IMPACT OF RAIN-FED LOWLAND RICE PRODUCTION PROJECT ON THE LIVELIHOODS OF BENEFICIARIES IN GHANA

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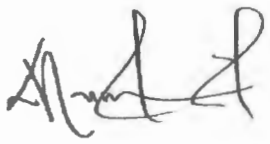
DECLARATION

I Eliasu Mumuni, declare that this thesis titled *"Impact of Rain-fed Lowland Rice Production Project on the Livelihoods of Beneficiaries in Ghana"*, hereby submitted for the degree of Doctor of Philosophy (PhD) in Agricultural Extension at the North West University of South Africa, has not been previously submitted by me or any other person for a degree at this or any other University. I further declare that this is my work in design and execution and that all materials contained herein have been duly acknowledged.

Signed: 

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ABSTRACT

The impact study of the rain-fed rice production project on the livelihoods of the farmers was done to determine the level of change on their livelihood status and to inform policy. This study therefore examines the differences and change on the natural, physical, human, social and financial capital of rice farmers on the project. The research was conducted in Ashanti and Northern regions of Ghana. Three hundred respondents from a total of 2,221 rice farmers were sampled using proportions and probability sampling methods. Wilcoxon sign rank test and paired t-test were used to test the differences in livelihood capital of the respondents. The statistical software, IBM-SPSS version 22, was used to analyse data with descriptive statistics such as frequency counts, z scores and percentages for interpretation.

The results revealed that, 86% of respondents were males, 36% were within the 46 -60 age bracket, age group. Many of the respondents 53% had 1-10 years' experience in rice cultivation. Thirty-six percent had basic of level education with only 5% having tertiary education. Forty-two percent of respondents had a yield between 2.9 - 3.9ton/ha. The study revealed that 39% of farmers earn within 1000-2000GHc per season from rice alone followed by 15% who earn 2000-3000GHC, 12% for 3000GHC and 11% earning over 5000GHC.

The results from the Wilcoxon sign rank and test statistics revealed that all the livelihood capital of respondents showed a strong significant difference. At $p < 0.05$, the variable indicators measuring the livelihoods include; water utilisation (z=-14.829) land access and utilisation (z=-10.222), land tenancy arrangement (z=-15.065) and soil fertility management of the lands/soil (z= -9.2) showed a strong significant difference. The indicators measuring the physical capital also revealed similar significant differences after respondents participated in the project at $p < 0.05$ which include; processing facilities (z=-5.904) irrigation infrastructure (z= -5.581) housing facilities (z= -5.045) access to market (z= -6.17) access to telephone (z= -2.354). In terms of human and social capital of respondents at $p < 0.05$, rice skills training (z= -14.267) training in land management (z= -15.229), extension service (z= -

12.655), marketing skills (z= -14.111), water management (z= -15.391) had a similar feedback. Relationship with relatives and neighbours (z= -7.552), labour networking (z= -7.153), network with financial institutions (z= -10.927), network with farmers' associations (z= -5.250), networking with input dealers by farmers (z=-9.849) also revealed significant differences. Similarly, the financial capital of respondents showed significant changes with farm incomes (z = -3.211), non -farm income/revenues (z= 3.475), savings (z= -5.250), self-help groups savings (z= -8.248), and self –help groups loan (FBOs) (z= -2.646). These are indications that there are significant differences and changes in the livelihood capital of respondents after participating in the project. The study concludes that access to livelihood capital of farmers increased exponentially after the technical project intervention. It is recommended that irrigation infrastructure, farm roads and access to credit facilities should be improved by government for farmers and that such projects should be replicated to other parts of the country.

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LIST OF ABBREVIATIONS AND ACRONYMS

RADU	Regional Agriculture Development Unit
DADU	District Agriculture Development Unit
AEAs	Agriculture Extension Agents
MOFA	Ministry of Food and Agriculture
DCS	Directorate of Crop Services
JICA	Japan International Cooperation Agency
UNDP	United Nations Development Programme
SSA	Sub Saharan Africa
GDP	Gross Domestic Product
GoG	Government of Ghana
GSS	Ghana Statistical Services
IFAD	International Fund for Agricultural Development
PPMED	Policy Planning Monitoring and Evaluation Directorate
DAO	District Agriculture Office
DDA	District Director of Agriculture
FASDEP	Food and Agriculture Sector Development Policy
METASIP	Medium-Term Agriculture Sector Investment Plan
NRDS	National Rice Development Strategy
DA	District Assembly
FAO	Food and Agriculture Organisation
OECD	Organisation for Economic Co-operation and Development
LDCs	Least Developed Countries
PCU	Project Coordinating Unit
WTO	World Trade Organisation
AGRA	Alliance for Green revolution in Africa

CHAPTER ONE

1.0. INTRODUCTION

1.1 BACKGROUND

Agriculture is a fundamental human activity, providing human societies with food, clothing, medicine and other useful products. It also provides a number of vital ecosystem services such as biodiversity, soil formation, water regulation, and carbon sequestration and more (Food and Agriculture Organisation-FAO, 2003). Approximately 1.5 billion people are engaged in smallholder agriculture across the world (Ferris Shaun *et al.*, 2014; IAAKATD, 2009 p 15). This figure includes a 75 percent of the world's poorest people whose food, income and livelihood prospects depend on agriculture (Ferris Shaun *et al.*, 2014). According to the Organisation for Economic Cooperation and Development (OECD) (2010), agriculture is undoubtedly seen as a bigger contributor to reducing poverty in a mass form than any other intervention. It embodies all categories and actors in its cycle of creating jobs and improving household incomes from primary producers to secondary processors and consumers making a unique livelihood option and a greater tool in development especially for Least Developed Countries (LDC). According to Shakhovskoy (2014), on the initiative for smallholder finance, an estimated amount of over $8 billion is spent annually on agricultural technical cooperation and assistance in third world countries such as Ghana and others. However, with about 450 million small scale farmers in these developing countries, a meagre amount of only $18.66 reaches each smallholder farmer per year.

The world has 1.2 billion extremely poor people and about 75% live in rural areas and largely depend on agriculture, forestry, fisheries and related activities for survival (Anriquez and Stamoulis, 2007). Development through agriculture as a strategy is perceived by experts as a process covering the achievement of a number of success factors including job creation for the masses, food security, industrialization of the economy and overall poverty reduction.

These are plausible with efficient and effective agricultural policies, research, performance and management of infrastructure for sustainable agriculture (Abebe, 2000). The promotion of rural economy in a sustainable way has the potential of increasing employment opportunities in rural areas, reducing regional income disparities, stemming pre-mature rural-urban migration, and ultimately reducing poverty at its very source. According to sustainable development theories, countries typically move through three phases from agriculture-based, to transformation and then to urbanisation. China and India are clear examples where they have moved from being agriculture-based and have transformed in the last 20 years. These arguments are further confirmed by the International Fund for Agricultural Development-IFAD (2001) that for many developing countries, increased agricultural production is a key to poverty reduction.

In a country like Ghana where the share of agriculture in overall employment is large, broad-based growth in agricultural incomes is essential to stimulate growth in the overall economy, including the non-farm sectors selling to rural people. In 2011, agriculture accounted for 25.6% of Ghana's gross domestic product (GDP) and employed 41.6% of the working population in 2010 (Ghana Statistical Services-GSS, 2011). About 80% of agricultural production is from smallholder family-operated farms, mainly below one hectare (Banson, 2008). Larger holdings produce mainly cash crops such as oil palm, citrus, rubber and pineapples. Only about one third of land suitable for agriculture is currently cultivated (World Trade Organisation -WTO, 2001). Thus, the agricultural sector (especially the sub-sectors that produce food) is critical in the provision of livelihoods and incomes, and developments within this sector are most important in terms of attaining the Millennium Development Goals (MDGs) such as the elimination of poverty for Ghana (Banson, 2008). Hence, it is not surprising that the World Bank (2009) called for greater investments in agriculture and warned that the sector must be placed at the centre of the development agenda if the goals of halving extreme poverty and hunger by 2015 are to be realised.

Rice is the second most important cereal crop after maize in Ghana and contributes 9% of the food requirements of the country (Seidu, 2008). The demand for rice consumption has risen to higher levels through importation with less production capacities and volumes by countries in many parts of Africa. Rice production is a major source of employment, income generation and nutrition in many poor food-insecure countries in Sub Saharan Africa (SSA) and a livelihood module that needs support (Norman and Kebe, 2006). The numerous activities along the production and value chain provide employment to millions of people who work either directly in rice production or in related support services.

Rice is the staple food for more than 3.5 billion people worldwide (about half of the world's population). It is the most staple food in Asia, with 600 million people living in extreme poverty. Globally, rice consumption contributes between 30% and 70% of the people daily calorie intake (IRRI, 2014). In continents such as Africa and Latin America, rice is gradually becoming a significant and food security crop not only to poor farmers but also to governments. This is mainly due to the changing preferences of diet by citizens. In 2003, Africa produced about 15.08 million tons of paddy rice on 10.23 million Ha of land, 3.3% and 6.11% of the world's total rice production and rice area respectively. Urbanisation and changing consumer preferences are the main drivers of significant growth in per capita rice consumption, as urban populations consume significantly more rice than rural populations. From a steady level of 7-8 kg before the 1990's and 11.5kg during the 1990's, rice consumption per capita moved to 27 kg from 2001-2005 (Jalaludeen, 2012) revealing the significant change of dieting to rice.

Rice production and other major crops are largely rain-fed in Ghana, with traditional systems of farming still prevailing in most parts of the country. Production levels vary according to weather conditions since Ghana's irrigation potential remains almost untapped. Poor technology and small production units prohibit economies of scale which leads to sub-optimal yields. For example, maize and rice are produced at a third of their potential yields

per hectare due to limited investments by the government in the sector (OECD, 2010). Rice production is now a major source of livelihood to farmers as it is being traded as a cash crop.

According to the International Federation of Red Cross Society (2010), livelihoods are a means of making a living. It encompasses people's capabilities, assets, income and activities required to secure the necessities of life. The Federation further argued that, a livelihood is sustainable when it enables people to cope with and recover from shocks and stresses (such as natural disasters and economic or social upheavals) and enhance their well-being and that of future generations without undermining the natural environment or resource base. The Women Refugee Commission (2011) defines 'livelihoods as capabilities, assets and strategies that people use to make a living'. That is, to earn enough money to support themselves and their families through a variety of economic activities such as education, vocational and skills training programmes, income generation activities, food for work programmes, apprenticeship placement projects, micro-credit schemes, agricultural programmes and activities, business start-up programmes, seeds and tools projects, animal disbursement projects, self-employment and job placement programmes.

