus, this study was conducted with the aim to explore application of a resilience perspective to CSA to address underlying gender inequality and gendered vulnerability to improve CSA adoption by diverse men and women smallholder-farmers.

Shortcomings of CSA have also been linked to the issue of a conceptual misnomer, arising from the general conceptualisation of CSA that includes policies, technologies, practices at farmer-level, landscape and ecosystem levels (Lipper et al., 2014). While some literature

labels CSA as an already compromised concept pushing a hegemonic agenda for the developed countries (Taylor, 2018), arguably the concept has potential to address some of the challenges faced by African societies in the face of climate change. Notwithstanding the misnomer concerns, this study situated CSA adoption assessment at farmer-level and with deliberate focus on technologies and practices that farmers have to adopt. Some scholars have proposed need for alternative frameworks tackling the shortcomings of CSA (Glover et al., 2019, Taylor, 2018). This gives currency to application of resilience-thinking in CSA adoption. It is this paper's contention that addressing some of these shortcomings can be realised through a reconnaissance of CSA that frames the concept through leveraging on its relationship with DRR.

3. Conceptualisation of climate-smart agriculture in DRR context

The second pillar of CSA is resilience-building and adaptation, and it is within this pillar that the interconnectedness of CSA and DRR is established (FAO, 2013). This relationship paves way for applying a DRR lens to CSA adoption to explore opportunities for improving CSA adoption by smallholder-farmers. Additionally, the climate-related risks and disasters affecting smallholder farming as already outlined in the introduction of this paper give credence to such an approach. Moreover, at farmer-level the demarcations between adaptation, resilience-building and DRR are indistinct as farmers are more concerned with surviving each disaster event.

A DRR perspective in CSA draws attention to issues of vulnerability reduction, while CSA implementation in smallholder farming provides a vehicle to deliver both risk reduction and adaptation simultaneously (FAO, 2013). A DRR approach to CSA could help resolve some of the shortcomings of CSA identified in literature in the preceding section. Greater strides have been made in DRR than in CSA, for example, in terms of appreciation of resilience-building, indigenous knowledge systems, application of socio-ecological systems concept to understand resilience-building and community-based participation (Coetzee et al., 2016, Alexander, 2013, FAO, 2013). Therefore, CSA could draw from progress in made in DRR this far as a way of resolving the adoption challenges. Unfortunately, there has been very minimal scholarly interrogation of CSA from a DRR perspective. Yet, in an era where increased climate risk threatens to wipe out development gains made in agriculture so far, such a consolidated approach could better cross-examine CSA adoption. Furthermore, the relationship of DRR and resilience provides basis to interrogate CSA adoption from a disaster resilience perspective.

Disaster resilience is framed as an ability, where systems and its units are able to anticipate, absorb, accommodate and recover from a disturbance by bouncing back or bouncing forward timeously and efficiently (Manyena et al., 2011, Bahadur et al., 2010, Bernier and Meinzen-Dick, 2014). A system and its units may have the ability to change without loss of basic structure and functions, or self-organise, attaining incremental capacity to learn, adapt and change through the absorptive, adaptive or transformative capacities (Béné et al., 2016). When smallholder-farmers make decisions to adopt CSA technologies and practices, then essentially that is indicative of their aspirations to be resilient to climate vagaries. Resilience of a system or its units, which in this study were individual farming households in a farming system, is better appreciated by considering resilience principles which include maintenance of redundancy and diversity, management of intra-system connectivity, feedbacks, promotion of social learning, participation and inclusion, embracing poly-centricity and understanding that agricultural systems are complex adaptive systems (Carpenter et al., 2012, Coetzee et al., 2016). Therefore, in assessing CSA adoption challenges from a resilience perspective, this paper conceptualises that these resilience principles can be applied to assess barriers to CSA adoption and how improvements may be made to build resilience of farming households and communities.

When considering resilience capacities within climate change affected agricultural systems, absorptive resilience is when households are able to contend with negative impacts of climate disasters through persistent coping and resistance, without any distinct changes to function or structure (Bennett et al., 2014). An example is when households cope with a drought through humanitarian interventions such as food aid distribution. Adaptive resilience is when the agricultural system or its units have ability to learn from acquired or experiential knowledge, and make adjustments in response to disasters (Walker et al., 2004). In adaptive resilience the aim is to make adjustments within a household or system for continued functioning. Transformative resilience refers to the capacity for change in structure and function of the system or households owing to disturbance. Transformation is more concerned with changes made in behaviours, cultural ethos, stereotypes, institutions and policy direction (Walker et al., 2004). Thus, transformation is anchored on interrogation of the status quo and advocating for pragmatic changes in structure or function to be instituted. Adaptation and transformation are long-term and essential dimensions of resilience from a development standpoint. It is important to bear in mind that the three dimensions should not be pursued separately in linear fashion, but realise that they are independent and harness the existing synergies among them (Béné et al., 2016).

Accordingly, for the majority at-risk rural smallholder-farmers, CSA offers a pragmatic relevant conduit to pursue resilience. The assorted CSA options (see Table 1) contribute, or have potential to contribute to, the three resilience dimensions, hence it is worth mentioning that CSA implementation and policies should not elevate any one dimension, and subordinate the others. Rather, in building on the synergistic relationships of absorption, adaptation and transformation, CSA can assist smallholder-farmers and their systems to become resilient.

In the context of smallholder-farmers in developing regions within which CSA is promoted, it is key to recognise the heterogeneous composition of this population (Khoza et al., 2019c).

Table 1: Climate smart agriculture options

CSA options	**Examples**
Crop management	• Intercropping • crop rotation • crop diversification • improved seed varieties • value chains and marketing • improved post-harvest storage • agro-processing
Livestock management	• fodder crops • feedlots • improved breed • rotational grazing • grassland restoration and conservation
Soil and water management:	• basin/ mechanised conservation farming • solar-powered irrigation • rehabilitation of degraded landscapes
Agro-forestry	• woodlots • fruit trees • nitrogen-fixing trees • multi-purpose trees
Integrated food- energy systems	• biogas stoves • energy saving stoves
Infrastructure	• roads • housing • mobile network
Access to climate information	• ICT platforms/ information hubs
Fisheries	• aquaculture • capture fisheries

Adapted from (FAO, 2013)

Diversity of smallholder-farmers draws attention to existing inequalities within farming systems that relate to vulnerability and shape power, agency, ownership and control of resources,

decision-making and participation (Ensor et al., 2018, Matin et al., 2018). This magnifies need for resilience-building in CSA to pay attention to the skewed landscape within which CSA adoption decisions have to be made by different farmers. Ultimately, this mandates that over and above absorptive and adaptive resilience, transformation is required in CSA, and this starts with an interrogation of existing social imbalances that determine whether a smallholder-farmer will adopt, dis-adopt or not adopt CSA.

4. Methodology

An exploratory-sequential mixed-methods design (Teddlie and Tashakkori, 2009) was applied in Chikwawa, Malawi and Gwembe, Zambia to gather empirical data at local-level where smallholder-farmers interface with climate-related disasters, and where resilience-building is essential. The initial phase entailed collection of qualitative data from purposively selected key informants at district level, and focus group discussions (FGDs) at ward level, through semi-structured, face-to-face interviews. A total of 16 interviews and six FGDs were conducted (three in each country; men only, women only and mixed men and women). Thematic qualitative data analysis informed the design of an instrument used in quantitative cross-sectional data collection. In the quantitative cross-sectional survey, a total of 102 smallholder-farmers were interviewed, 51 from each study site. The cross-sectional survey served to explore generalisability of the themes established from the qualitative findings (Creswell and Creswell, 2017). In order to capture the perspectives and contexts of the gender dimensions in CSA adoption, the study was biased on qualitative findings. This is in line with the methodological provisions of a mixed methods research design (Teddlie and Tashakkori, 2009). Quantitative data was analysed with SPSS version 26 for descriptive statistics that established distribution and trends.

5. Findings

5.1 Ownership of land

Findings established that in Chikwawa average land owned by men household-heads was 1.4 ha, while for women it was 0.7ha. In Gwembe land renting by women household-heads to practice CSA was observed in approximately 40 percent of households who indicated they rented land. While men household-heads generally rented land in addition to what they owned, the women household-heads rented land because they were land-less. While the issue of land ownership by women in Africa is pervasive (Doss et al., 2015), these findings give resolution to the issue and call for renewed effort to address this issue. Land ownership influences adoption of agricultural technologies and practices, therefore if CSA is to contribute to

resilience-building, then there is need for equal distribution of land as a starting point towards equitable resilience (Matin et al., 2018).

5.2 Participation in CSA technology development

Qualitative findings established that CSA technology development was top-down, with smallholder-farmers not engaged in technology development as they are generally considered as recipients *'who receive your technology you have developed for them'* (NGO respondent, Chikwawa). In both study sites, field days and demonstration plots were identified as opportunities for farmer participation in technology development. However, respondents acknowledged that even these events were top-down as they mainly showcased technologies that had been developed *for* the farmer, and technologies developed *with* the farmer's involvement were rare if any. Currently, there seems to be no consideration of a mixed approach to CSA technology development that comprises technologies developed for and with the farmers. This may be due to perceptions of farmers as technology recipients, as reflected by some interviewees; *'they cannot contribute anything in technology development...what do farmers know that they can contribute in CSA?'* (Government department respondent, Gwembe)

These sentiments were corroborated by quantitative findings which established minimal participation of farmers in technology development irrespective of gender. In Chikwawa 25 percent of the households, with over 70 percent of these as men headed-households, stated that they had been involved in meetings when conservation farming and irrigation schemes were first brought to their communities. In Gwembe 11 percent of the farmers acknowledged participation in similar meetings. In both study sites, those who participated in meetings went on to become adopters as they benefited from the respective CSA projects.

However, this is insufficient as participation should also be at problem identification and evaluation of options to eventual selection of technologies that farmers know will address their problems. This also creates room for consideration of indigenous knowledge systems, which can also be considered as alternatives to solve problems faced by farmers. For example, in Chikwawa, farmers shared how they had used the fish broth to control the fall armyworm before pesticides were available. Scientific research could be incorporated to explore how indigenous knowledge can be improved and harnessed.