The goal of any livelihood strategy is to develop self-reliance and resilience. Rice farming, as a culture, is one of the livelihood options for a greater population of farmers as the world consumption level of the grain exponentially grows yearly (UNDP, 2010). Future increases in Ghana are projected by the Ministry of Food and Agriculture (MOFA) based on a combination of overall population growth, rising incomes and increasing urbanisation. Based on these, Ghana's MOFA estimates that the demand for rice in Ghana will increase at an annual growth rate of 11.8% from 939,920 metric tons to 1,644,221 metric tons between 2010 and 2015 (Millennium Development Authority, 2010). The total quantity of rice produced in Ghana in 2010 and 2012 stood at 491,603 and 485,500 (SRID, 2011, 2012) metric tons respectively against an estimated 900, 000 metric tons of rice required for the country causing shortfall of 314,500 tons of rice.

Over the past decades and through the Ministry of Food and Agriculture (MOFA), Ghana has been able to implement several diverse agricultural projects aimed at improving the fragile food security situation in the country. A few of such projects include the Root and Tuber Improvement and Marketing Programme, the Inland Valley Rice Development Project, the Sustainable Tree Crop Production, the Northern Rural Growth Programme, Rice Sector Support Programme and the Sustainable Development of Rain-fed Lowland Rice Development Project (CSD, 2010). To consolidate and clearly maximize the benefits of these projects, Food and Agricultural Sector Development Policy (FASDEP I and II) was developed as a policy guide with the aim of leveraging the technical expertise of all related stakeholders to develop the country's food and agricultural situation.

Agricultural projects are instituted to specifically address certain targets focusing on some strategic areas of agriculture in order to boost food security and reduce poverty for the rural poor and small scale farmers (IFAD, 2013). The basic logic of implementing agricultural projects is to intervene in such a way that it ultimately leads to higher and more secure incomes from agriculture. This can occur through a number of mechanisms including increased investments to the sector, greater input use, adoption of new technology, lower input prices or higher output prices, reduced risks and greater long-term sustainability (Winters *et al.,* 2010). Furthermore, the intention of a land-titling project is to improve tenure security and may induce greater investment in the natural capital for its beneficiaries. An agricultural extension project may lead to technology adoption that alters input use, increases productivity and improves the long-term management of agricultural lands (Mumuni, 2011). A crop insurance project provides an instrument to deal with risks allowing farmers to invest in more profitable yet potentially riskier activities and to avoid the dissimulation of assets when bad outcomes occur. A project that links smallholders to high value markets may increase input costs, but might lead to much higher prices for output and thus greater profits (Leibniz Institute of Agricultural Development in Central and Eastern Europe -IAMO, 2003).

Premised on these analyses, the government of Ghana spent over $450million each year on imports, representing 70% of the rice consumption requirements of the country with only 30% produced locally (NRDS, 2009). This put a huge burden on the budget of the government given that the taste of the citizens shifted towards rice delicacies. The government then introduced a rain-fed rice project as an intervention measure to boost production and increase the incomes and profitability of famers.

The introduction of the Project for Sustainable Development of Rain-fed Lowland Rice Production from 2009 to 2014 was critical to the smallholder rice farmers in Ghana. Implemented by MOFA and supported by Japan International Cooperation Agency -JICA, the project was aimed at increasing the income of farmers through interventions such as strengthening of farmer organizations, farming management capacity, post-harvest technologies, credit utilisation and marketing capacity. Another dimension focused was on capacity development of extension workers and farmers, improvement of extension systems to facilitate well-planned extension activities and to establish an effective and efficient extension methodology. Also, self –effort by farmers towards improvement of rice production and increasing rice cultivated area is essential.

1.2.THE PROJECT FOR SUSTAINABLE DEVELOPMENT OF RAIN-FED LOWLAND RICE PRODUCTION

The government of Ghana requested the Japanese government to support the implementation of *"The Project for Sustainable Development of Rain-Fed Lowland Rice Production in The Republic of Ghana"*. This was after a joint feasibility study was carried out on the rice production situation in Ghana between 2007-2008 by the respective government agencies, thus JICA and MOFA. Ultimately, MOFA and JICA representing Ghana and Japan respectively signed a Technical Cooperation agreement that saw the full implementation of a rain-fed rice project.

The need to implement the project was based on the fact that 80% of domestic rice was produced semi-intensively in lowland ecologies in the country by the small scale rice farmers. This was expected to have significant impacts on poverty reduction by supporting the rice farmers who relied on unstable farming systems as well as increase farmers' incomes in line with the National Rice Development Strategy (NRDS) document, Food and Agricultural Sector Development Project (FASDEP) I and II and the current Medium Term Agricultural Sector Investment Plan (METASIP) of MOFA policy guidelines. As a technical cooperation project between MOFA and JICA, it took five years to promote local rice production under the rain-fed lowland conditions. In addition, the project aimed at improving the economic conditions of small scale rice farmers in both the Ashanti and Northern regions of Ghana.

The main objective of the project was to develop a model for the sustainable production of rice under rain-fed lowland conditions through the activities carried out in the model and priority sites in five districts of Ashanti and four districts of the Northern region. The implementation of the project was also in line with the objective of the Coalition for African Rice Development (CARD) instituted by Japan and governments of some selected African countries.

With seven districts as pilot zones, the project was carried out for five years (2009 to 2014) and the Crops Services Directorate of MOFA was the implementing directorate. The total target beneficiary of the project was one thousand (1000) rice farmers with at least 30 regional and district officers.

The overall goal of the project is to increase the productivity and profitability of rice farming in rain-fed lowlands in project areas with the aim of accelerating the dissemination of sustainable rain-fed lowland rice module. This goal will be achieved through a three pronged outputs namely;

1. Development of a technical package of improved rain-fed lowland rice production.

   To realise the sustainable rain–fed lowland rice development, techniques and methodologies applied in the project need to be low –cost and applicable for farmers based on their extension systems and the methods should also correspond to the social, economic and cultural contexts of farmers to foster their self –effort, based on the structure, budget and human resources of extension administration.

2. Verifying a methodology to improve farming support systems for sustainable rain-fed lowland rice production.

   In order to increase the income of farmers, the project conducted activities such as strengthening the organisation of farmers, farming management capacities, post–harvest technologies, credit utilisation and marketing capacities.

3. Extension and dissemination procedures of the model for sustainable rain-fed low land rice production are developed.

1.2.1. The project goal

The aim of the project was to increase the production of rice in the Ashanti and Northern Regions of Ghana, resulting in the ultimate improvement of productivity and profitability of rice farming in rain-fed lowlands.

Output 1

Technical Package (TP) of improved rain-fed lowland rice production practices is developed.

Output 2

Methodology to improve farming support systems for sustainable rain-fed lowland rice production is verified.

Output 3

Extension procedures for sustainable rain-fed lowland rice development model are established.

1.2.2. Features of the project and beneficiaries

According to the implementers and officers, the project targeted small holder farmers under rain-fed lowland ecology in Ashanti and the Northern regions of the country. The techniques introduced by the project had the following characteristics;

- Simplified intervention techniques;
- The techniques were easy for Agricultural Extension Agents (AEAs) to learn and disseminate;
- The techniques were simple and suitable farmers who want to change from extensive rice cultivation to intensive rice farming;
- Promotes the use of simple farming tools for land development, rice cultivation and post-harvest activities;
- The technologies extended were suitable for small holder farmers to reach more advanced stages in rice farming;
- Concept chosen by farmers based on their environment and available resources.
- Enhances farmers' self-investment to increase profit through rice production and contribute to reduce the risk of rice cultivation;
- Develops the capacity of farmers under rain-fed and increases of domestic rice production and
- Disseminate the Technical Package (TP) through a detailed rice extension guideline from the Project Coordination Unit (PCU), the District Agricultural Development Unit (DADU), Key Farmers (KF) and Group Farmers (GF).

Moreover, for both the Northern and the Ashanti regions which shared different ecological conditions, the same interventions and technologies were extended to the farmers including selecting valleys that had permanent water sources during the major seasons of the rice production process, use of the same land and water management techniques, extension dissemination procedures and methods, rice agronomic practices and farming management systems. These interventions were the same on the premises that the ecological differences will have little impact on the type of intervention extended to them and specifically because the northern region has the highest number of valleys in the country (NRDS, 2009). Therefore, the study of the impact of the project on beneficiaries in both regions brings out no significant peculiarities in terms of the geographic conditions. However, the interventions, treatments, technologies and trainings offered to the respondents by the project are critical for this study.

For the beneficiary farmers, the project targeted farmers who had prior knowledge or experience in rice production irrespective of gender. However, women in particular were encouraged to join the project due to the complimentary nature roles the offers especially during the postharvest stages of the production cycle. It focused on farmers who were eager and motivated to learn the techniques and apply it to their fields. As beneficiaries, it was expected that members had the readiness and interpersonal anilities to work in groups and learn from each other.

The project used the farmer group system through demonstration plots with a farmer to farmer concept to disseminate the technical package. Considering the scarcity of agricultural labour situation, encouraging farmers to work together as groups was seen as the best by the project. Again as a prerequisite and the features of beneficiaries, it was expected that every farmer on the project will have their own rice farms where the adoption and practice of what was learnt from the demonstration plot. Children or farmer who were in their school going

age were not allowed to be part of the project because the MOFA had principle of no child labour and children under school going age be allowed in active farming.

These features of the project and beneficiaries were to help the project disseminate the interventions easily and quickly and also enhance an effective adoption process. Their existing rice culture and access to rice valleys were important prerequisite for a successful implementation of the project.

1.3 PROBLEM STATEMENT

Farmers and other beneficiaries who took part of the project were at a certain economic and social level of their livelihoods. The introduction of the project was mainly to improve and increase farmers' rice production, incomes and profitability. Importantly, an increase in production, incomes and profitability of farmers ideally will inure to their wellbeing and enhance their livelihoods. The Alliance for Green Revolution in Africa (AGRA) (AGRA, 2014) argued that when the productivities and incomes of farmers are increased, it significantly improves their wellbeing and livelihood assets capabilities. The activities of the project covered land development on trial and demonstration plots, training of farmers and extension officers, group formation, linking farmers to support services required for rice cultivation, extension services and general rice agronomic practices at on-farm and off-farm levels. These activities were expected to improve the yields, improve the quality of rice produced, increase their incomes and ultimately increase the profitability of farmers' rice production. The indicators of the intended outcome of the rain-fed lowland rice production project can be used to describe the livelihood outcomes of the beneficiaries. The sustainable livelihood framework describes the outcome of a livelihood as a result of the combinations of livelihood capital based on a particular strategy in the presence of shocks, risks and disasters. An assessment of impact of agricultural projects over the years often focuses excessively or exclusively on how much cash, how much production, or how many jobs have been

generated, rather than on a broad range of livelihood issues and how beneficiaries were able to adopt and utilised the technologies and cope after such interventions ended (Ashley and Huseein, 2000).

According to Dart and Davies (1998), evaluation of projects involves the systematic collection of information about activities, treatment or interventions of the project on the people, the environment and general beneficiaries in order to determine its worth or merits. It is a major part of learning, and can provide a wealth of useful revelations in telling the story of the project from the evaluation. Evaluation trends and findings are based on collecting and reviewing stories of significant changes associated with the value added to the interventions extended to the beneficiaries.

The impact of the activities of the sustainable development of rain-fed lowland rice project on the outputs on the livelihood assets (human, natural, physical, social and financial) of beneficiaries has not been ascertained after its implementation which could contribute to future project formulations focusing on the needs of the beneficiaries. This study therefore seeks to determine and compare the impact of the project on the livelihoods assets of beneficiaries in Ghana.

1.4 RESEARCH QUESTIONS

The research questions asked were;

- What are the personal characteristics of rice farmers within the project and how it influenced their livelihood assets?
- How has the project impacted on the natural and physical capital of rice farmers in the Ashanti and Northern Regions of Ghana?
- What are the changes in the farmers' human asset development in the project?
- What are the changes in the social and financial capital of farmers in the project?

1.5 OBJECTIVES OF THE STUDY

The main objective of the study was to access the impact of the rain fed lowland rice production project on the livelihood of farmers in the study areas.

The specific objectives were to;

i. To identify and analyse the personal characteristics of the beneficiaries and its relationship to their livelihood improvement.

ii. To find how the project activities influenced the natural and physical asset base of the participating farmers in the project

iii. To examine the change and developments of project farmers in relation to their human capital.

iv. To determine whether the project socially and financially influenced/changed the capacities of the beneficiary farmers

v.

1.6 HYPOTHESIS

- **Null hypothesis= H0:** There is no significant difference in the financial, natural, physical, human and social capital of farmers before the project and after the project

1.7 SIGNIFICANCE OF THE STUDY

Rice farming as a livelihood option is as important as rice consumption and all its delicacies. The welfare, benefits, needs and responses of the projects farmers on their livelihoods will greatly contribute to similar and subsequent interventions in any part of the country. More so, findings of the study indicate that, outcomes and outputs of projects should not only focus on production per tonnage and profits, but consider other livelihood issues such as human

development, social change and improvements, sustainable environment management and general living standards of the people.

The study is intended to contribute to knowledge on issues related to rice production, agricultural livelihoods, livelihood capital and agriculture in general. The government, through the Ministry of Food and Agriculture and the donor community supporting agriculture, will benefit from the findings of this study in relation to feedback from beneficiaries of the projects and how future projects could be operationalised for pro farmer benefits. The output of the study will also contribute to the partial fulfilment of the requirement for the degree of Doctor of Philosophy (PhD) in Agricultural Extension.

1.8 ORGANISATION OF THE STUDY

The study is divided into of five chapters. *Chapter 1* is the introduction consisting of a general background to the study, the problem statement, and significance of the study, main and specific objectives and scope of the study.

Chapter 2 presence the literature review covering agricultural livelihoods, rice as a livelihood option, the theoretical framework, adaption, vulnerability and poverty.

Chapter 3 discusses the research methods and approaches used in conducting the study such as sampling units, methods of sampling, data collection tools and analysis.

Chapter 4 focuses on data presentation, analysis and discussion of findings of the study. This is done in relation to the four objectives (five livelihood capital) of the entire study.

Chapter 5 provides a summary of the research findings, recommendations and conclusion.

1.9 CHAPTER SUMMARY

The chapter presented an introduction to the study, a clear and detailed background, statement of the problem, the objectives and justification for this study as well as the hypothesis set out in the study. The research questions were highlighted and an outline of the study and the issues covered in the implementation of the study discussed. The next chapter is literature review.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 INTRODUCTION

This chapter reviews relevant literature on lowland rice production and its impact on the livelihoods of beneficiaries. It covers sustainable livelihoods and livelihoods frameworks, livelihood assets, rice production as a sustainable livelihood, agricultural livelihoods and impacts and contribution of projects to beneficiaries. The aim of the review is to enhance understanding of the current literature on agriculture, rice and livelihoods and project impact analysis on beneficiaries as a contribution to knowledge and literature. Equally important in this chapter is the review of the sustainable livelihood framework, the diffusion innovation theory, the participatory approach theory and beneficiary assessment theory that served as the anchor for which the study is premised on. The review will also help guide the methodology and data analysis process of this study.

2.2 THEORETICAL FRAMEWORK

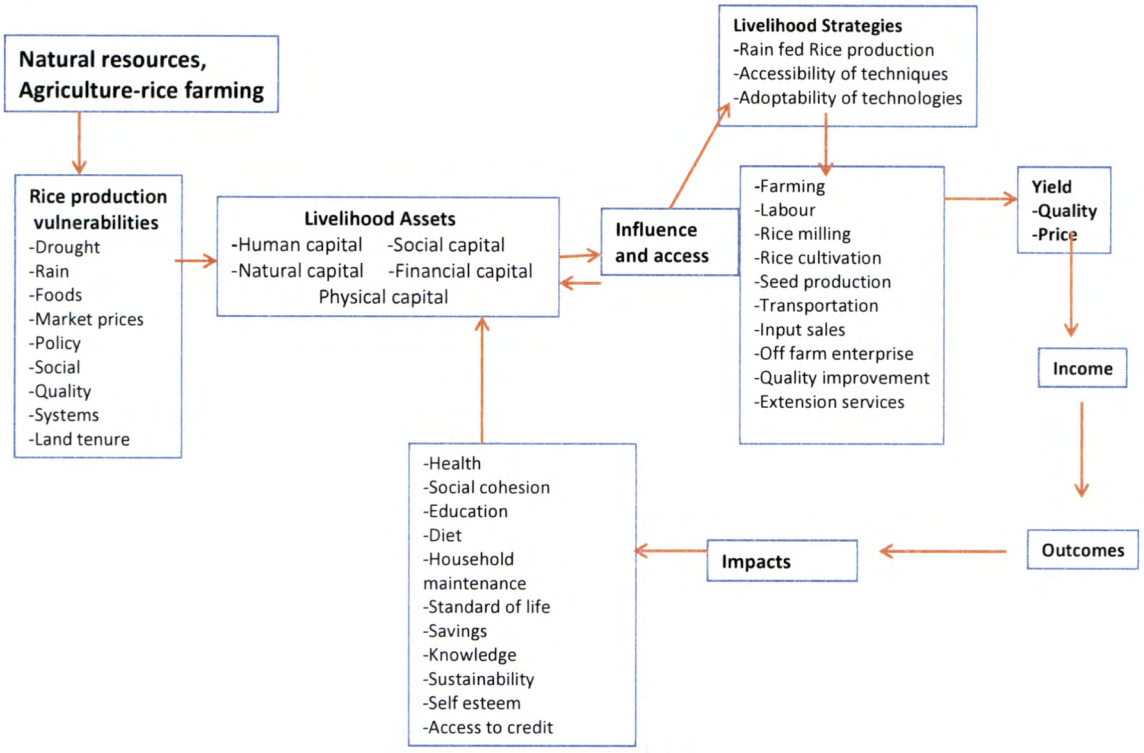
People's ability to escape poverty depends on access to assets (FAO, 2008). Rural livelihood strategies are often heavily reliant on the natural resource base (IDS, 1996). These livelihood activities include the production of food crops, cash crops, the gathering of forest and tree product gathering, consumption, processing and sale, and income earning enterprises both on and off the farm (Brycesson, 1999).

This study relies on the sustainable livelihood framework of the Department of International Development in order that the interventions and livelihood strategies disseminated by the project over the period with the beneficiaries should turn out some positive sustainable outcomes on the five (5) thematic areas or assets of livelihoods namely; social, human, physical, natural and financial capital. Therefore, with the influence and access provided

through the livelihood activities of the project, the yields and incomes of beneficiaries are expected to increase resulting in several impacts on their livelihood status.

Rice farming as a livelihood option, has become the mainstay for most farmers in the valley rich areas suitable for agriculture in Ghana. Vulnerabilities from the environment in respect of rice production such as floods, droughts, disease outbreaks, crop failures, price fluctuations, land tenure problems affect livelihood outcomes. The outcomes may be positive depending on the availability and access to any of the livelihood assets and how they are used by the farmers and actors in the rice value chain. As Scoons (1998), put it; *'sustainable livelihoods are achieved through access to a range of livelihood resources (natural, economic, human, social, and physical capital) which are combined in the pursuit of different livelihood strategies.'*

Figure 2.1 Modified Sustainable Livelihood Framework



DFID (2000), Scoons (1998), Chambers and Conway (1992), Ellis (1999), opined that livelihoods comprise of the capabilities, assets (including both material and social resources) and activities required for a means of living. The means of living leads to strategies and coping mechanisms to vulnerable events. All the authors argue that a livelihood is sustainable when it can cope with and recover from stresses and shocks maintain or enhance its capabilities and assets, while not undermining the natural resource base. The ability of a livelihood to cope and recover from stresses and shocks is fundamental to the definition of sustainable livelihoods. Such resilience in the aspect of stresses and shocks are important to both livelihood adaptation and coping mechanism as expressed by Davies, (1996).

Based on the Sustainable Livelihood framework, Ellis (1998) explains livelihood as 'the activities, the assets, and the access that jointly determine the living gained by an individual or household'. He further defines rural livelihood diversification as 'the process by which households construct a diverse portfolio of activities and social support capabilities for survival and in order to improve their standard of living'.

2.2.1 Human capital

Human capital refers to the availability of farmers, rice processors, rice marketers, agro inputs dealers, labour and agricultural technical officers who have the skills, knowledge, ability to utilise their capabilities to undertake rice production as their livelihood option. The type of knowledge, experience applied on the pre and post production scale of rice, directly relates to the outcomes. The experience, skill and knowledge gained help to minimise the adverse effects of vulnerabilities which the production processes are exposed to. The ability of farmers to select good seeds, prepare and keep good records of their income and expenditure incurred, appropriate

agronomic practice on the life cycle of the rice plant and the right technique to reduce postharvest losses, will inure to good yields and better incomes.

Labour is an important form of human capital (Mahdi *et al.,* 2009). How good the quality of rice will be, rice millers and marketers getting good return on their investments all will depend on the quality of labour (human capital) available to them. From figure 2.1, farmers' ability to recover from shocks from rice production vulnerabilities will be quicker if the coping mechanisms such as knowledge and experience in supplementary irrigation and water management to conserve moisture during droughts, observation of rainfall patterns to plant and avoid floods are well adopted. As Mahdi *et al.,* (2009) put it, coping mechanisms within the sustainable livelihood process depends on the quality of human skills and knowledge. To enhance farmers' skills and other assets, their contacts and exposure to agricultural officers and extension agents as livelihood strategies is important (figure 2.1). Trainings and teachings from these technical officers on rice production helps boost their knowledge base and enhance a positive livelihood outcome.