5.3 CSA options available for farmers

Qualitative findings established that conservation farming was the major form of CSA that farmers had adopted, and quantitative findings corroborated with 100 percent of farmers

practicing CSA in both sites stating they used improved seed varieties (ISVs), soil and moisture conservation techniques, and in both study sites less than 40 percent of sampled households were engaged in more than one form of CSA. In Chikwawa other forms of CSA included small-scale irrigation schemes, while in Gwembe a new aquaculture project was at inception stage at the time of data collection (February 2018). In Gwembe, less than 20 percent of interviewed farmers had also been engaged in previous improved livestock breed projects. However, qualitative findings showed there were concerns that conservation farming alone was insufficient in addressing farmers' needs as explained by practitioners;

> *'…we know that crop production is always vulnerable, we also need to bring in livestock for the farmers, to help them when crops fail…especially goats which they can sell when crops fail.'* (Respondent from government department, Chikwawa)

Quantitative findings showed that livestock ownership differed between men and women headed-households. In both sites married men owned the most cattle, with average cattle ownership in Chikwawa as two head, while in Gwembe it was eight. More women household-heads owned cattle in Gwembe than in Chikwawa, 16 percent and 7 percent respectively. Viewing these trends from an intersectionality perspective shows intersection of gender with education and wealth status as the women who owned cattle in Gwembe were predominantly retired professionals who were categorised as better-off in the community wealth rankings.

5.4 CSA goals for farmers

In Chikwawa qualitative findings established that intended CSA outcomes of improved agricultural productivity as well as resilience-building were not being achieved through CSA options available to farmers. Evidence of these shortcomings of CSA was linked to humanitarian food assistance where qualitative findings indicated that there was no major difference in terms of food security between CSA farmers and those who were not involved in any form of CSA because *'we see it when it comes to food aid, they all need assistance because they will be all food insecure'* (Respondent from Government Department, Chikwawa). More concerning were sentiments from non-adopters who then were not motivated to adopt available CSA options because *'we are all the same, CSA does not make us any better than them'* (Discussants in mixed gender FGD, Chikwawa). These findings were confirmed through the quantitative survey where 100 percent of farmers who adopted conservation farming also reiterated that they benefited from food aid each year because of low crop yields. Farmers using ISVs raised concerns on their susceptibility to fall armyworm, and thought their traditional open pollinated varieties (OPVs) were better resistant.

In Gwembe a different scenario was observed upon assessing whether CSA options were able to contribute towards food security and resilience-building. Qualitative findings established that while yields increased through conservation farming, there were post-harvest crop losses as they could not sell their surplus anywhere. Quantitative findings confirmed these sentiments as 100 percent of the farmers who were practicing conservation farming techniques were utilising less than half of their arable land for CSA to *'avoid high yields that they would still lose through spoilage'*, as farmers concurred during household survey in Gwembe.

6. Discussion

Accordingly, this section discusses study findings and proposed recommendations to improve CSA adoption by men and women smallholder-farmers. Findings show that men and women household-heads may not be realising benefits of CSA activities they are involved in. Study findings further show that currently CSA is not contributing towards resilience of farmers as they still fall into food insecurity, often relying on food aid to see them through to the next season which then creates a dependency syndrome, thus demotivating farmers from CSA adoption. Moreover, dominance of conservation farming leaves farmers vulnerable to climate hazards that have negative impact on crop production. These findings illuminate insufficiencies of current CSA and gaps which continue to hinder CSA adoption, especially among women-headed households. Hence, this paper accentuates that a resilience framing of CSA gives room for broader consideration of the decision-making context within which smallholder-farmers exist.

This paper incorporates a resilience perspective to contribute towards improving CSA adoption by way of a proposed normative gender-sensitive CSA adoption model (Figure 1). The aim of the framework is to provide a normative approach to improving CSA adoption, especially by diverse women smallholder-farmers in developing regions, considering the critical role they play in smallholder farming. The framework is conceptualised within a resilience viewpoint, enabling a more holistic approach to the issues that may enhance decision-making by different groups of farmers, especially by diverse women smallholder-farmers. There is need for gender-transformation at various CSA implementation levels, starting at household level up to national and global levels. The required transformation requires various strategies and enablers to be put in place to create equality and address gendered-vulnerability, which should potentially result in improved CSA adoption at household level. The gender-sensitive CSA adoption framework comprises various interconnected components which should be engaged with from a gender-perspective throughout, with the aim to transform towards more egalitarian resilient societies. In the proposed framework the

desired adoption route likely to help achieve gender equitable resilience is illustrated with black arrows, and the undesired route likely if gender disparities are not addressed is shown with red dotted arrows, while the blue curved arrow shows that the enablers, strategies, gender equality and risk information are all interconnected, all interacting to inform gender-sensitive technology development and risk-informed decision-making. The various components are discussed in the following sub-sections:

6.1 Enablers for CSA adoption

6.1.1 Gender-sensitive policies

Findings of this study show that there are pre-existing gender inequalities in farming communities, at household level and perpetuated by gender-blind CSA implementation. This paper submits that for CSA adoption by women farmers to improve, there is need for existing and new policies to be gender-sensitive to ensure that issues of gender inequality are addressed to achieve gender parity. This requires a holistic assessment of CSA that will consider implementation strategies and resilience capitals, and not just limited to technological benefits of CSA. There is need for policies directly or indirectly linked to CSA, to be assessed for their implications on different genders, for instance, when considering issues of land tenure, marriage and property inheritance laws which affect CSA adoption decisions (Doss et al., 2015, Khoza et al., 2019c). Furthermore, other policy frameworks that need to be gender-sensitive include technology development and economic empowerment.

6.1.2 Gender-equal farmer participation

CSA presents various opportunities where farmers should be engaged for active participation in CSA technology development. However, study findings showed that currently, participation of farmers in CSA is mainly as recipients of already developed technologies and CSA information. CSA is characterised by top-down approaches, which when a gender lens is applied may fail to pay attention to critical gender issues that hinder adoption. This paper reiterates need for CSA implementation to ensure equal participation of farmers in technology development and in identification of CSA options to adequately meet the resilience needs of diverse farmer categories. Gender-equal participation is also required in co-creation of knowledge through research, in gendered- risk assessments, vulnerability assessments and multi-hazard analysis. Gender-equal participation of farmers will likely assist in identification of gender-differentiated barriers of CSA adoption, and opportunities that can be harnessed to improve adoption across different genders.

When smallholder-farmers are given equal opportunities to participate in various aspects of CSA, this is likely to also bring to the fore critical contextual gender issues and facilitate transformation. Gender-equal participation may potentially enable bottom-up engagement in CSA, where farmers can also contribute their knowledge and experiences in CSA. This is especially important when considering the role of indigenous knowledge systems in CSA. Ultimately, equal participation of farmers allows CSA to engage with their various realities, ensures farmers have a voice in design of CSA projects and technologies that are developed, thereby enhancing their ownership of CSA projects. When farmers are given space to participate in various components of CSA, not just as recipients, they are more likely to adopt CSA. This is essential for the sustainability of CSA in communities.

6.1.3 Provision of adequate funding

There is no doubt that technological requirements of CSA are likely to be costly and beyond the reach of many individual farming households. For instance, capital investment for some CSA options, such as irrigation schemes and aquaculture may be costly. This means at a higher national and global scale, there is need to improve funding for CSA projects. This can be achieved through multiple funding streams. For example, at national level fulfilling commitments of the Malabo Declaration that states that African governments need to allocate 10 percent of their public spending towards agriculture (AU, 2014). Other funding sources could be explored through other government sectors, for example on the basis of its relationship with DRR, then DRM departments could also fund some of the CSA work. Similarly, at global level, multiple sources may be explored apart from specific CSA projects, such as Resilience-building, climate change adaptation or DRR Funds.

Important in CSA funding is to ensure that funds provided address the resource needs of local-level institutions on the ground, such as provision of vehicles, information and communication technology equipment, and recruitment of more extension agents. This will improve quality of contact extension services provided to the farmers. This may also mean there is need for strategic direction towards integration of local-level institutions.

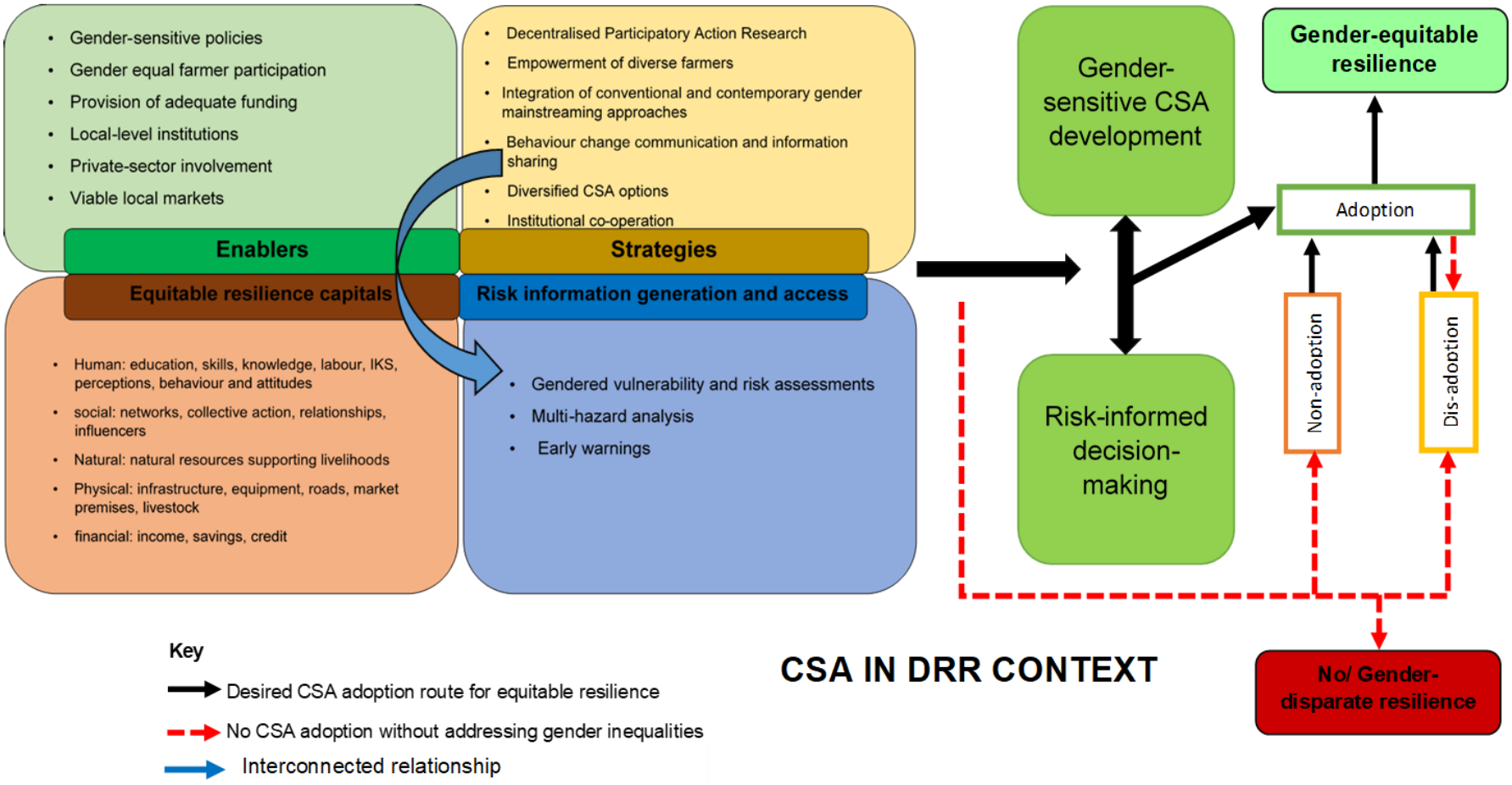

Figure 1: Proposed gender-sensitive CSA adoption framework

6.1.4 Local-level institutions

Strong operational relationships among local-level government and non-government institutions are required to facilitate gender-sensitive CSA adoption. According to Carpenter et al. (2012), poly-centricity is key in resilience, often helping to promote connectivity within systems and facilitate learning, and likewise this is key in CSA where diverse institutions need to work together. These institutions are the first-level responders to different hazards affecting smallholder-farmers, hence their ability to co-operate is necessary to improve CSA adoption. These local-level institutions may be essential in provision of extension services, information dissemination and in facilitating gender transformation in communities. Strong relationships among these institutions are important to ensure collective action that will enhance delivery of CSA with precision and efficiency to meet specific farmer resilience needs.