Still relating to the framework (figure 2.1), a weaker human asset or farmers with low agricultural skills and knowledge are likely to be exposed more to vulnerable situations. In other words, if the human resource for the sector is low skilled and weak, it can result in low production, higher postharvest losses, exposed vulnerabilities, lower incomes and the ultimate dependence on imported rice and other commodities will be more. This makes the entire sustainable livelihood approach or concept on human capital unsustainable. Human skill development (human capital) is thus greatly linked to the capabilities of a person who drives the management and accessibility of other assets (financial, physical, social and natural) for effective coping strategies and sustainable livelihoods. Human and social capital do not function in isolation in a typical rice farming community. The two are linked in a complex manner and, to

some extent, feed into one another. In other words, social capital promotes the development of a sustainable human capability.

2.2.2 Social capital

The idea of social capital first appeared in Lyda Judson Hanifan's discussions on rural school community centres (Hanifan 1916; 1920). He used the term to describe *'those tangible substances [that] count for most in the daily lives of people'*. Astone and Mclanaham, (1991) describe social capital as the relationship between different family members that determines how individual members can take advantage of whatever financial and human capital other family members possess. The World Bank also termed it as: '*institutions, relationships, and norms that shape the quality and quantity of a society's social interactions. Social capital is not just the sum of the institutions which underpin a society – it is the glue that holds them together'* (The World Bank 1999).

The social capital of farmers includes family members, friends, trust, norms, communality, gatherings, and networks of farmers' associations and other actors such as agro inputs dealers, land owners and agricultural extension officers. All the networking within these knowledge communities is done with a common purpose and interest. Availability and accessibility to rice production technologies and the rate of adoption by farmers have stronger links to their social capital (Figure 2.1). Social networks may indirectly affect agricultural productivity by influencing farming practices and the propensity of the household to adopt newer technologies through the supply of information via these networks (Katungi, 2007; Liverpool and Winter-Nelson, 2010).

The networking and membership allows them to learn from each other and depend on specific individual capabilities for their own benefits. The levels of adoption by farmers also increase if they are influenced by their colleagues and not outsiders. Antoh (2005) argues that, networks and connectedness between individuals with shared interests increases people's trust and the ability to work together and expand their access to wider institutions such as political or civic bodies. The power distance feeling among farmers reduces if they are in group with stronger interdependence (early and late adopters) to draw more synergies. Memberships in more formalised groups (farmer-based organisations), often adhere to mutually-agreed or commonly accepted rules, norms and sanctions. This improves their yields and livelihood outcomes with good strategies to manage the variability of rice farming. More so, labour, which is a bigger agricultural capital, is largely a family source for their agricultural or rice production activities (Mumuni *et al.,* 2013). Therefore, the family plays an important role in terms of labour for rice production. This helps in reducing the cost and to cope with the intensification process and the vulnerabilities involved. However, there could be adverse impacts if the bond and belongings is no there. The solidarity component with trust helps them in times of disasters like droughts, poor yields, pest and disease outbreaks and flooding by supporting each other with inputs and even labour in the affected member's farms. Roslan *et al.,* 2010a and 2010b; Balogun and Yusuf, 2011) affirmed that assistance, company and support for one another in times of hardships is another stronger form of social capital that helps farmers to cope with the vulnerabilities or disasters.

Communities with high levels of social capital produce superior outcomes in joint actions. It is believed that communities with low social capital can be assisted to build up stocks of this resource in order for their performance to improve over time (Shahjahan and Hans, 2005). Norman and Kebe (2006) maintain that rice contributes to the social and economic aspects of

communities and countries. They argue that 'rice forms an integral part of religious ceremonies, festivals and holidays. In Sierra Leone, West Africa, for example, rice is the preferred staple food and is central to Sierra Leone's economy. Rice plays a significant role and is an integral component of the economic and social order within rural communities. It is seen as a good livelihood option that significantly pulls farmers out of poverty, economically develop communities and countries as a whole.

2.2.3 Natural capital

Natural capital which includes improved access to land, cultivated agricultural land, fertile soils, availability water, elements of pollution, livestock and crops are the main drivers of agriculture. The use and access to natural capital may facilitate improvements in other livelihood assets such as financial capital – for example, households collecting reeds to weave baskets that are later sold in markets (Pereira, Shackleton, and Shackleton, 2006). The availability and access to these elements as shown in Figure 1, depends on the capability of the farmers to access and utilise the resources. Rice produces well under fertile soils and available water, and relies on the farmer's best use of knowledge and agronomic practices.

The knowledge to maintain and sustain the availability of natural capital relates to the efficiency of the human capital and the shared values of social capital. Water shed management and maintenance, not polluting the streams and canals for irrigation, dredging of the water ways, protecting the vegetation and good soil management helps in the farmer's production process and improves coping mechanisms to shocks and vulnerabilities. More so, the maintenance helps in sustaining the availability of the capital for continues use.

Conway (1985) and Holling (1993) argue that the ability of these resources to recover after disturbances of natural ecosystems to support the natural of provision of livelihood options to the rural poor is natural resource base sustainability. Environmental stress and the depletion of scarce natural resources can be a significant challenge in many farms. Issues around the access to natural resources (land, water, forest, timber and hunting) can be a source of tension and conflict between the farmers and community members. Depletion or degradation of natural resources such as water or wood can have a significant impact on future livelihood strategies (Pandya and Cronin, 2009).

The outcomes from the use of this capital with human, social and physical capital will be positive and well impacted if the elements of the natural capital are rejuvenated and sustained. The challenge with natural capital for agriculture has largely been accessed to some of the elements such as land, water and access to good seeds. However, the issue of land security has been the most exposed vulnerability for agriculture (Figure 2.1) (Racodi, 1999). Coping strategies will be on government policy on irrigation, good seed breeding and supply, environmental conservation and streamlining the issues of land tenure system. These can easily help them cope with the adverse impact of the anthropogenic activities of farmers. Livelihood diversification of available natural resources by rice farmers can also help them cope with disasters and vulnerabilities. Vegetables can be grown during off-peak seasons in order to improve household incomes and financial capital as well.

2.2.4 Physical capital

Rice farming is one of the livelihood sources with higher return on investments in Ghana excluding cocoa (MOFA, 2011) which helps farmers to acquire physical assets. This fact suggests that production (acreage and yield), rice milling machines, power tillers, land, tractors

and many others may be accessible to farmers who have good return on their investment or otherwise, good incomes. Farmers tend to invest more in housing, health care and the education of their children (MOFA-JICA Report, 2013). Access to irrigation facilities, roads, storage and markets, facilitates the strength of the physical capital of farmers and improves livelihood. The incomes generated from the production process provide cash to cover the expenses for clothing, housing, education and other social amenities of the majority of people in rural areas (Norman and Kebe, 2006).

However, the non-availability of these capital weakens the resilience and coping mechanisms of farmers during disasters or adverse events such as bush fires and droughts (Figure 2.1). The inter-relationship between social capital to physical capital is the link and network between the seed, input suppliers and ice millers. This usually ends up being a goodwill relationship for the farmer and other actors concerned. The financial capital of the farmer will have to be better and strong if the physical capital is to be sustainable (BCI Report, 2009). The knowledge, innovation and training of the farmer, the processors as elements of human capital greatly contribute to a better coping strategy and recovery during difficulties and challenges. Government support to them in boosting their resilience will be to provide good roads for easy access, access to processing and bigger warehouses for produce and easy land acquisition for rice production.

2.2.5 Financial capital

Financial capital is seen within the sustainable livelihoods framework as the financial resources people use to achieve their livelihood objectives. This capital is generated and converted from a farmer's produce into cash for household expenses and also for savings towards trying moments and bad seasons. Farmers depending on their trainings and support from extension officers can utilise formal and non-formal financial resources and institutions.

The type of livelihood strategies and activities can guarantee the level of financial capital they can access or its availability. MOFA (2011) maintains that farmers who belong to stronger famer based-organisations (FBOs), which is considered a social capital element, are able to obtain financial assistance from local banks and microfinance institutions as well as from their own contributions. It is inferred that a higher level of social and financial capital occurs in FBOs with internally generated revenue sources and a culture of savings (Akpabio, 2008). This view had previously been upheld in 1996 by the World Bank with a declaration that, most successful groups are those in which a larger proportion of lending capital is derived from the savings group members. This will automatically add up to improve their coping mechanisms during hard times and better livelihood outcomes. Aside converting produce into cash and getting support from financial institutions, labour by the farmer and other diverse livelihood activities within the available period can result in to a strong financial capital for the famers (FAO, 2013).

While accessing the strategies and coping mechanisms of rice farmers and the likely outcome from agricultural interventions such as in the current project, it is necessary to examine the policy and institutional contexts within which these capital exist. While some capital may be vulnerable to certain shocks, it may be because authorities are able to act and limit any damages which may occur or perhaps provide compensation (Morse *et al.,* 2009). In this case, the response and support of the district assemblies and government agencies to external threats to their livelihoods will be critical.

2.3. DIFFUSION OF INNOVATION THEORY (DOI)

Aside the adoption of Scoons and DFID livelihood theoretical framework, the study takes its netting from diffusion innovation theory. Diffusion innovation theory argues that, interventions,

knowledge, ideas, information and even products gets value, momentum, acceptance and dissemination or spreading over time through a specific population or social system who could be the target. A theory developed by E.M. Rogers in 1962, it became one of the oldest social science theory related to information dissemination. Drawing down on the importance of this theory to this study is centred on adoption of interventions and techniques extended to beneficiaries, an explanation of a process where people accept and do things differently from what they used to or practice. Adoption of technical innovations and interventions do not happen once in social setting but on a gradual process and with time (Boston University School of Public Health-BUSPH, 2015). This is because society is heterogeneous in nature with people having different abilities and capacities to accept and practice new things given to them. Hence whilst some will be quick to accept and adopt, others may be late and some not at all.

- **The Innovators** – According Rogers, these are people who want to be the first to try the idea, the knowledge or product. They are enterprising and curious about new things and are ready to take risk that comes with new idea development. Once their minds are made on a particular innovation, nothing changes it until their curiosities are satisfied.

- **The Early Adopters** - These are people who are the key farmers, the change and community opinion leaders who enjoy leadership and like to lead. Accepting new change is one of their qualities. Other feature of them is the open mind about issues that makes them try and embrace new ideas with comfort. Hence, in the agricultural front, using them for the farmer to farmer concept of knowledge adoption and dissemination is important. They are the first point of farmer link to the extension officers who can be relied on. The extension officers do not require leaflets and other information manuals to convince them.

- **The Early Majority** – They prefer to work not as leaders but support the leader. As part of the majority, they determine whether or not the innovation or intervention in question will be widely spread and adopted. They determine the success of the spread and they do not wait to see yields of crops and incomes before they accept the technologies; however, they need to be assured of the reliability, technical and other assurance metrics before. Projects that succeed need strategies to appeal to this population.
- **The Late Majority** – The skeptics who are always having double views of things and change in particular. They follow, act and adopt when the innovators, early adopters and early majority adopters have used the intervention or technology and affirm or testify the on results. Hence to convince them, projects need statistics and results to bring them on board.
- **The Laggards** – The conservatives, the traditionalists who are never moved or develop any form of curiosity. They are very skeptical of change and are the hardest group to bring on board. Strategies to appeal to this population include statistics, fear appeals, and pressure from people in the other adopter groups.

The challenges of this theory to adoption of innovations as argued by the BUSPH (2015) is that it does not foster more of participatory approach to adoption of interventions or programmes especially from the public health since that is related to prevention most of the times than adoption. However, for the agricultural sector, this model is a best fit. Also, it is argued not to consider the individual's resource level or social support to adopt the new technology or innovation.

Adding to the discourse, issues of compatibility with the culture and social norms of the people to accept or adopt the intervention is essential. How easy or difficult it is to try or

experiment the technology or product will also determine the level of adoption or acceptance. From these viewpoints of diffusion innovation theory, this research considers the features and strategies of each of these actors espoused by the theory in relation to the adoption of agricultural technologies that can add to better understand the respondents access and adoption of the rice technologies to improve their livelihoods. This theory has been applied in several knowledge communities and industries.

2.4.PARTICIPATORY APPROACH THEORY

This study identifies with the principle and concepts of the participatory approach to development and getting involve effecting a change. Community participation has been recognized as a vital ingredient in successful planning and execution of projects (lhadi Amy, 2009). Most important step for participatory approaches to development in Africa came in 1990 with an international conference in Arusha Tanzania (Arusha, 1990). Participatory Approach theory has been acclaimed and given high international reputation as a possible solution to addressing community and rural development issues (Daniel Wandera and Sam Afrane, 2013). Persons participating together in projects and development initiatives often lend a completely different perspective to the traditional development approach.

Focusing on agriculture, people and farmers in particular gets involve/participate in activities aiming to learn, practice and adopt agricultural activities for their own livelihoods. Employing a participatory approach allowed local community group and farmers to articulate their needs, wants, problems and proposed solutions to what affects them (FAO, 2009).

Dawn Chatty, Stephan Baas and Anja Fleig, (2003) explains that participatory approach learning goes along with the iterative process of implementation projects and community development programmes using project cycle. They are given an active role in the design, re-

design and decision making in all stages of a project cycle. For agricultural projects and interventions, the FAO argues that the use of participatory approach for agricultural information dissemination and getting farmers involved has been effective for agricultural development. Stephan Baas et al, (2003) gave a typology (table 2.1) of participation of people in groups, the processes, characteristics and behavioural patterns of people and the strategies required.

Table 2.1 Typology of Participatory Approach

Passive Participation	People participate by being told what is going to happen or has already happened. It is a unilateral announcement by an administration or project management without any listening to people's responses.
Participation in information giving	The information being shared belongs only to external professionals. People participate by answering questions posed by extractive researchers using questionnaire surveys or such similar approaches. People do not have the opportunity to influence proceedings, as the findings of the research are neither shared nor checked for accuracy.
Participation by consultation	People participate by being consulted, and external agents listen to views. These external agents define both problems and solutions, and may modify these in the light of people's responses. Such a consultative process does not concede any share in decision making, and professionals are under no obligation to take on board people's views.
Participation for material benefits	People participate by providing resources such as labour, in return for food, cash or other material incentives. Much on farm research falls in

	this category, as farmers provide the fields but are not involved in experimentation or the process of learning. It is very common to see this called participation yet people have no stake in prolonging activities when incentives end.
Functional participation	People participate by forming groups to meet predetermined objectives related to the project, which can involve the development or promotion of externally initiated social organisation. Such involvement tends not to be at early stages of project cycles or planning, but rather after major decisions have already been made. These institutions tend to be dependent on external initiators and facilitators, but may become self-dependent.
Interactive participation	People participate in joint analysis, which leads to action plans and the formation of new local institutions or the strengthening of existing ones. It tends to involve interdisciplinary methodologies that seek multiple objectives and make use of systematic and structured learning processes. These groups take control/ownership over local decisions, and so people have a stake in maintaining structures or practices.
Self-mobilisation	People participate by taking initiatives independent of external institutions to change systems. Such self-initiated mobilisation and collective action may or may not challenge existing inequitable distributions of wealth and power.

Source: (Dawn Chatty, Stephan Baas, Anja Fleig, 2003)

These classifications and typologies (table 2.1) espoused above adds to how farmers can be convinced using this approach to access and adopt agricultural technologies and knowledge extended to them. As a new paradigm of development that is taken over the traditional method,

participatory approaches is seen as sustainable development process that puts ownership of policies and projects at the community at the doorstep of the people. They take part and become part of the cycle and that fastens acceptance and adoption.

2.5.BENEFICIARY ASSESSMENT THEORY (PAT)

This is a theory or methodological tool that is widely used and advocated by development partners such FAO, IFAD and the WORLD BANK. Beneficiary Assessment (BA) is one of the research tool used to improve the impact of development activities on people by gaining the views of intended beneficiaries through feasibility regarding a planned or ongoing intervention or project (Lawrence, 1992, 1995, 2002; IFAD, 2002; FAO, 2008). Its main aim is to assess the value of an activity as perceived by project beneficiaries and how such information can be integrated into project activities or used as an evaluation of the project to understand the impact on the people (Salmen, 2002). Projects that uses this model specifically tries to undertake systematic feasibility study through forums and other stakeholders' consultative processes to gather more information and incorporate or mainstream it to the project cycle. This method of systematic consultation is used by project management as a design, monitoring, and evaluation tool that enhances project effectiveness and success (Salmen, 2005).

Assessment before the start of the project

FAO, (2008) posits that deciding what information is needed for the beneficiary results assessment exercise is key to clarify which methods and how the methods should be used to source information them is important. Equally, knowing when (at the start, during or after the project), and what type of data (primary/secondary, qualitative/quantitative) should be collected are critical to the evaluation process. Many successful projects especially projects related to rural

development and agriculture uses the log frame method and cycle in the operations of the projects (FAO,2008). It clearly defines the goal but also the outcomes and expected outputs of the project and provides the relevant correspondent indicators. The indicators are the variables used to measure progress towards specified objectives of the projects. Such methodologies are well embedded in the project document serving as a guide to the entire project period and post project for evaluation.

In advocating for a better implementation process of projects, the FAO and IFAD spells out that, good indicators display two key structures namely;

1. It should be logically related to the identified objective of the project i.e. measure factors that reflect the goal, objective or result and is directly linked to it; and
2. Important data and information on the beneficiaries, the communities and other related parameters needs to be available (or the possibility to be collected at reasonable cost and time span) to track the indicators set or outlined in the project document.

Lawrence (1999), believe that beneficiary assessment is the most important framework to use before and after the execution of projects if indeed such projects are to impact lives and foster development and close identified gaps (Lawrence 1999). To advance such argument, Lawrence used the beneficiary assessment theory to understand the perspective of farmers on agricultural projects implemented in Cameroon, Cote d'Ivoire, Ghana, Guinea, Madagascar, Mali, Mozambique, Senegal, Uganda, and Zambia between 1994 and 1999. These assessments of the projects in these selected countries represented the first efforts of extension organizations to systematically understand and document the views of their clients with the objective of improving the quality of their services to them. Each of the programs assessed were national in scope; the average number sampled was 1,200. Women comprised 39% and "contact farmers" were 44% (Lawrence 2002).

Assessment or evaluation after the project

The BA approach is not intended to supplant quantitative surveys and other traditional methods for data gathering. Use of this approach helps to complement data gathering processes and methods by providing reliable, qualitative, in-depth information on the sociocultural conditions and perceptions of the project's target group, for example farmers. This helps to elucidate critical information and feedback from beneficiaries that can be used by project managers, policymakers and other development partners responsible for improving the welfare and state of the people in question. For evaluation and assessment effectiveness of executed projects, use of interviews, participant observations, focused group discussions are ideal (Bird, 2002; Salmen, 2005).

Depending on what to measure and using BA theory requires the evaluator to consider the following processes as espoused by the guidelines of World Bank on project assessments and Lawrence perspectives on beneficiary assessments.

- Project users or beneficiaries' information should be specific and clear
- Determine how the information from them will be gathered
- Triangulate the information collected: verify the information by cross-checking information from different sources
- Measure it or relate it to the aim of the evaluators study
- Match it with the logic frame to determine the level of progress by the project.

2.6.LIVELIHOOD CAPITAL AND AGRICULTURE

A livelihood may be defined as the sum of ways in which households obtain the things necessary for life, both in good years and in bad times. These necessities include food, water, shelter,

clothing and health care (with education often included too). Pertinent activities can include crop and livestock production, fishing, hunting, gathering, bartering, and other endeavours and income generating activities (including off-farm work). Livelihoods vary significantly within a country, from rural to urban areas, and across countries (FAO, 2006a). In the same vein, FAO has to distinguished livelihoods approach from a production-based approach as that makes the household the centre of the analysis, taking an integrated view of the importance of all its assets or forms of capital (physical, financial, human, natural and social) (FAO, 2006a).

FAO has summarised livelihood simply words as the 'means of making a living'. In a food security context, it refers to people, capabilities, their assets (both material and social), income and activities required for a means of living (including ways to obtain food). Livelihoods in any form are determined by multiple factors, a combination of different types of information needed to understand these factors. The following are the components of the livelihoods framework in the agricultural context:

- Vulnerability context from drought, floods, low yields, poor soils, conflicts and bush fires;
- Livelihood resources or assets (capital, inputs, available land, agricultural water, vegetation and labour);
- Policies, institutions and processes (irrigation, rain-fed agriculture, seed, value chain addition, government agencies on agriculture, projects and capacities of agricultural officers);
- Livelihood strategies; and
- Livelihood outcomes or goals.

The market plays an important role in livelihoods, especially in emergency contexts. Access to markets and how the market functions can be critical to the success or failure of livelihoods.

To enhance their agricultural capacities and base, farming households require water in order to produce crops and raise livestock. Households also depend on the quality of soils and rangeland.

Many households also gather fuel wood and fodder from areas within walking distance of their homes. Rainfall is important in maintaining the quality of rangeland and other common areas. In arid areas with a substantial population density, the demands placed on natural capital can exceed sustainable supply. Severe degradation of natural resources can reduce the livelihood status of households that depend on them for production or consumption (FAO, 2008).

For sustainable livelihood approach to work effectively, households exploit multiple activities and assets as part of their livelihood strategies (Ramirez Ricardo, 2002). Agricultural production and off-farm employment are among the components of the asset base; hence they are interrelated variables rather than dependent variables (Ramirez Ricardo, 2002). He maintains that the livelihoods approach regards awareness of the asset status of poor individuals or households as fundamental to an understanding of the options open to them. One of its basic tenets, therefore, is that poverty and food security policies should be concerned with raising the asset status of the poor, or enabling existing assets that are idle or underemployed to be used productively. The market plays an important role in livelihoods, especially in emergency contexts. Access to markets and how the market functions can be critical to the success or failure of livelihoods.