6.1.5 Private-sector and viable markets

Findings established that one major drawback against adoption of CSA by both men and women farmers is the lack of improved quality of life from CSA. This was connected to the lack of economic opportunities that resulted in farmers not earning meaningful income from sale of their produce. This paper recommends that innovative strategies be implemented to involve the private-sector in CSA to ensure win-win scenarios for farmers and business. CSA adoption is negatively affected by unviable local markets hence, an enabling environment for CSA adoption requires viable local markets where farmers can buy and sell CSA inputs and outputs respectively. This may help create a thriving local economy, and increase income earned from CSA to meet household needs.

From a gender perspective, a thriving local economy is required to meet especially the needs of women farmers whose mobility to travel to bigger cities frequently may be limited whether they are household-heads or not. Stimulation of a local market economy requires activities such as agro-processing and value-addition, in the absence of which farmers may be faced with post-harvest losses and lack of income from CSA. As was shown in Gwembe, when farmers experience post-harvest losses it demotivates them from adopting CSA, or from expanding their CSA initiatives. This needs to be considered especially for crop production from conservation farming and irrigation schemes, as well as aquaculture.

6.2 Strategies to improve CSA adoption

6.2.1 Decentralised participatory action research

The gender disparities identified in the study magnify need for CSA adoption to be informed by participatory action research (PAR), which can be achieved with an enabling environment for gender-equal participation of smallholder-farmers. PAR may facilitate engagement with farmers, giving them a platform to share their experiences in gender issues that demotivate them from adopting CSA, or drive them to discontinue CSA. Furthermore, PAR needs to be decentralised, allowing research to be conducted at the local epicentre of climate disasters. The strength of PAR in driving CSA adoption is recognition of farmers as both sources and users of knowledge, where their involvement in research taps into their knowledge, perspectives and realities. At the same time, they are able to use the information from PAR to inform their CSA adoption decisions. Decentralisation of PAR needs from national-level to local-level also has to be gender-sensitive, identifying the best ways to cross-examine the challenges and opportunities in CSA for specific groups of farmers. Farmer-participation will illuminate the socio-psychological, behaviours, attitudes and perceptions of diverse groups and will ensure information is as precise and complete as possible to equip farmers in decision-making. PAR is also essential in creating a platform for behaviour change communication and information sharing.

6.2.2 Diversity of livelihoods and CSA options

Considering CSA from a resilience perspective magnifies need for CSA to move beyond dominance of conservation farming as revealed by this study. If CSA is to contribute towards resilience of diverse smallholder-farmers, then there is need to provide diversified CSA options in addition to conservation farming. Diversified CSA options ensure redundancy, such that in the face of a climate-related disaster affecting one component of the farming systems, farmers have other alternatives to rely on (Carpenter et al., 2012). The dominant focus on conservation farming could help explain protracted food insecurity and vulnerability with farmers often relying on food aid assistance. Therefore, a resilience lens in CSA advocates for transformation, where consideration is also given to other livelihoods and CSA options, for example income-generation through sale of improved livestock breeds, honey from apiculture, fish from aquaculture among others. Diversity and redundancy should improve resilience of farmers and gender considerations should be made to assess which CSA options would be relevant to each category of farmers.

6.2.3 Empowerment of diverse women farmers

In view of the study findings, this paper accentuates the need for empowerment of communities in general, and specifically women to equip them to be able to articulate their resilience needs,

and to demand for more space to participate in different aspects of CSA. The heterogeneity of women smallholder-farmers is suggestive of their corresponding diverse resilience needs. This is especially essential when considering issues of economic empowerment in CSA. CSA adopters have not been able to derive tangible economic benefits, yet this is one of the three pillars of CSA. Empowerment of farmers means they will participate in technology development, they will contribute towards defining the CSA options that they need and are relevant for them, and they will participate in decision-making at various levels from intra-household level going up.

Empowerment in CSA adoption needs to ensure that women in smallholder-farming communities can speak and share their experiences, practice autonomy and agency while at the same time being able to collectively come together to tackle structural bottlenecks that affect their adoption decisions. However, this requires a transformation from traditional gender mainstreaming approaches that have directed empowerment efforts in the past, towards an integrated approach that also considers contemporary approaches such as intersectionality, African feminisms and positive masculinity (Arndt, 2002, Davis, 2008). Studies have shown insufficiencies of traditional gender mainstreaming approaches in addressing gender inequality and patriarchy in agriculture (Khoza et al., 2019c). Hence, integration between traditional and contemporary approaches may compensate for the weaknesses of each approach applied on its own. Empowerment is required to address the practical gender needs, while also ensuring that attention is paid to structural gender issues that may hinder especially women household-heads from adoption of CSA. Empowerment should also pave way for participation and inclusion of farmers, especially women, in the various aspects of CSA as explained in earlier sections, and remains an essential vehicle for transformation.

6.3 Gender-equitable resilience capitals

Based on study findings, this paper accentuates that a resilience framing of CSA adoption compels consideration of gender inequality and gendered-vulnerability in access to, control and ownership of resilience capitals (Mayunga, 2007). The gender constructions that determine who owns, has access and controls need to be assessed in CSA as they shape farmers' adoption decisions. In order to achieve resilience-building through CSA, there is need for deliberate strategies aimed at establishing gender equality and equity in the ownership, control of and access to social, natural, physical, financial and human resilience capitals. This will require CSA to engage with the disparities and improve especially ownership of resilience capitals such as farming equipment, livestock, land and finance by women farmers to enable them to not only cope with climatic disturbances, but that they can also be equipped to build back better or bounce forward from each disturbance. Paying attention to resilience capitals also helps illuminate the key vulnerability issues that dispose farmers to either dis-adoption or non-adoption of CSA.

Creating gender equality and equity in resilience capital ownership will require innovation in tackling the socio-culturally entrenched patriarchal systems and women's subordination, and contemporary gender mainstreaming approaches may be useful therein.

While addressing identified gender inequality issues may not be the primary mandate of agricultural departments, a resilience framing places emphasis on inter-institutional integration and collective action. Other development actors need to be involved in CSA, such as gender departments, disaster risk management, community development, NGOs, women's rights activists and local leaders. These structures already exist at local level, although agriculture departments may need to lead the integration and collective action to ensure the expertise of various groups is channelled towards addressing inequality and vulnerability, as well as pursuing resilience.

6.4 Risk information: generation and access

In a related study, (Khoza et al., 2019b) established that there was gender unequal access to CSA-related information, which often resulted in non-adoption. Accordingly, any attempt to improve CSA adoption requires strategies to ensure there is supply of adequate information that equips farmers for decision-making. Collective action, participation and inclusion are key to generation of risk information. Processes to generate risk information are undertaken by governments, NGOs and donor agencies in many countries. These are usually in the form of vulnerability and risk assessments, as well as hazard analysis (FAO, 2013). However, there is need to move beyond simple gender-disaggregated data generated in these processes to critically engage with the gender implications of collected data in terms of resilience-building. Risk information is not only useful to technocrats and practitioners, but farmers should also have access to the information for decision-making. Knowledge is required to make informed decisions, hence across different gender groups its creation and acquisition is important to equip decision-makers. The proposed framework advocates for the involvement of farmers in knowledge co-creation which will harness valuable indigenous knowledge, useful especially with relation to climate hazards and early warnings. This means attention also has to be paid to access of gender-sensitive risk communication. Gender-sensitive risk-information is also requisite in development of gender-sensitive CSA technologies.

A systemic approach helps appreciate that CSA adoption decisions are not only made based on technological benefits of CSA options. Farmers consider other risks which affect their resilience capitals negatively or positively within the wider systems context. For instance, for many communities, disease epidemics such as HIV/AIDS remain a health risk that threatens agricultural labour provision in the households. Therefore, any adoption improvement strategy needs to

engage farmers to identify what other risks they face in their contexts, and this may be achieved through gender-vulnerability and risk assessments, as well as multi-hazard analyses which should endeavour to obtain in-depth qualitative perspectives on systemic risks.

6.5 Risk-informed decision making

Adoption decisions of men and women smallholder-farmers are influenced by various factors depending on their gender roles (Khoza et al., 2019b, Khoza et al., 2019c). Importantly, decision-making for men and women household-heads needs to be viewed in the multi-faceted context within which decisions are made and has to be risk-informed. There is need to acknowledge different factors and drivers that shape decision-making for different genders. A resilience framing of CSA accommodates risk-informed decision making (RIDM) even at smallholder-farmer level (Weichselgartner and Pigeon, 2015). RIDM acknowledges that decision-making is not in simple linear fashion as traditionally understood. It is a more comprehensive analytical approach that interrogates and seeks to understand complex interactions between people, risks, hazards and systems. Risk-informed decisions pay attention to qualitative information from gender-differentiated risk assessments (Gardoni et al., 2016), narratives and realities which shape decisions made by different farmers. However, (Apostolakis, 2004) caution against exclusive use of risk assessments to inform decisions, hence need for a more consolidated approach where gender-vulnerability assessments and multi-hazard analyses will also feed into decision-making.