Better and enhanced livelihood of farmers and actors in the agricultural value chains enhances their entrepreneurial abilities and business acumen (Kahan, 2012). In complex changing economies and development trends, farmers need to be more entrepreneurial with business sense and approach. There is pressure for farmers to change their production roles to all-round entrepreneurship paradigms, diversifying away from the production of crops and livestock as raw commodities to an agro based transformation and further up on the agricultural value chain (Warren, 2004 Pp 372). Farmers ability to deal with challenges such as vulnerability to

production and post-production shocks, access to finance and credit, access to required information, low bargaining power for their produce, unskilled or low technical knowledge etc. relates to the strength of their livelihood capital and how they access it (Kahan, 2012).

2.7.RICE AND SUSTAINABLE LIVELIHOODS

Rice is the staple food for more than half of the world's population, influences the livelihoods and economies of several billion people and for hundreds of millions, it is the only thing between them and starvation (IRRI, 2006). Rice production is the most important source of employment and income for rural and migrant Asians. For 700 million Asians, surviving on incomes of less than one dollar per day, rice can account for as much as 70 percent of their daily calories and 40 percent of their income (IRRI, 2008). In 2003, approximately 151 million hectares were cultivated worldwide, of which Asia accounted for some 138 million hectares, constituting 90 percent of global rice production (IRRI, 2008). This trend is now being replicated in many African countries through the rice intensification programme in search of green revolution in Africa like the Alliance for Green revolution Project across Africa for enhanced food security.

Attractive livelihood opportunities according to Mumuni *et al.,* (2013), are normally accessible to households that have better endowments in terms of human, financial and physical assets. Even where households have similar endowments, production techniques, preferences, constraints and incentives attached to particular livelihood activities may be different. This suggests that rice is one commodity that has a higher propensity of improving the welfare and livelihoods of farmers globally as the taste for rice cuisines increases, thereby increasing the demand for rice. To meet such demands, Oladele (2004) argues that, Nigeria in particular had to import foreign milled rice to augment the shortfall through intervention programmes such as improvement in extension service delivery and rice projects.

These can all be sustainable when resilience levels of rice production by farmers are higher in the face of external shocks, sustained dependency on external support such as trade and marketing, and available funding that is economically and institutionally sustainable. Again, rice production as a livelihood option, can be sustainable if the pattern maintains a long-term productivity of natural resources like fertile soils, water and vegetation for rice and other arable crop production.

2.8.LOWLAND RICE PRODUCTION

The potential land area for rice production in West Africa is between 4.6 million and 4.9 million ha. Out of this only about 3.7 million Ha or 75% of the available land area is presently used to cultivate rice. Cultivable land to spread over five ecologies, namely: rain-fed upland, rain-fed lowland or shallow swamp, irrigated rice, deep water or floating rice and tidal mangrove swamp (Nwilene *et al., 2011*). Thenkabail *et al.,* (2000) are of the opinion that in West Africa, the estimated area of inland valleys ranges between 8-28% of the total geographic area with only about 7-20% of this area cultivated. Inland valley wetland areas are highest in humid forests, followed by derived savannas, southern Guinea Savanna, Northern Guinea Savanna, Sudan Savanna and Sahel. However, the importance of inland valley wetlands actually increases in drier areas, since in these areas, its use for lowland rice cultivation is high due to the availability of water compared to the uplands for most of the year (Thenkabail *et al.*, 2000).

Rice production in Ghana in particular and West Africa in general comprise of upland methods of production, rain-fed lowland methods of production and irrigated method of rice production Among these, lowland rice has the highest priority, being the ecology that represents the largest share of rice area and rice production. Smallholder farmers with farm holdings of less than 1 ha cultivate most of the rice produced in West Africa (Nwilene *et al.,* 2011).

Ghana's rice production estimates range from 200,000 to 300,000 MT of paddy or roughly 120,000 to 180,000 MT of milled rice, the bulk of which comes from the Upper East, Northern and Volta Region normally from the lowlands (USAID, 2009). Rainfall remains the greatest driver of production variance. Ghana's rice production can be categorised into three primary cropping types which include: lowland rice production; upland rice production and irrigated rice production. Lowland rain-fed, which includes rice planted in the receding waters of the Volta and other rivers, accounts for 78 percent of production; upland rain-fed accounts for 6 percent; and irrigated rice accounts for 16 percent. Rice production expanded steadily from 1994 to 2004, primarily from an expansion of land under paddy production.

According to Donkor *et al.,* (2011), though the potential exists for rice production, yields obtained from lowlands by small-scale farmers on the whole are very low. The low yields are mostly due to: lack of water control measures to make maximum use of the uneven rainfall distribution; inadequate input use (e.g. fertilizers and pest Ricides) either due to high cost or non-availability; and inadequate tractor and bullock services for proper land preparation. Farmers are also not well organised, with little information available to them from extension services. They also have difficulties in accessing short and long term credit facilities.

2.9.IMPACTS OF PROJECTS AND IMPROVEMENT IN LIVELIHOODS

Projects have been used widely as a means of improving the wellbeing, reducing poverty and improving health and food security of people. Improvements and contributions are two folds; direct and indirect benefits for beneficiaries. An AMBIO project in Mexico on climate change mitigation evaluated by the FAO (2010) indicates that before the project, beneficiaries were using slash-and-burn activities were widely practised in the states of Chiapas and Oaxaca from

where the project is baseline survey was conducted. The land was mainly used for maize cultivation and pasture, and there was secondary vegetation. After the project implementation, the following new activities are now being practised by farmers which include; improved fallowing, living fences, forest restoration, forest management and improved coffee plantations. Farmers' active participation in projects has high tendencies to succeed. After two years of project implementation on a Grassland and Pasture/Crop Systems Group by the FAO and small scale farmers and Herders in Nepal, significant direct improvement on farm family livelihoods of the beneficiaries were made according to Pariyar et al, (2005). Their incomes improved, reduced cost of production, their animal rearing skill and animal health improved and general wellbeing after taken part of the project. This progress was made because the beneficiaries were ready to participate and was involved actively in the planning of the project which captured their needs to the execution. Through projects and by facilitating better access to new skills, tools and services, the FAO believes it can help the rural poor to make lasting improvements in their own livelihoods.

Similarly, according to Boris *et al.,* (2006), a postharvest project implemented in Asia had a study that compared its project farmers and control farmers with the same inputs and support provided to them for impact assessment. It was revealed that higher yields and farm price, net income of project-site farmers and general livelihood capabilities were significantly higher than those of control-site farmers. This implied that the programmes, package of technologies and interventions provided by the project had a significant positive impact on the net returns of project-site farmers. Interventions carried out were to combine harvesters during the harvesting of seeds for storage, hermetic super bags for storage as cocoons, market information, and moisture meters.

According to Duryea and Morrison (2004), there are inherent limitations of the simple comparison of means and one of them is that there is no way to control other factors that affect the impacts and that may likely vary between the project and control sites. It is thus recommended that other impact evaluation methods such as propensity score matching be done to further validate the impacts.

FAO (2007) in its study on the role of agricultural projects and development, revealed that since projects are implemented towards addressing specific constraints and issues, it helps to provide both short and long term reliefs to beneficiaries while enhancing the technical capacities and livelihoods of both beneficiaries and project implementers as shown in Table 2.2.

Table 2.2 Categories of Agricultural Project Contributions to Food Security and Poverty

Categories	Provision of private goods and services	Provision of goods and service with externalities
Direct impact	• food production • income generation employment • opportunity	• poverty alleviation (within households) • food security (within household)
Indirect Impact	• surplus labour • provision • saving for • investment • market for • industrial goods • export earnings • materials for agro processing • industries	• poverty alleviation (spill-over) • food security (spill-over) • environmental • externalities • out-migration control • buffer in times of economic shock • • culture formation

Source: (FAO, 2007)-Role of Agricultural Projects

2.10. CHAPTER SUMMARY

This chapter reviewed the sustainable livelihoods and livelihood framework, diffusion of innovation theory (DOI), the participatory approach theory and the beneficiary assessment theory as the theoretical underpinning base to this study. It further explored the five livelihood capital or assets in relation to agriculture in general and rice in particular. The need for rice production to be considered as a sustainable livelihood option was reviewed and how it has contributed to the wellbeing of small scale farmers. Furthermore, the chapter discussed the impacts and contribution of projects and interventions to people and the need for policy makers to strengthen and promote the use of technical projects as developing tools to improve on the livelihood of people. The chapter relied heavily on the agricultural epistemologies derived from USAID, OECD, FAO, DFID, JICA, The World Bank and MOFA because these institutions serves as the main source of agricultural projects support to developing countries and implementers of such interventions.

CHAPTER THREE

3.0. METHODOLOGY

3.1 INTRODUCTION

This chapter describes the procedures and methods used in conducting the study. The study is mainly quantitative and utilises data from the survey of rice farmers in the Ashanti and Northern regions of Ghana. The chapter briefly outlines the study area, the study population, sampling procedures and techniques, sample size, method of data collection, data analysis as well as the ethical consideration.

3.2 THE STUDY AREA

The study was conducted in the Ashanti and Northern Regions of Ghana. The Ashanti Region is in the middle of the country sharing bothers with the northern and southern parts of the country. It is endowed with fertile land conducive for agriculture. Food crops such as cocoa, plantain, citrus, and other cereal crops like maize and rice are grown in the region. It falls within the semi-deciduous agro-ecological zone of Ghana and is located at latitude 6°52'N and longitude 1°51'W. The area is on an altitude of approximately 280 m above sea level. The region experiences double maxima rainfall in a year, with peaks in May/June and October. Mean annual rainfall is between 1100 mm and 2900mm. The mean annual temperature ranges from 25.5^0c in the southern districts and 32^0c in the northern parts of the region. Humidity is high averaging about 85% in the southern districts and 65% in the northern part of the region.

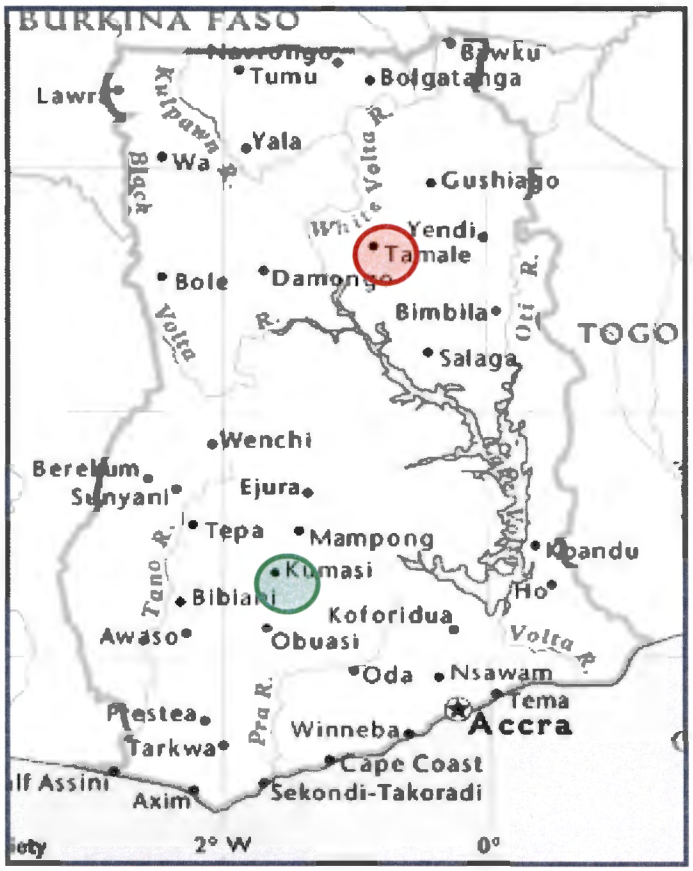
The region has a total surface area of 24,389 square kilometres with about 1,463,340 hectares (60%) of arable land. About 1,181,788 hectares (81%) of the arable lands are cultivated. The region has a population of 4,881,422 inhabitants as per the 2010 population census by the Ghana Statistical Service (GSS). Approximately 65% of the total population depends on agriculture for

livelihoods. The Region however has a farmer population of 2,274,745 representing 46.6% of the total population of the Region. In terms of forest resources, about 3,180 Sq km representing 22.5% of Ghana's forest reserves are found in the region. About 2,340 Sq km (65%) of this is currently being exploited while the remaining 1,240 Sq km (32%) is protected. Some economic trees found in the region include Wawa, Odum, Sapele among others. Lumbering activities therefore take place in almost all districts in the region.

The Northern Region on its part occupies an area of about 70,383 square kilometres. It is the largest region in Ghana in terms of land area. It shares boundaries with the Upper East and the Upper West Regions to the north, the Brong Ahafo and the Volta Regions to the south, and two neighbouring countries, the Republic of Togo to the east, and La Cote d' Ivoire to the west. The land is mostly low lying except in the north-eastern corner with the Gambaga escarpment and along the western corridor. The region is drained by the Black and white Volta and their tributaries, Rivers Nasia and Daka. It is much drier than the southern areas of Ghana, due to its proximity to the Sahel and the Sahara. However, the southern part of the region has similar ecological conditions as in the middle belt of Ghana.

The vegetation is predominantly grassland, especially Savannah with clusters of drought-resistant trees such as baobabs or acacias, mangoes and neem. The rainy season runs between May and October with an average annual rainfall of 750 to 1200 mm (30 to 40 inches). The dry season is between November and April.

Figure 3.1: The study area



Source: (1998 National Geographic Society)

The highest temperatures are experienced at the end of the dry season, the lowest in December and January. However, the hot harmattan winds from the Sahara blows frequently between December and the beginning of February. Temperatures can vary between 14°C (59°F) at night and 40°C (104°F) during the day. More than 75% of the economically active population practise agriculture. The low population density is partly caused by emigration. The region has the highest number of lowland valleys suitable for rice production and farmers in the region has culture rice compared to other parts of the country with most of the local production margins coming from the region (NRDS, 2009).

3.3 STUDY POPULATION AND SAMPLE SIZE

By 2013, the project had 2, 221 farmers from both the Ashanti and Northern Regions of Ghana. These 2, 221 farmers were supposed to be knowledgeable in rice production have access to lowlands or valleys suitable for rice production and be ready to learn and apply the technology from the project in order to be considered part of the project. The project subsequently extended same interventions to farmers in all its pilot areas (Northern and Ashanti) such as bund construction, levelling, water drainage, seed treatment, split fertiliser application, farmer group dynamics, onsite or field site trainings and record keeping etc. Probability sampling was used to select farmers in order to ensure that all farmers had equal chance of selection and avoid bias by the researcher. Proportions were used to determine the sampling size for all the farmers (Table 3.1).

Table 3.1 Sample size of the study

PCU	Project Farmers Population	Sample Size Selected
Ashanti and Northern	2,221	300

Source: (MOFA-PCU, 2013)

A sample size of **300** farmers was selected for the study based on this sampling formula. With a total farmer population of 2221 and a confidence level of 95% and 5% precision level, a sampling formula of $n=N/1+N\ (e)^{2}$ was used to arrive at the sample size, where n=the sample size, N=total population and e= error tolerance. Sarantakos (1997) argues that a bigger sample size gives better accuracy than smaller sample sizes. The advantage of choosing a representative sample size is that it enables models to behave well as a result of large degree of freedom.

3.4 QUESTIONNAIRE DESIGN AND ADMINISTRATION

Open and close ended questionnaires were used in collecting data for the study. The variables were grouped based on the five (5) livelihood assets classifications of the livelihood frameworks (Bio-data, rice farming, physical capital, social capital, human capital, financial capital and natural capital). The researcher used questionnaire because it helps respondents in providing specific and direct answers to questions asked. It does not allow the researcher to ask further questions that dot not contribute to achieving the stipulated research objectives. Prior to the questionnaire administration, a focus group discussion was held to explain the purpose of the study and the questions to them. Respondents, who could read and write, directly filled the questionnaires while those who could neither read nor understand were orally interviewed. Participatory interactions with respondents were used for the data collection process with respondents. The interactions were very important in generating information which could not have been easily solicited using closed ended questions.

The questionnaire was categorised according to the following livelihood capital;

i. Personal characteristics of rice farmers;
ii. Natural livelihood capital of rice farmers as beneficiaries of the project;
iii. Physical livelihood capital of beneficiaries;
iv. Human livelihood capital of the respondents;
v. Financial livelihood capital of the project farmers; and
vi. Social livelihood capital of rice farmers.

Table 3.2 Key Indicators for measuring livelihood capital

Livelihood capital	Measuring period	
	Before the Project High/Low scores	After the Project High/Low scores
FINANCIAL CAPITAL		
(i) Sources of income		
Agricultural income		
Non agriculture income		
(ii) Savings		
Savings		
Self-help groups savings		
Cash in bank		
(iii) Credits		
Relatives		
GoG subsidies		
Access to banks		
Neighbour or associate		
Self –help groups loan (FBOs)		
HUMAN CAPITAL		
Extension services		
Rice Skills training		
Technical training		
Land management training		
Disease treatment		
Water management		
Soil management		
Marketing skills		
Level of education		
Innovative and creative thinking		
Knowledge of farm management		
Record keeping		
Health status		
Educational status		
Training and other extension services		
Health facilities availability		
Knowledge and skills of person		
PHYSICAL CAPITAL		
Road and transport to the farms		
Available agricultural water		
Market access		
Silos and storage facilities		
Agricultural machinery		
Health facilities availability		

Housing facilities
Farm sheds
NATURAL CAPITAL
Land access and utilisation
Water utilisation
Land tenure arrangement
Payment for land if rented
Land quality and fertility of soil
Watershed development and conservation facilities
Water streams
SOCIAL CAPITAL
Relationship with relatives / neighbours
Labour networking (for farm work)
Network with MOFA, AEAs and Assemblies
Network with financial institutions
Network with transporters
Network with stores or silos
Network with processors and millers
Network with farmers' associations (FBOs)
Network with other production group (NGOs and civic group)
Network with village committee

These variables (table 3.2), in relation to the five livelihood capital were analysed using the before and after frameworks and verified in accordance with the available baseline data from the inception of the project. This method is confirmed by Ezemenari, *et al.,* (1999) as a tool for measuring the impacts of projects on beneficiaries. It implies using baseline and feasibility data to measure the current state after the intervention or treatment. The change, availability and accessibility of these elements and variables on the livelihood capital were measured.

3.5 DATA COLLECTION

The data collected for the study was quantitative in line with the specific research objectives of the study. The quantitative method used enabled respondents to express themselves in a directive manner (McCracken, 1988 in Hoggart, Lees and Davies, 2002). Also, one advantage of the quantitative approach is the ease and speed with which the research is conducted and also its wide coverage of a range of situations (Amaratunga *et al.,* 2002). Another advantage of the method is that the final results are based on quantities rather than interpretations, which may simplify potential future development and comparisons with the study, especially projects such as under reviewed. This research design also enables the researcher to collect data through the use of self-administered questionnaires and farmer household interviews. Primary data was derived from the interviews with key informants (project farmers, other secondary beneficiaries and stakeholders) through structured questionnaire and field direct observations. Participatory approach was used in order to obtain more information from participants. This approach is holistic and takes into account a broad range of factors and relationships. This facilitates the discovery of unanticipated consequences of intervention, such as a second round, unforeseen, positive or negative effects (Ezemenari, *et al.,* 1999). A more direct and personal relationship established between the interviewer and the respondents promotes trust and facilitates in-depth inquiry into sensitive issues which may be difficult to approach through a survey research. The baseline and follow-up survey data available were used for the research.

3.6 MEASUREMENT OF VARIABLES

The level of measurement refers to the relationship among the values that are assigned to the attributes of a variable (table 3.3). It is important as a tool in this study because understanding the level of measurement helps the researcher to decide on how to interpret the data from the

variable. It also helps the researcher to decide on what statistical analysis is appropriate on the values that were assigned.

Table 3.3: Measurement of Variables

Variables	Levels of Measurements	Method of Analysis
Age	Interval	Frequency, percentages and standard deviation (σ)
Gender	Nominal	Frequency, percentages, σ
Education	Interval	Frequency, percentages, σ
Farm size/Acreage size	Interval	Frequency, percentages, σ
No of farm houses	Interval	Frequency, percentages, σ
Types of farm implements/tools	Nominal	Frequency, percentages, σ
Source of credit	Ordinal	Frequency, percentages, σ
Types of social groups/FBOs	Nominal	Frequency, percentages, σ
Household expenditure	Interval	Frequency, percentages, (σ)
Average daily meals of farmers	Interval	Frequency, percentages, σ
Average yields of farmers	Interval	Frequency, percentages, σ
Varieties used	Nominal	Frequency, percentages, σ
Market outlets	Nominal	Frequency, percentages, σ
Rice technologies	Nominal	Frequency, percentages, σ
Household size	Interval	Frequency, percentages, σ
Entrepreneurship	Nominal	Frequency, percentages, σ
Number of dependents	Interval	Frequency, percentages, σ
Farming experience	Interval	Frequency, percentages, σ
Farming enterprises	Nominal	Frequency, percentages, σ
Income	Interval	Frequency, percentages, σ
Sources of information	Nominal	Frequency, percentages, σ
Programme effectiveness	Interval	Frequency, percentages, σ
Farmers attitude	Ordinal	Frequency, percentages, σ
Farmers assets	interval	Frequency, percentages, σ
Constraints to participation	Ordinal	Frequency, percentages, σ

(Source: Author's Construct, 2014)

3.7 DATA ANALYSIS

The data collected was subjected to descriptive analysis using frequency counts, percentages, and standard deviation as shown in Table 3.3. A quantitative approach was used in the study using survey and comparative design method. Survey and comparative designs methods according to

Mills (2006), offers similarities, variance and data significance of variables in research and also helps to establish patterns of change or differences in respondents.