6.6 Gender-sensitive CSA technology development

Findings of this study showed that smallholder-farmers, irrespective of gender, were not directly involved in the development of CSA technologies. Technology development was rather top-down process where farmers' role seemed to be that of being recipients. However, this paper argues that if CSA adoption is to be improved, there is need for farmers to participate in technology development. CSA technology development should be two-way, with provision for consideration and development of local farmer innovations for further scaling up. Development and dissemination of CSA technology needs to be participatory, to generate and manage perspectives that may determine adoption decisions made especially by the women farmers. CSA technology development therefore needs to be informed by the gender analyses that recognise gender roles and interactions with technology in relation to culture, behaviours, attitudes and social influences (Khoza et al., 2019c, Ngigi et al., 2018). Development of CSA technology needs to appreciate and address any underlying disparate distribution of asset capitals required for resilience. Failure to consider these underlying factors and corresponding strategies to address them may manifest as low adoption of CSA by women farmers.

Additionally, through gender analyses CSA technology development will consider existing and projected changes in gender roles. CSA technology may seek to improve current gender roles, or transform them, depending on identified inequalities and farmer needs (Nyasimi and Huyer, 2017), where technologies will be developed to help bridge the gender productivity gap and contribute to equitable resilience across the heterogeneity of smallholder-farmers. For instance, in this study both women in men-headed households and women who were household-heads lamented the labour demands of basin conservation farming which they stated increased their workload. Qualitative findings showed that women were opposed to increasing land area under conservation farming because it would increase their workload in weeding, whilst they had other reproductive and community roles too. Moreover, caution should be exercised to ensure CSA does not reinforce gender stereotypes, for instance when CSA projects target women only for energy-saving stoves distribution.

Critical in gender-sensitive technology development is the cost of CSA technologies. For some women who are already less economically empowered than men, they are less likely to afford costly new CSA technologies, with actual need for CSA focus to also be on women's economic empowerment. Ultimately, rural women need appropriate CSA technologies that will transform their contexts and realities where necessary, helping them to become more resilient. This can be achieved through engaging the diverse groups of women to establish their practical and structural gender needs. Gender-sensitive CSA technology development needs to be as pragmatic and transformative as possible in pursuit of resilience.

6.7 Operationalisation of the framework

This paper advances that the utilitarian value of the framework lies in its ability to identify and confront issues of inequality and social disparities in a broader context, which may pave way for decision-making that favours CSA adoption by smallholder-farmers. Operationalisation of this framework should start at district level and bring together communities and experts from diverse disciplines such as agriculture, disaster risk management, climate change, gender, community development, local leaders, businesses, weather services, research institutions and NGOs. Most of these disciplines are already represented at district level, although there in need to transition towards collective integrated operations. The agriculture department may maintain the leadership and co-ordinating mandate, ensuring representation and multi-directional participatory engagement, communication and information dissemination. Use of the framework can then feed into large-scale administrative processes, such as provincial and national level. Some components of the framework are already addressed through on-going activities, such as vulnerability assessments, hazard and risk assessments. However, a gender lens needs to be applied in these processes, which should include smallholder-farmers in their diversity, and

findings from assessments should be used to inform all DRR components, not just for response through humanitarian food assistance.

The proposed framework is worth exploring as it derives value from the participatory nature of its formulation and has a strong focus on social dimensions in CSA adoption. As such, it addresses some of the gaps in current appreciation of CSA adoption which seems to elevate the technological merits of CSA at the expense of the equally important social dimensions. This ingenuity of the framework also lies in that it speaks to the insufficiencies of a linear approach to CSA at present. Challenges may arise in that the framework was developed independent of any existing CSA project, hence its uptake by different institutions is not guaranteed. Nevertheless, it does present a normative approach towards improving CSA adoption so that men and women smallholder-farmers can be enabled to *'build back better equally, leaving no-one behind'*, which should form basis for resilience and sustainable livelihood outcomes in Africa.

7. Conclusion and implications

The CSA adoption enigma compels exploration of various approaches to improve understanding of CSA adoption and explore possible ways of improvement. A resilience-thinking approach applied to the development of a pragmatic gender-sensitive CSA adoption framework enriches current scholarship on CSA adoption and resilience which may help all farmers' equally and equitably realise tangible benefits. In taking a deliberate focus on gender, the framework reifies need to tackle gender inequality that stands in the way of CSA adoption, and inhibits successful pursuit of resilience. Interrogation of CSA adoption from a gender-equitable and resilience perspective carries potential to address the developmental challenges in Africa. At local-level where loss and damage from each disaster event amplifies agency for resilience-building, the framework offers a good start to deliberations and interrogation on the resilience and adaptation pillar of CSA. Without a deliberate focus on the resilience pillar of CSA, and advancing gender-equitable resilience, CSA may exist as a glorified concept at macro-level with little acceptance by the men and women at the frontline of climate disasters for whom resilience is essential. In almost a decade of existence, a journey that remains marred by controversy and ambiguity, this framework also presents an opportunity to critically interrogate applicability and usefulness of CSA to build resilience of smallholder-farmers who directly interface with climate-hazards.

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CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

Understanding gender tensions within CSA adoption among smallholder-farmers in disaster-prone, climate change hotspots forms a key tenet in solving the CSA adoption conundrum. Thus, this study was conducted with an aim to probe the possible tensions between gender and CSA adoption in disaster-prone smallholder farming regions in Malawi and Zambia. Ultimately, a gender-sensitive, CSA adoption framework that can be adapted for use in various developing country contexts, was developed. This was realised from the basis of the transformative and pragmatic worldviews which underpinned the entire study, subsequently informing theoretical and conceptual frameworks, research questions and research methodology. In answering the research questions, the study sought perspectives at local grassroots level where smallholder-farmers are at the frontline of climate-related disasters, faced with food insecurity and poverty, giving currency to needs for adaptation and resilience-building through CSA. To that end, four articles were developed to fulfil each of the objectives set out at the beginning of the study, and to answer the corresponding research questions. Therefore, this section is an exposition of how each article addressed the research questions, fulfilled the study objectives and the conclusions drawn for each article. The remainder of the chapter builds on the conclusions to tender recommendations, highlighting significant contributions made by the study as well as directing future research.

7.2 Article-based conclusions and achievement of research objectives

Article 1: Understanding gender dimensions of climate-smart agriculture adoption in disaster-prone smallholder farming communities in Malawi and Zambia

This article sought to answer research questions 1 and 2 simultaneously. Research question 1 was posed as: *'What are the theoretical imperatives on gender mainstreaming in DRR and CSA adoption in smallholder agriculture?'* and research question 2 as: *'What are the gender-differentiated profiles of smallholder-farmers who adopt, dis-adopt and reject CSA?'* Correspondingly, the article contributed towards achievement of two research objectives, viz., to formulate gender-differentiated profiles of smallholder farmers who adopt, dis-adopt and do-not-adopt CSA; and to provide theoretical imperatives on gender mainstreaming in CSA adoption. In tackling these two research questions to achieve the objectives, the main point of departure for this article was that agenda to improve CSA adoption in smallholder farming should be anchored on knowledge of who adopts, dis-adopts or does-not-adopt CSA. Application of a gender theoretical lens, which considered both traditional and contemporary approaches, was used to

elucidate the gender-differentiated profiles of the categories, drawing on local gender perspectives to explain why there were differences between men and women smallholder-farmers who were adopters, dis-adopters and non-adopters. Traditional gender mainstreaming approaches considered included WID, WAD and GAD. Contemporary approaches included intersectionality, which is just gaining traction in CSA, alongside African feminisms (AFs) whose application has mainly been domiciled in the literary arts. Innovative inclusion of contemporary approaches in the theoretical framings was necessary as an alternative to traditional feminist theories whose inadequacies especially in gender mainstreaming for African contexts continues to be challenged.

Empirical evidence was collected from various local actors involved in CSA implementation at farmer-level, who comprised local-level government and NGO staff, local leaders and farmers, to establish characteristics of farmers in different adoption categories and understand the local contextualisation and realities of gender. A gender theoretical lens was applied to understand the underlying socio-cultural context that could explain the gender-differentiated profiles. The study established that adopters of CSA were predominantly married men, with a small proportion of de jure women household-heads. De jure women household-heads dominated the dis-adopters' category, while households headed by men, whether married or not, mainly constituted the non-adopters' category. Widows were the major group of women in the non-adopters' category in Gwembe, while in Chikwawa there were no women non-adopters, which was attributed to women-specific targeting strategies in CSA.

In exploring reasons behind the observed farmer typologies, underlying factors were considered. These factors were identified as education level, decision-making and power dynamics, wealth status, land tenure and ownership, as well as ownership of productive assets. Pre-existing structural gender inequality in all these factors maintained women-farmers at the peripherals of CSA adoption. Theoretical perspectives were used to further interrogate the socio-cultural context and its role in shaping decisions to adopt, dis-adopt and non-adoption of CSA. Significance of the study lies in that assessment of the gender-differentiated profiles shed light into dominant influence of traditional gender mainstreaming approaches, with little done to interrogate and transform unequal gender contexts. Evidence showed that traditional feminist theories on their own were inadequate in informing gendered approaches in CSA. Contemporary theories were also applied to assess whether they could inform gendered approaches to CSA adoption. Therefore, in line with the transformative and pragmatic worldviews upon which the study was premised, an integrated approach to gender mainstreaming in CSA could facilitate practical transformation.

The study asserts need for transformation in CSA implementation ideology, shifting from dominance of traditional gender mainstreaming paradigms, towards a more integrated approach where both traditional and contemporary paradigms will be applied to mainstream gender in CSA. An integrated approach recognises that each of the paradigms has strengths and shortcomings that may be enhanced or leveraged by the other. Accordingly, an integration of traditional and contemporary gender mainstreaming approaches helps interrogate biased focus on practical gender needs, and advocates that attention also be paid to structural gender issues which limit women farmers from CSA adoption. Secondly, the study evidence provides compelling need to understand and consider conceptualisation of gender from the communities' perspectives. This accommodates a shift away from the classical view of homogeneous gender dichotomies towards recognition of heterogeneity, which remains essential in designing and meeting articulated needs of the diverse farmers in CSA. Practically speaking, unravelling gender-differentiated profiles of adopters, dis-adopters and non-adopters, illuminates a need for CSA options that are tailor-made to meet resilience and adaptation needs across the heterogeneity of farmers. This study also found that in terms of research in CSA, there was dominant monopoly of agricultural research which could be responsible for a limited understanding of the rather multi-dimensional, gendered context within which CSA adoption occurred. The article identified exigent need for a broader approach to CSA adoption, building on its interconnection with DRR, to further access vulnerability and inequality framing CSA adoption patterns.

Article 2: Vulnerability and inequality: understanding drivers of climate-smart agriculture adoption among smallholder-farmers in Malawi and Zambia

This article answered the third research question: *'what are the gender-differentiated drivers of CSA adoption, dis- and non- adoption among smallholder-farmers?'* In answering this research question, the thesis was addressing the research objective that sought to identify the gender-differentiated drivers of CSA adoption, dis- and non- adoption among smallholder farmers. This research question was related to some of the gaps identified in Article 1, surrounding gendered vulnerability and inequality, and their influence on adoption of CSA technologies by different men and women farmers.

This paper provides critical evidence-base on the underlying gender-differentiated vulnerabilities affecting decision-making and shaping CSA adoption among smallholder-farmers in rural climate-sensitive regions. Findings identified gender-differentiated drivers of CSA adoption, non-adoption and dis-adoption, and the gendered-vulnerabilities which determined CSA technology adoption, dis-adoption and non-adoption. When juxtaposed with the gendered Pressure-and-Release model, the study was able to identify the underlying risk factors and dynamic pressures that needed to be addressed to address inequality and vulnerability, ultimately improving technology

adoption across genders. The ability of smallholder-farmers to identify climate-related hazards affecting them indicates their awareness of the problem, hence their contributions should form part of efforts to improve CSA adoption. Understanding of gender-differentiated drivers of CSA adoption, dis-adoption and non-adoption, creates opportunity to explore ways of ensuring CSA inclusivity of marginalised and heterogeneous social groups of farmers. The paper magnifies the need for transformation of CSA policy-framework and implementation strategies to become inclusive, equitable, locally-appropriate and sustainable.

This paper accentuates the importance for CSA policy-makers, implementers and researchers to realise that gender-differentiated drivers for adoption, dis-adoption and non-adoption are linked to gendered vulnerability, underlying risk factors and dynamic factors. These are all intricately connected and may be mutually reinforcing, and interacting in such ways that addressing one driver could potentially have knock-on effects on other drivers. Recommendations from the paper include application of a DRR lens in assessing gender inequality and vulnerability shaping adoption of CSA technology. A DRR lens amplifies the need for transdisciplinary collective action that enhances collaborations and partnerships required in research and practice to improve CSA delivery at farmer-level. Therefore, in identifying gender-differentiated drivers of CSA adoption, dis-adoption and non-adoption, various actors and sectors critical in addressing gender inequality and vulnerability, and contributing to improved CSA adoption can be identified. Ultimately, a collective multi-stakeholder approach aimed at transforming gender norms and stereotypes shaping vulnerability and inequality may contribute towards precision and efficiency in deliverance of CSA technologies that will enable smallholder-farmers to be food secure, resilient as well as adapt to climate change. However, the application of the gendered-Pressure and Release (PAR) model, although giving insights into gendered-vulnerability, was insufficient in establishing the micro-level nuances of technology decision-making.

Article 3: A gender-differentiated analysis of climate smart agriculture adoption by smallholder farmers: Application of the Extended Technology Acceptance Model

The article sought to answer research question 4, which was stated as: *'What are the theoretical perspectives that can be applied to predict adoption of new CSA technologies by smallholder-farmers?'* In answering this research question, the objective *'to provide theoretical perspectives on prediction of adoption of new CSA technologies by smallholder farmers'*, was achieved.

In answering this research question the article sought to tackle the enigma of low CSA technology adoption by smallholder-farmers. The study made its point of departure from a realisation that in the face of climatic change, there would likely emerge new and unfamiliar CSA technologies and practices that smallholder-farmers would need to adopt for food security, adaptation and

resilience. Therefore, it was essential to consider predictive theoretical perspectives of CSA adoption from a micro-level decision-making perspective. Basis of this component of the research was recognition of the multi-dimensional nature of decision-making in CSA adoption, which warranted an in-depth exploration beyond the superficial decisions that farmers made.

To answer the research question, the study theorised that behavioural and attitudinal patterns at individual farmer-level shaped CSA adoption decisions, thus, theoretical perspectives of CSA adoption were based on the decision-making context among farmers. This was explored through a socio-psychological theoretical lens where applicability of Extended Technology Acceptance Model (TAM2) was tested. The study explored whether there were differences in socio-psychological determinants of decision-making between men and women household-heads. In using the TAM2, the study explored smallholder-farmers' perceptions, behaviour and social influences shaping their decisions to adopt and use new CSA technologies, or not to. The study used primary data collected through an exploratory-sequential mixed methods design.

Accordingly, study findings show applicability of socio-psychological theories as one way for understanding CSA adoption decisions. The results from this study highlighted that there were gender-differentiated socio-psychological determinants shaping the farmers' CSA adoption decisions, such as perceptions on climate risk, ease of use and usefulness of CSA technologies, intention to use technology and actual use of CSA technology. These findings have various implications for policy and practice. Firstly, there is a need for policy and practice to be informed by theoretical perspectives of CSA adoption, such as socio-psychological theories, as this enriches comprehension of the CSA adoption decision-making context. Understanding of micro-level decision-making dynamics can inform macro-level strategies and policies to address perceptions, behaviours and attitudes that determine adoption decisions. The study unravels critical insights into gender-differentiated structural issues that must be tackled and solved, and positive factors that can be harnessed to improve adoption and use of new CSA technologies.

Secondly, both policy and practice need to devise strategies aimed at leveraging the power of collective action through social processes to improve CSA technology adoption. These social relationships could play out in a positive way encouraging farmers to adopt new technologies, or negatively to dissuade them from adoption, especially where tangible benefits were not seen from use of CSA technologies. Social influencers drawn from non-agricultural social platforms, such as religious leaders and groupings, traditional leaders, community-based disaster risk management committees, can be used in information dissemination on CSA to reach out to positively influence CSA adoption among different groups of men and women smallholder-farmers. Information dissemination needs to be anchored on inclusive participatory engagement of diverse groups of men and women farmers. Inclusive participation should also encourage multi-

directional flow of information, where diverse farmers are also able to contribute towards CSA technology development and dissemination, and farmers' own innovations are considered. Lastly, any attempt to improve perceptions, behaviour and attitudes need to be anchored on a gender-sensitive behavioural change communication strategy. At macro-level, strategies to encourage positive perceptions, behaviours and attitudes need policy backing, mandating gender-sensitive, participatory and inclusive CSA technology development and dissemination processes. CSA technology development and dissemination needs to engage with gender norms and roles, tackle existing gender inequalities and stereotypes, ultimately contributing towards development of CSA technologies that facilitate increased agricultural productivity, resilience and adaptation for the diverse men and women smallholder-farmers.

Article 4: Rethinking climate-smart agriculture adoption by smallholder-farmers: A proposed new gender-sensitive adoption framework

It is through Article 4 that research question 5 of the thesis was addressed. The research question was stated as: *'What framework considers gender mainstreaming in the promotion of CSA by smallholder farmers?'* This research question was essential in achieving the research objective to formulate a gender-sensitive CSA adoption framework that responds appropriately to climate-induced disasters affecting smallholder farming. The research question was general and sought to establish the normative landscape within which gender was mainstreamed in CSA to create equal opportunities facilitating CSA adoption by different genders. The question was formulated on the backdrop of other components of the thesis which had made a number of establishments through Articles 1, 2 and 3, viz., Gender-differentiated profiles of CSA adopters, dis-adopters and non-adopters, and the underlying socio-cultural milieu shaping the profiles, gender-differentiated drivers of adoption, dis-adoption and non-adoption and the role of gendered-vulnerability, underlying risk factors and dynamic pressures in shaping observed drivers, and micro-level gender-differentiated socio-psychological determinants of adoption, dis-adoption and non-adoption, respectively. The multi-faceted consideration of CSA adoption through previous articles, complemented by existing literature, illuminated need for a normative, gender-sensitive approach in CSA which would harness opportunities and address identified issues of gender inequality and structural bottlenecks responsible for gendered-vulnerability and social imbalances in farming communities.

Subsequently, a normative, gender-sensitive CSA adoption framework was proposed in this article. The framework was situated within the second pillar of CSA, resilience-building and adaptation, on the basis that farmers needed to adopt CSA technologies for climate resilience. While an assortment of resilience lexicon exists, the study considered resilience from a disaster risk perspective, on the basis of the interconnection of CSA and DRR. It was envisaged that

through the three resilience dimensions then gender mainstreaming in CSA could tackle the gender issues, and improve CSA adoption for resilience-building. Apart from literature, formulation of the framework was also informed by primary evidence collected at district and local community level through an exploratory-sequential mixed methods study research design. This was necessitated by the target for the framework to be operationalised starting at district level, and be informed by local voices and contexts.

On the basis of its resilience-framing the framework takes on a socio-ecological systems approach that recognises agricultural systems as complex adaptive systems. Therefore, if farmers were to be meaningfully engaged in CSA there was need for entrench CSA on the relationships between social and ecological systems, especially given dependence of rural livelihoods on natural resources, and that some CSA resilience technologies could be dependent, or have impacts on ecosystems and their services. In a gendered approach to CSA adoption this was important given the notion that rural women have an intricate relationship with natural resources. The framework also advances that CSA adoption decisions are not exclusively based on perceptions of climate risk, but rather on a systemic risk context. The framework has two major core components that intricately interplay with each other and the rest of the components: firstly, the risk-informed decision-making component emphasises that the decision to adopt, dis-adopt or not-adopt CSA should be risk-informed. This the paper argues is more essential and a deviation from the current norm of risk-based decision-making which is quantitavely informed, lacking consideration of qualitative narratives. Apart from risk assessments, the framework advances that decision-making on which CSA options to pursue should be informed by multi-hazard assessments, gendered-vulnerability assessments, and risk reduction components including early warnings. Secondly, CSA technology development and dissemination needs to be gender-sensitive and be informed not only by the risks, but also consider culture, behaviours and attitudes, resilience capitals, gendered-vulnerability, ecosystems and other factors that may determine adoption decisions made by different farmers. Importantly, gender-sensitive enabling factors for CSA adoption need to be in place. Broadly speaking, these should ensure there is equal participation of all genders in CSA, information generation and dissemination needs to be multi-directional, scientific research to include role of indigenous knowledge in CSA. Gender-sensitive policies are required, together with improved local market economies to improve especially economic empowerment of diverse women, and the private sector should play an integral role on that.

Altogether, CSA adoption improvement for all genders will require adequate funding and holistic inter-institutional co-operation bringing together experts and practitioners at the local-level to address issues of gender inequality and inequity in access to, ownership and control of resilience

capitals. This addresses some of the barriers to CSA adoption. The framework accentuates need to not only focus on absorptive or adaptive resilience in CSA but that all three resilience dimensions be pursued. The framework reifies that resilience is not homogeneous and therefore, neither should CSA be. Through a resilience-thinking perspective, the framework provides opportunity to initiate and pursue transformation within agricultural systems, in terms of power, equality and agency. The conceptualisation of the framework on the interconnection of CSA and DRR, resilience-thinking and transformation brings to the fore critical issues that have not received much attention in literature. Therefore, the framework provides a stepping stone to further engage primarily with gender equality in resilience-building in future research.

7.3 Thesis contribution to existing body of knowledge

In all four articles the thesis had a consistent gendered approach that provided empirical evidence from social dimensions of technological adoption ranging from socio-cultural, socio-psychological, gendered-vulnerability and gender-equitable resilience. This helps fill the empirical void arising from dominant focus on the econometrical paradigm in CSA adoption. The research's contribution further lies in its use of a bottom-up approach to feed into development of strategies and policies that may drive promotion of adoption of CSA approaches by different farmer groups of men and women in the developing regions.

The theoretical framings of gender mainstreaming applied in Article 1 of the thesis included both orthodox and contemporary feminisms in gender mainstreaming. Through the innovative consideration of African feminisms and intersectionality, the thesis contributes to scholarly architecture on contemporary gender mainstreaming which cross-examines insufficiencies of conventional gender mainstreaming approaches, providing alternative gender mainstreaming pathways that can account for the missing voice of local communities in sharing their contextual perspectives and realities. This thesis advances an alternative integrative approach to gender mainstreaming, of relevance in addressing gender inequality in resilience-building in CSA. Such an integrative approach constitutes a paradigm shift in gender mainstreaming in development.

In undertaking an in-depth assessment of drivers of CSA technology adoption and linking this to gendered-vulnerability through the gendered-PAR model, this thesis improves understanding of the multi-faceted nature of CSA adoption in an era where a linear approach has traditionally attempted to frame adoption. Therefore, through Article 2 the thesis contributes to the CSA adoption discourse where need for qualitative insights into CSA adoption dynamics to complement econometrics is gaining traction. In establishing a link between the drivers of adoption, dis-adoption and non-adoption, and gendered-vulnerability the thesis adds new knowledge from the underexplored relationship between CSA and DRR.

In Article 3 where the gendered approach to CSA adoption is explored through a socio-psychological lens, the thesis enhances understanding of the micro-level dynamism of decision-making among men and women smallholder-farmers. By identifying gender-differentiated socio-psychological determinants the thesis provides new theoretical insights on the micro-level beliefs, cognitive and social processes interacting to determine resilience and adaptation decisions of at-risk farmers. The thesis extends literature advocating for a paradigm shift within the framings of technology adoption for resilience, from a parochial perception that decisions are made on the basis of the benefits of a proposed technology, towards understanding that adoption decisions are framed by wider perspectives that include socio-psychological dimensions.

Through article 4 the thesis contributes to existing literature in both CSA and DRR disciplines by providing a normative, gender-sensitive CSA adoption framework. In the proposed framework, thesis contribution is on conceptualisation and operationalisation of the relationship between CSA and DRR through resilience-building. The proposed framework can be adapted and contextualised for normative application in diverse CSA or DRR contexts in developing regions. Its distinctive goal towards gendered equitable resilience provides a vehicle through which gender equity and equality may be pursued to contribute towards resilience. Furthermore, through article 4 the thesis contributes to the eclectic CSA and resilience discourse by proposing a framework whose conceptualisation is broader than has traditionally been considered.

The thesis was anchored on the broad and dynamic variables of gender and CSA, where CSA was considered in relation to DRR in developing regions already contending with increasing climate risk. Each of these concepts exists in a controversial space, marred by debates and antagonism and a thirst for new engagement dimensions. Through all the four articles, this thesis does not shy away from rocking the scholarly boats of all three, but rather makes a bold attempt to wade through, interrogating existing paradigms and shedding new insights to scholarship in regions of the global South. In tackling the extant orthodoxies, the thesis submits contemporary insights to steer transformation and alternative pragmatic pathways to address gender inequality and its influence on adoption of technologies aimed at resilience-building. Lastly, the thesis contributes by identifying future research frontiers, specifically making a clarion call for more research engrained upon the relationship of CSA and DRR. Moving forward, agricultural transformation in the climate change discourse requires empirical studies investigating issues of equitable resilience and social injustices across various social demographics. While there is scope for resilience-thinking in CSA and contemporary feminism approaches in gender mainstreaming, literature on these subjects is sparse.

7.4 Recommendations

Drawing from the four articles produced in this research the following recommendations are made:

Embrace holistic, trans-disciplinary approach to CSA in research, practice and policy. The gendered approach to CSA adoption undertaken in this study revealed that the agriculture discipline cannot single-handedly steer the CSA agenda. Based on empirical evidence, such a parochial approach is insufficient in addressing various dimensions of CSA adoption, especially when issues of dis-adoption and non-adoption are probed. Drawing from experiential evidence, the thesis posits that an inter-institutional poly-centric collective approach that brings together practitioners and researchers from diverse disciplines be taken so that at farmer-level within CSA, underlying risk factors and dynamic pressures anchored by gender inequality and gendered-vulnerability which tend to especially limit diverse women farmers, can be addressed.

Promote inclusive gender equal participation of local communities in CSA research, policy formulation and implementation. The proposed gender-sensitive CSA adoption framework is anchored on people-centredness where farmers, regardless of their gender are recognised as key actors in CSA. This means farmers are recognised as both recipients and innovators of technologies, as those with knowledge, including indigenous knowledge that can be applied to inform technology development, or to modify developed technologies. Participation of local communities will facilitate multi-directional flow of information, incorporate local perspectives and realities in CSA technology development and dissemination, while also harnessing strengths of local social capital to improve adoption.

Promote integration of orthodox and contemporary feminism theories to inform gender mainstreaming in CSA and DRR, contributing towards inclusive gender equal participation. The thesis established inadequacies of traditional gender mainstreaming approaches such as WID, WAD and GAD. These often fail to acknowledge the heterogeneity of smallholder-farmers, with likely consequential outcomes of perpetuating gender inequalities and stereotypes, or possible creation of new inequalities, and entrenching the undesirable ‘one-size-fits-all’ approach. An integration of orthodox and contemporary gender mainstreaming approaches may direct pragmatic transformation of CSA implementation from a dominant focus on practical gender needs, towards addressing structural gender issues. Integrated gender mainstreaming approaches are likely to include local perspectives and realities, with a tack on patriarchy, women’s subordination, while also drawing on the inherent capacities of the diverse women to achieve egalitarianism.

Embrace resilience-thinking in CSA to inform research, policies and implementation strategies. The basis of a resilience approach in CSA draws from the second pillar of CSA, which also establishes the conceptual link between CSA and DRR. This paper recommends that domesticating CSA within DRR creates opportunities for more collective action that will address complexity of gendered-vulnerability that otherwise tends to inhibit CSA adoption. A resilience-thinking approach in CSA unearths other aspects of CSA adoption that would remain hidden within a simplistic linear approach. A resilience lens stimulates more consideration to transformation and equality goals as CSA is informed from a broader perspective. Importantly, contemporary resilience-thinking should form the basis of any attempts to build resilience of smallholder-farmers.

Build resilience of diverse categories of smallholder-farmers through improved CSA adoption by operationalising the proposed normative, gender-sensitive CSA adoption framework. The proposed normative framework derives its utilitarian value from the fact that some of its components constitute part of on-going work that needs simple modifications. For instance, in developing countries vulnerability studies and risk assessments are conducted, although few pay attention to gender, or where this is done it is framed by parochial traditional approaches already alluded to. However, in pursuit of transformation, the framework proposes that studies and assessments should apply integrated gender mainstreaming approaches to inform CSA technology development and drive adoption by both men and women smallholder-farmers of diverse backgrounds. In using the proposed framework to guide CSA adoption strategies, systemic components of adoption are considered in a gender-sensitive way.

Pursue transdisciplinary research in the area of gender, CSA and resilience-building. The thesis amplifies relevance of the 'gender-CSA-DRR' nexus in the face of climatic risk in smallholder agriculture where primary actors at the frontline are diverse women. Currently literature on the interconnections is sparse, yet policy, practice and research in the broader development spectrum stands to benefit from generation of more evidence. Further research on resilience in smallholder agriculture also needs to be conducted, and the proposed gender-sensitive framework may be a starting point.

7.5 Limitations and identified research frontiers for future

The study was context-specific, and this limits external validity. However, the methodology used in the study may be adapted for replication in various similar developmental contexts. Within Southern Africa, where a number of in-land countries have a similar disaster risk profile, replication of the study could yield similar results. It is on this basis that this study suggests that

although the proposed framework was not tested in the study, this provides opportunity for future research to test applicability of the framework in any of the Southern African countries, or other developing regions. The key is sensitivity to site-specific contexts on issues of gender, inequality, power and agency.

CSA adoption itself is a difficult variable to assess through a cross-sectional survey. While the study was biased towards qualitative findings, longitudinal studies including establishment of a baseline, may be considered in future research. This would enhance investigation of transformation processes in tackling gender inequality, power balances and other social imbalances in resilience-building through adoption of climate-smart technologies. Longitudinal studies could also consider a larger quantitative sample when assessing socio-psychological determinants through models such as the extended technology acceptance model.

7.6 Chapter Conclusion

This study applied a gendered approach to CSA adoption by smallholder-farmers. From the onset it was imperative to appreciate how gender was contextualised at local level. This was in line with the study's attempt to probe the tensions between gender and CSA adoption in disaster-prone smallholder farming regions in Malawi and Zambia, therefrom developing a gender-sensitive CSA adoption framework that can be contextualised for developing regions as alluded to in Chapter 1. The thesis was informed by a combination of transformative and pragmatism worldviews. The study was informed by a literature study from which theoretical framings of the broad variables of the study gender, technology adoption and CSA were established. CSA was also conceptualised on the basis of its relationship with DRR, which provided ground to explore CSA adoption on its resilience-building function.

The study was also informed by empirical data collected through an exploratory-sequential mixed methods study design. The methodology of the study sought to address some of the methodological flaws of previous CSA adoption studies. Chief among these being the dominance of econometric paradigm that plays blind to the narrative-rich qualitative methodologies that could enhance understanding of the CSA adoption dynamics. Hence, a mixed methods approach with a bias on qualitative findings was more appropriate to explore CSA adoption through a gender lens.

In this study interrogation of CSA adoption through a gender lens took a broad perspective, beginning with the establishment of gender-differentiated profiles of CSA adopters, dis-adopters and non-adopters. This was achieved through Article 1 in Chapter 3, which shed light on the heterogeneity of smallholder-farmers beyond the conventional man/ woman gender dichotomies. The article also assessed the underlying socio-cultural milieu within which CSA adoption was

occurring, where theoretical framings were drawn from traditional and contemporary feminist theories that shaped or could shape gender mainstreaming respectively. While intersectionality is already gaining traction in CSA, on the other hand emergent African feminisms primarily situated within the literary arts were also considered in relation to the identified need to frame gender within local contexts and perspectives.

Based on Article 1 it was imperative to follow up and explore gender-differentiated drivers of CSA adoption, dis-adoption and non-adoption. This was done through Article 2 in Chapter 4 where gendered-vulnerability and inequality were identified as responsible for differentiated drivers established from empirical data. Building on the relationship of CSA and DRR, findings were also explored through a gendered-PAR model. Some of the findings from Article 2 were also suggestive of possible behavioural and attitudinal determinants of decision-making in CSA. Thus, through Article 3 in Chapter 5, this was further probed in a socio-psychological approach where applicability of the extended technology acceptance model (TAM2) CSA technology adoption was tested. Through this model gender-differentiated socio-psychological determinants categorised into cognitive, social and behavioural processes were found to shape farmers' adoption decisions. Taken together, the first three articles illuminated underlying gender inequality and vulnerability responsible for most of the adoption barriers mainly faced by diverse groups of women irrespective of their civic status.

The traditional linear approach that informs current thinking in CSA adoption was insufficient to address identified gender issues and this stimulated thought on how CSA adoption could be improved through gender-sensitive strategies which would enhance climate resilience among farmers as sought by CSA. A normative gender-sensitive CSA adoption framework was proposed in Article 4 in Chapter 6. The framework was developed from a resilience-thinking perspective base on the second pillar of CSA, and gives recognition to the three resilience dimensions. While exploiting synergies among the three, transformative resilience was specifically considered for its potential to steer transformative measures that would confront gender inequality and vulnerability.

The proposed framework is targeted for use at local level, from the district up to villages and draws its pragmatism on that it builds on processes that are implemented in the communities, but demanding a gender focus. Operationalisation of the framework will require inter-institutional co-operation because, as shown by the study findings in all the articles, the gender issues in CSA cannot be addressed through agriculture departments alone, even where gender personnel existed within the agriculture department. Although this provides a good starting point, other disciplines need to be incorporated to achieve transformation where required, from household and community levels, feeding into large-scale transformation processes in institutional and policy architecture.

In synthesis, the study showed that there exist gender-differentiated barriers to CSA adoption, which mainly affected diverse groups of women, which need to be addressed in order to enhance climate resilience of smallholder-farmers through CSA. There also exist opportunities that can be optimised to improve CSA adoption. All three major aspects of this thesis, gender, CSA adoption and smallholder-farming are prominent within the development landscape faced with increasing climate risk. Hence, a gendered approach to CSA adoption remains relevant as part of efforts to enhancing farmers to *'build back better equitably and equally, leaving no-one behind'*.

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ANNEXURES

APPENDIX A: LETTERS OF PERMISSION FROM CO-AUTHORS

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20 November 2019

To whom it may concern,

LETTER OF PERMISSION TO INCLUDE CO-AUTHORED ARTICLES IN PHD THESIS: S KHOZA

This letter confirms that Ms. Sizwile Khoza (PhD Student, Number 29795397) has been granted permission to include the following four co-authored research articles in her PhD thesis submission;

- Khoza S., Van Niekerk, D and Nemakonde L. D. (2019), Understanding gender dimensions of climate-smart agriculture adoption in disaster-prone smallholder farming communities in Malawi and Zambia, *Disaster Prevention and Management: An International Journal* (published)
- Khoza S., Van Niekerk, D and Nemakonde L. D. (2019), Vulnerability and inequality: A gendered approach to understanding drivers of climate-smart agriculture technology adoption among smallholder-farmers in Malawi and Zambia, (submitted to Journal of Peasant Studies)
- Khoza S., De Beer, L., Van Niekerk, D and Nemakonde L. D. (2019), A gender-differentiated analysis of climate smart agriculture adoption by smallholder farmers: Application of the Extended Technology Acceptance Model, (submitted to Gender, Technology and Development)
- Khoza S., Van Niekerk, D and Nemakonde L. D. (2019), Rethinking climate-smart agriculture adoption by smallholder-farmers: A proposed new gender-sensitive adoption framework (upcoming book chapter)

Ms. Khoza was the main author in all the articles that constitute her PhD study, while in our role as promotor and co-promotor respectively, we provided academic direction and support in the conceptualisation, review and editing in all the papers.

I do hope this is in order.

Yours sincerely,

Prof. Dewald van Niekerk (and on behalf of Dr. L. Nemakonde)
Head: African Centre for Disaster Studies
Unit for Environmental Sciences and Management
Faculty of Natural and Agricultural Sciences
North-West University
South Africa

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South Africa, 2520

Tel: 018 299-1111/2222
Web: http://www.nwu.ac.za

November 2019

RE: Confirmation of co-authorship

To whom it may concern,

This is to confirm that I, the undersigned, provided permission to be added as a co-author to the article titled: ***A gender-differentiated analysis of climate smart agriculture adoption by smallholder farmers: Application of the Extended Technology Acceptance Model for potential publication*** in the journal: Gender, Technology and Development (Taylor and Francis).

I trust you will find this in order.

Yours sincerely,

Prof. Leon de Beer
Associate Professor
WorkWell Research Unit
Potchefstroom Campus
DeBeer.Leon@nwu.ac.za

WorkWell Research Unit

APPENDIX B: EDITOR'S LETTER

Dynamic Language &
Translation Specialists

Antoinette Bisschoff
71 Esselen Street,
Potchefstroom
Tel: 018 293 3046
Cell: 082 878 5183
Language@dlts.co.za
CC No: 1995/017794/23

Friday, 22 November 2019

To whom it may concern

Re: Confirmation of language edit, typography and technical precision

Chapters 1 and 2 of the PhD thesis: "*A gendered approach to climate smart agriculture adoption by smallholder farmers in Malawi and Zambia*" by S Khoza was edited for language precision.

Final, last minute corrections remain the responsibility of the author.

Antoinette Bisschoff

BA Languages (UPE – now NMU); MBA (PU for CHE – now NWU); Translation and Linguistic Studies (NWU)

Officially approved language editor of the NWU since 1998
Member of SA Translators Institute (no. 100181)

APPENDIX C: RESEARCH ETHICS CLEARANCE

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Prof Nico Smit
Director: Unit for Environmental
Sciences and Management
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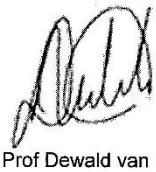
Fax: +27 18 299 2370

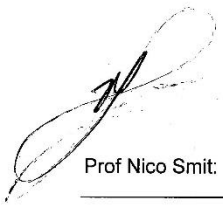
To whom it may concern

The following student is conducting research in Disaster Risk Sciences and with zero risk.

Name	: Me. S. Khoza
Student nr	: 29795397
Degree	: Ph.D (N901P)
Title	: A gendered approach to the adoption of climate smart agriculture by smallholder farmers in Malawi and Zambia
Supervisor	: Prof Dewald van Niekerk
Co-supervisor	: Dr. Livhuwani Nemakonde



Prof Dewald van Niekerk: Chair of the Scientific Committee: Disaster Risk Sciences sub-programme, Unit for Environmental Sciences and Management.



Prof Nico Smit: Director, Unit for Environmental Sciences and Management

Recommendation of the Research Proposal Committee to the Research Ethics Committee Research Using Human Participants

Title of the study:	A gendered approach to the adoption of climate smart agriculture by smallholder farmers in Malawi and Zambia		
Researchers involved in the study:	Sizwile Nyamande Prof. Dewald van Niekerk Dr. Livhuwani Nemakonde		
Executive summary of the research:	The proposed study seeks to address the problem of how gender interplays with adoption of CSA among smallholder farmers (SHFs) in Malawi and Zambia. Literature reviewed identifies the problem of low adoption, dis-adoption or the rejection of climate smart agriculture (CSA) technology by SHFs but there is paucity of documentation and findings on how gender interplays with CSA adoption. The study makes its departure from technology acceptance and adoption theories and models such as the Extended Technology Acceptance Model (TAM2) and the Unified Theory of Acceptance and Use of Technology (UTAUT) which use social constructs, as well as feminist theories of empowerment, gender and development. The purpose of the study is to develop, through bottom-up participatory engagement of SHFs, an adoption framework that considers gender mainstreaming in the promotion of CSA adoption in the face of climate-induced disasters affecting smallholder farming. The proposed study being transformative exploratory sequential mixed methods in nature will involve collection of qualitative and quantitative data in a three-phase process, starting with qualitative data collection, whose analysis will lead to design of a questionnaire to collect quantitative data from both male and female CSA and non-CSA smallholder farmers. The adoption framework and SHF profiles produced by the study can be adapted for use within the contextual settings of the SADC countries and beyond. The framework will also be useful in informing policy and programming by governments and development partners in the countries, and guide further investment in CSA.		
Potential risk level for human participants:	No risk		Motivate: The risk is likely to be discomfort that may arise due to the fact that discussions during interviews will address male-female relations in the participants' socio-cultural context. Participants may also be inconvienced by the amount of time taken during data collection through interview guides and questionnaires. However the researcher will endeavour to collect data from separate groups of male and female farmers to enable both groups, especially the women to fully express themselves. The interview guides and questionnaires will be succinct to avoid taking too much time from the research participants' schedules. For the household interviews the questionnaires will be administered in the local languages to enable the respondents to fully comprehend the
	Minimal risk	✓	
	Medium risk		
	High risk		

			questions.
Potential risk level for children and incapacitated adults:	No risk	✓	Motivate: There is no anticipated risk for children and incapacitated adults as the study does not primarily target them for data collection. However given that women farmers may also have the reproductive role in their families and the community the research will ensure that the role is not disturbed. HHIs and FGDs will be brief and conducted in the homesteads for the former and over the shortest possible distance in the latter. Where nursing mothers are identified to be part of the FGDs they will be allowed to bring their children to the meetings.
	No more than minimal risk of harm		
	Greater than minimal risk with the prospect of direct benefit		
	Greater than minimal risk with no direct benefit		
Recommendation for the ethics committee	Expedited review	✓	Motivate: The proposed study requires an expedited review because it looks at gender and the socio-cultural context of smallholder farmers. The expedited review will allow the student to commence the study.
	Full review		
	Exempted from review		
Any additional comments			

Committee members present during the review	**Members present**	**Signatures**
	Dr. Christo Coetzee	
	Dr. Livhuwani Nemakonde	
	Me. Kristel Fourie	
	Mrs. Leandri Kruger	
	Mr. Bradley Shoroma	
	Mr. Gideon Wentink	
	Prof. Dewald van Niekerk	
Date of review	2 June 2017	

Signature of the Chairperson

Signature of the Research Director

2 June 2017
Date

Date

Decision of the Ethics Committee:

Expedited review		**Motivate:**
Full review		
Exempted from review		

Signature of the Chairperson of the Research Ethics Committee

Date

APPENDIX D: CORRESPONDENCE FOR STUDY CLEARANCE

AFRICAN CENTRE FOR DISASTER STUDIES
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31 January 2018

To whom it may concern

PERMISSION TO COLLECT DATA: MS. SIZWILE NYAMANDE

Ms. Sizwile Nyamande (Passport number BN772492, Student Number 29795397) is a PhD student at the North West University, Potchefstroom, South Africa enrolled in the Doctor of Science (Disaster Risk Science) course. Her thesis is titled: ***A gendered approach to climate smart agriculture adoption by smallholder farmers in Malawi and Zambia***. The main purpose of the study is to develop a framework that considers gender mainstreaming in the promotion of CSA adoption in the face of climate-induced disasters affecting smallholder farming.

In partial fulfilment of the requirements of our PhD course Ms. Nyamande needs to gather data from officials and communities by way of key informant interviews, focus group discussions and individual farmer interviews at household level in Chikwawa, Malawi and Gwembe, Zambia. These countries have been selected because in both there is smallholder farming which depends on rain-fed agriculture, they are already dealing with the climate change impacts of changing rainfall and temperature patterns, and in recognition of the extensive work that has been conducted in climate smart agriculture this far. Study in these two countries will also offer new learning opportunities for the student.

In light of the above, your office is requested to assist by permitting the student to collect data required for her study from the various sources under your jurisdiction as outlined in the attached data collection schedule. You are also invited to share your

experience and understanding in the subject area thus informing the development of the CSA adoption model.

Please note that participation by all interviewees will be confidential and voluntary as outlined in the attached consent letter.

Should any further information be required in connection with this study kindly contact the undersigned on the contact details stated on the letterhead. Thanking you in advance for your assistance in this regard.

Yours sincerely,

Prof. Dewald van Niekerk
Head: African Centre for Disaster Studies
Unit for Environmental Sciences and Management

School of Geo- and Spatial Sciences
Faculty of Natural and Agricultural Sciences
North-West University
South Africa

Tel.: (265) 01 420 214
Fax: (265) 01 420 214
Email: chikwawada@yahoo.com

Republic of Malawi

Communications should be addressed to;
The District Commissioner
Chikwawa District Assembly
Private Bag 1
CHIKWAWA

13 February 2018

Dear Prof. D. van Niekerk,

REF: PERMISSION TO COLLECT DATA: MS. SIZWILE NYAMANDE

The above matter refers.

Reference is made to your letter of request for Ms. Sizwile Nyamande (Student Number 29795397, Passport Number BN772492) to be granted permission to collect data for her PhD research in Chikwawa District of the Southern Region in Malawi. I am pleased to advise that permission to collect the required data as outlined in the fieldwork methodology she shared with us has been granted. She will be supported by relevant offices in the district office of the Ministry of Agriculture, Irrigation and Water Development. Her point of entry at the community level will be the Agriculture Extension Development Officers.

Should there be any need for clarification, you can contact me personally on +265 (0)991 058 660 or jonakafa@gmail.com.

May I take this opportunity to wish the student well in her exercise and my office will be available to offer the necessary support.

Yours sincerely,

JONATHAN KAFAUSIYANJI

Principal Irrigation Officer – Chikwawa.

(49)

All correspondence should be addressed to:
The Director of Agriculture
Telephone: Lusaka [illegible]
[illegible]

In reply please quote:
No. DAH/7/8/3

REPUBLIC OF ZAMBIA

MINISTRY OF AGRICULTURE

DEPARTMENT OF AGRICULTURE
MULUNGUSHI HOUSE
INDEPENDENCE AVENUE
P.O. BOX [illegible]
LUSAKA - ZAMBIA

13th February 2018

Programme Against Malnutrition
P. O .Box 30599
LUSAKA

REF: AUTHORITY FOR MS. SIZWILE NYAMANDE TO CONDUCT STUDY ON CLIMATE SMART AGRICULTURE IN GWEMBE DISTRICT

Reference is made to your letter PAM/STF/182 dated 7th February 2018 on the Authority for Ms. Sizwile Nyamande to conduct a study on Ciimate Smart Agriculture in Gwembe District.

I have no objection for Ms. Sizwile Nyamande to conduct this study because the subject is of great benefit to Zambia including Programme Against Malnutrition (PAM) in particular as we promote adaptation and mitigation strategies among small scale farmers in Zambia.

Peter K. Lungu
Director
DEPARTMENT OF AGRICULTURE

APPENDIX E: JOURNAL REQUIREMENTS AND AUTHOR GUIDELINES

DISASTER PREVENTION AND MANAGEMENT

ARTICLE 1 PUBLISHED IN THIS JOURNAL

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2018 Impact Factor: **1.247*** CiteScore 2018: **1.74**
5-year Impact Factor (2018): **1.483*** CiteScoreTracker 2019: **1.28** (Updated Monthly)

Our new journal cover features Tlaloc, the Aztec deity associated with rain and water as well as soil fertility.

It is believed to live in mountains and to be the cause of storm, hail, lightning and thunder, thus reflecting both the positive and negative nature of natural hazards.

Disaster Prevention and Management (DPM) advances knowledge in the field of disaster risk reduction and management.

DPM bridges the gap between academic disciplines and stakeholders, including policy makers, practitioners, representatives of the civil society and local communities. It particularly welcomes contributions which emphasise multi-disciplinary and multi-actor perspectives on innovative topics related to disaster risk reduction and management.

Watch the latest videos from the Disaster Prevention and Management Seminar Series @ The University of Auckland

The journal covers:

- Hazards and disasters studies
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- Impacts of and response to disasters
- Post-disaster recovery

The journal encourages the contribution of junior scholars, authors from less affluent countries and non-native English speakers. Support is provided to assist them throughout the reviewing and publication of their manuscript.

The journal publishes two types of articles. Long papers (up to 7,000 words) cover conceptual and theoretical reflections, methodological contributions and case studies. Short articles (up to 4,000 words) including commentaries, policy and practice briefings and field reports and book reviews. For the latter, reviewers are encouraged to send their review to the book author(s) to solicit a reply, which will be published along with the review. All articles submitted are subject to a double-blind peer review, for a full list of our referees please see below.

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Reducing and managing the risk of disaster in Philippine jails and prisons

Jails and prisons and their inmates and prisoners often suffer silently from natural hazards and disasters.

Many jails and prisons, in such diverse contexts as Indonesia following the 2004 tsunami and the United States of America when Hurricane Katrina struck in 2005, have been badly affected by natural hazards in recent years. In the Philippines, typhoons Ondoy, in 2009, and Yolanda, in 2013, severely impacted jails and prisons in Metro Manila and Eastern Visayas.

Find out more in this policy briefing.

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Cooperation towards disaster risk reduction in the Belt and Road region

Regional disaster risk reduction (DRR) is one of the essential tools to minimise losses caused by natural hazards across country borders.

Due to geological, social, cultural and political resemblance, different countries from one region often share similar characteristics of disaster risks, which make regional DRR possible and efficient. Among many other regional alliances, the Belt and Road (B&R) region is a new concept proposed by the Chinese government to promote the connectivity of Asian, European and African continents, within which regional cooperation of DRR should play a role.

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The effectiveness of hazard risk communication- expert and community perspective on Orewa in Auckland, New Zealand

In recent years, there have been considerable advances in data observation, modelling and analysis of natural hazard forecasting for disaster risk and reduction.

However, the most important factor in risk reduction is, arguably, the ability to successfully communicate these natural hazard forecasts to the communities they will affect. The small coastal community of Orewa in Auckland, New Zealand, was selected in order to study hazard communication and risk reduction. Two surveys were undertaken; the first involving emergency management and disaster risk resilience experts, together with academics. The second focused on members of the Orewa community.

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- DPM Reviewers

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  Liezel Longboan
  Volume: 27 Issue: 4

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JOURNAL OF PEASANT STUDIES

ARTICLE 2 SUBMITTED IN THIS JOURNAL

Journal

The Journal of Peasant Studies ›

This journal

Aims and scope

2018 Impact Factor: 4.754

Ranking: 1/90 (Anthropology); 1/41 (Development Studies)

2018 5-Year Impact Factor: 6.160

A leading journal in the field of rural politics and development, *The Journal of Peasant Studies* (*JPS*) provokes and promotes critical thinking about social structures, institutions, actors and processes of change in and in relation to the rural world. It fosters inquiry into how agrarian power relations between classes and other social groups are created, understood, contested and transformed. *JPS* pays special attention to questions of 'agency' of marginalized groups in agrarian societies, particularly their autonomy and capacity to interpret – and change – their conditions.

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The Journal of Peasant Studies ›

This journal

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GENDER, TECHNOLOGY AND DEVELOPMENT

ARTICLE 3 SUBMITTED TO THIS JOURNAL

Journal

Gender, Technology and Development ›

This journal

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Journal

Gender, Technology and Development ›

This journal

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AFRICAN HANDBOOK OF CLIMATE CHANGE ADAPTATION: LEARNING, SHARING AND ADVANCING EFFORTS TO PROMOTE CLIMATE CHANGE ADAPTATION IN AFRICA

ARTICLE 4 ACCEPTED

ABSTRACT ACCEPTENCE 211: AFRICA 2030- Strenghtening the Capacity of African Countries to Handle the Challenges of a Changing Environment Inbox

Jelena Barbir Tue, Nov 5, 10:13 AM (3 days ago)
to me

Dear Colleague,

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Rgds,
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Chapter 7
Managing the Impacts of Climate Change in Latin America: The Need for Technology Transfer

Walter Leal Filho and Franziska Mannke

Abstract Due to its geo-political characteristics and social and economic features, the Latin American region is considered as being among the most vulnerable ones, as far as climate change is concerned. The combination of two further important elements, namely limited access to technologies and restricted adaptation capacity, may help to explain why the region is so vulnerable and is likely to remain so, unless fundamental changes in decision-making processes are implemented. From an objective point of view, decision-making processes may play a key role in facilitating the ways countries perceive and, as importantly, manage the impacts of climate change. Yet, there is a paucity of research which looks at the extent to which the sound management of the impacts of climate change may take place, across Latin America, in a systematic way. This paper addresses this need, by discussing the extent to which individual Latin American countries handle matters related to climate change, and by illustrating a number of the problems and deficiencies which have been limiting progresses over the past two decades. It also describes some of the recent and on-going initiatives from across the region, and introduces the project CELA, an initiative to promote technology transfer on climate change by means of cooperation between universities in the European Union and Latin American nations.

Keywords Climate change • Latin America • Vulnerability • Impacts • Technology transfer

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