3.7.1. The Wilcoxon Sign

A non-parametric quantitative model- The Wilcoxon Sign Sum Rank was used to measure the changes in the livelihoods of the beneficiaries before and after the project. Nominal, ordinal and interval levels of measurements were used to analyse the variables. IBM-SPSS version 22 and Microsoft excel sheets were used to analyse the data. These statistical tools and measurements were used because members of a pair (sample units) are assumed to have identical, symmetrical and normal distributions in terms of the same technology and interventions received for the period. This fits well with the Wilcoxon theory of sign test, which compares two related samples (before and after) with the same sample population for scoring and ranking (Wilcoxon, 1945). It is used when there is paired design of scores for sample groups for comparison during the treatment and after the treatment.

The Wilcoxon Signed-rank Sum Test applies to two-sample designs involving repeated measures and matched pairs. It could also be "before" and "after" measures like the t-test for correlated samples and a non-parametric version of a paired samples t-test. The Wilcoxon Signed-rank Sum Test as used in the study, does not assume that the difference between the variables are interval or normally distributed but assumes that the differences are ordinal. The test is robust and highly efficient for moderate to heavy tailed underlying distributions. In particular, it is an improvement over the sign test and very efficient when the underlying distribution is normal (Hettmaspherger *et al.,* 1997). Hettmaspherger *et al.,* (1997) further added that Wilcoxon Signed-rank statistics can be computed as sign statistic of the pair-wise averages of data.

Table 3.4 Analytical methods

Specific Objectives	Analytical methods
Personal characteristics of rice farmers	Percentages, frequencies, Standard deviation (σ), Probit and X^2
Natural and physical livelihood capital of rice farmers as beneficiaries of the project	Wilcoxon sign rank test, Percentages, frequencies and Standard deviation
Human and social capital change of respondents	Wilcoxon sign rank test, Percentages, frequencies and Standard deviation
Financial capital of farmers	Wilcoxon, Percentages, frequencies and Standard deviation

Mathematically, the explanation for the Wilcoxon

Signed-rank Test for the study is as follows;

$$W = |\sum_{i=1}^{N_r}[\mathrm{sgn}(x_{2,i} - x_{1,i}) \cdot R_i]| \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where W = Wilcoxon signed –rank test

N_r = Sample size

X_{12} = Measuring levels

For I = 1, 2 …n

$X_1(N_1, H_1, P_1, S_1)$ …… before the project

$X_2(N_2, H_2, P_2, S_2)$ …….... after the project

R_i ……...Rank

With N……...Natural capital

H……...Human capital

P……...Physical capital and

F……...Social capital

Hence: $W = [\sum_{i=1}^{Nr} \mathrm{sign}\ (X2\ (N2, H2, P2, S2) - X1\ (N1, H1, P1, S2).Ri]$……...2

As N_r increases, the sampling distribution of W converges to a normal distribution.

The remaining N_r pairs were ranked (R_i) from the smallest absolute difference to the largest (low and high) absolute difference of the capital, thus [X_2 (N_2, H_2, P_2, S_2) - X_1(N_1, H_1, P_1, S_2)]. For the ranking, the pairs start with the smallest number as 1 to a bigger value. If there are ties in the ranks for before and after treatments, the ties receive a rank equal to the average of the ranks they span. Let R_i denote the rank. Wilcoxon indicates that the higher the rank of the scores the better their livelihood capacities and the lower the ranks of the scores, the weaker their capacities.

3.7.2. The Probit model

Access to livelihoods and personal welfare improvement of farmers depends on some qualities and characteristics. The Probit model is often used in situations where an individual makes choices between two alternatives. In this case, the decision is to either adopt or not adopt technologies or interventions in rice production to improve on their livelihoods and entrepreneurial activities. The Probit model was then used to establish a relationship of farmers of some selected variable indicators i.e. farming experience, income, market access, extension services, livelihoods capital and farmers' entrepreneurial abilities. According to Mussei *et al*; (2001), farms and farmers associated attributes and characteristics are some of the factors influencing the adoption of new agricultural technologies to improve their livelihoods. Dealing with all rice value chain actors including; input dealers, suppliers, transporters, farm labour, extension officers, marketers, consumers etcetera requires some level of skills and assets. In the Probit, model the discrete dependent variable Y is a rough categorization of a continuous, but unobserved variable Y^*.

If Y^* could be directly observed, then standard regression methods would be used (such as assuming that Y^* is a linear function of some independent variables, for example:

$$Y^* = \beta_1 X_{1i} + \ldots\ldots\ldots \beta_j X_{ji} + ui \quad \ldots\ldots (3)$$

In this study, Y^* is entrepreneurial abilities which is used as a proxy for Y^*. A Probit model is appropriate when the dependent variable to be evaluated is dichotomous according to Maddala, (1983). Following from Greene (2003), the binary probit for the two choice models can be written as:

$$Y_i^* = \begin{cases} 1 \, if \, Y_i^* > Y \\ 0 \, if \, Y_i^* \leq 0 \end{cases} \quad \ldots\ldots (4)$$

$$P\left(Y = \frac{1}{X}\right) = F(XB) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{XB} e^{\frac{-(XB)^2}{2}} dx \quad \ldots\ldots (5)$$

$$X = (1, x_{1i}, x_{2i}, \ldots\ldots, x_{ki}) \quad \ldots\ldots (6)$$

$$\beta' = (\beta_0, \beta_1, \ldots\ldots\ldots\ldots, \beta_k) \quad \ldots\ldots (7)$$

The actual model specification of some variable indicators and entrepreneurial capacities of farmers as a result of access to the livelihood capital is;

$Y_i = \beta_0 + \beta_1 + \beta_2$Years of farming experiences $+ \beta_3$ Income $+ \beta_4$ Ready market $+ \beta_8$ Extension contact $+ \beta_9$ Human capital before $+ \beta_5$ Human capital after $+ \beta_6$ Natural capital before $+ \beta_7$ Natural capital after $+ \beta_8$ Social capital before $+ \beta_9$ Social capital after $+ \beta_{10}$ Financial capital before $+ \beta_{11}$Financial capital after $+ \beta_{12}$ Physical capital before $+ \beta_{13}$Physical capital after $+ \mu_i$

Where Y_i and μ_i represent farmers' entrepreneurial capacities with access to livelihood capital.

3.8 ETHICAL CONSIDERATIONS

Ethical considerations were diligently applied to all respondents irrespective of gender, sex, religion or age. The privacy and confidentiality of information of respondents were highly respected and participants were guided during and after the survey. Equal respect and standard measurement and treatment to every respondent were adhered to. Permission and consent were obtained at every level and stage of the survey process from respondents before the start of the interviews and interactions. Questions and interactions focused largely on the objectives of the study. Information from the Ministry of Food and Agriculture about the project was also done using the appropriate protocols and procedures by the Ministry and research codes guidelines. The next chapter is results and discussion.

Chapter Summary

The chapter explained the quantitative nature of the study, the study location and the category of respondents (rice farmers) involved. It explained the sample size, the data collection instruments and how the data was collected. As a quantitative method of research, use of statistical measuring tools (Wilcoxon sign rank test, t test, probit model) and other measuring methods has been explained. The chapter also explained the ethical considerations relating to the respondents' consent, privacy, respect and permission before data collection.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents results of the findings of the study relative to the research objectives and questions. It discusses the demographic features of respondents who are mainly rice farmers and as well examines the impact of the rain fed rice project on the five livelihood capital on the lives of the farmers.

4.2 PERSONAL CHARACTERISTICS OF THE BENEFICIARIES

The socio demographic characteristics discussed are age, gender, education and employment status of respondents. Many studies have proven and confirmed that, the socio-economic and demographic factors as well as personal characteristics of farmers involved in agricultural projects influence the performance of agricultural projects and other governments interventions (Deere and León 2001; Owens *et al.,* 2003; Leite *et al.,* 2004; Okon *et al.,* 2010 and Antwi, & Oladele, 2013).

The findings of the study (Table 4.1) revealed that a higher percentage of 35% of the total respondents fell within the 31-45 age brackets, was followed by 15-30 age groups of 29%. Table 4.1 shows that the majority of rice farmers involved in the project were mainly the youth. The project influenced the younger age by involving many of them in the cultivation and training process. They had the experience and were strong enough to withstand the drudgery and labour intensive nature of rice farming.

Table 4.1 Demographic characteristics of respondents

VARIABLES	FREQUENCY	PERCENTAGE (%)
Gender		
Male	258	86
Female	42	14
Age		
15-30	86	29
31-45	105	35
46-60	46	15
61-75	63	21
Marital status		
Married	220	73
Single	50	17
Divorced	13	4
Widowed	17	6
Religion		
Christianity	106	35
Islam	173	58
Traditional	17	6
Others	4	1
Level of education		
Basic level	109	36
Secondary level	13	4
Tertiary level	2	1
Others	19	6
Male households' dependents		
1-3 Dependents	161	54
4-7	98	33
8-11	32	11
No. of Dependents Involved in farming		
1-3 Dependents	157	52
4-7	98	33
8-11	20	7
No. of Female households' dependents		
1-3 Dependents	140	47
4-7	88	29
8-11	28	9
Years of Farming experience		

1-10 Years	200	67
11-20 Years	88	29
21-30 Years	12	4
Years of Rice cultivation experience		
1-10 Years	160	53
11-20 Years	126	42
21-30 Years	14	5

(Source: Field Survey, 2014)

The results also revealed that some respondents were in the age between 46 -60 and 61-75 years represented 36% of the 300 respondents (Table 4.1). This indicates that the old people could have more impact on the rice culture and experience than the younger groups' aside the collective technology and techniques the rice project extended to them as farmer groups. Many of the farmers 53%, had 1-10 years of rice cultivation experience with 42% having between 11-20 years (Table 4.1) indicating the extensive experience they have with rice farming.

Majority of the respondents (86%) were males with only 14% females. This confirms the fact that males still dominate the rice farming and the agricultural sector. FAO, (2011) argue that in developing countries there are about 43 % of women working in the agricultural sector as compared to their male counterparts with 57%. Motsi and Madyiwa (2007) opined that women and children have many different off -farm duties and still fulfil their on-farm obligations than men. However, contrary to this position, STATSSA (2007) reveals that there are more women in all nine provinces of South Africa are involved in farming than men. This shows that if given the required resources and exposure, women can also significantly produce more and better agricultural outputs.

Most of the respondents (73%) were married. Some of the married ones seemed committed to the rice production business because it was one of their main sources of livelihoods not only to feed

their families, but also to make income for other obligations like health, shelter and education. Equally important to the marriage link was the labour relief many of them had. From the results, family labour was one of the dominant sources of farm labour to them aside through hiring. This meant that marriage in major farming communities offers incentives and benefits.

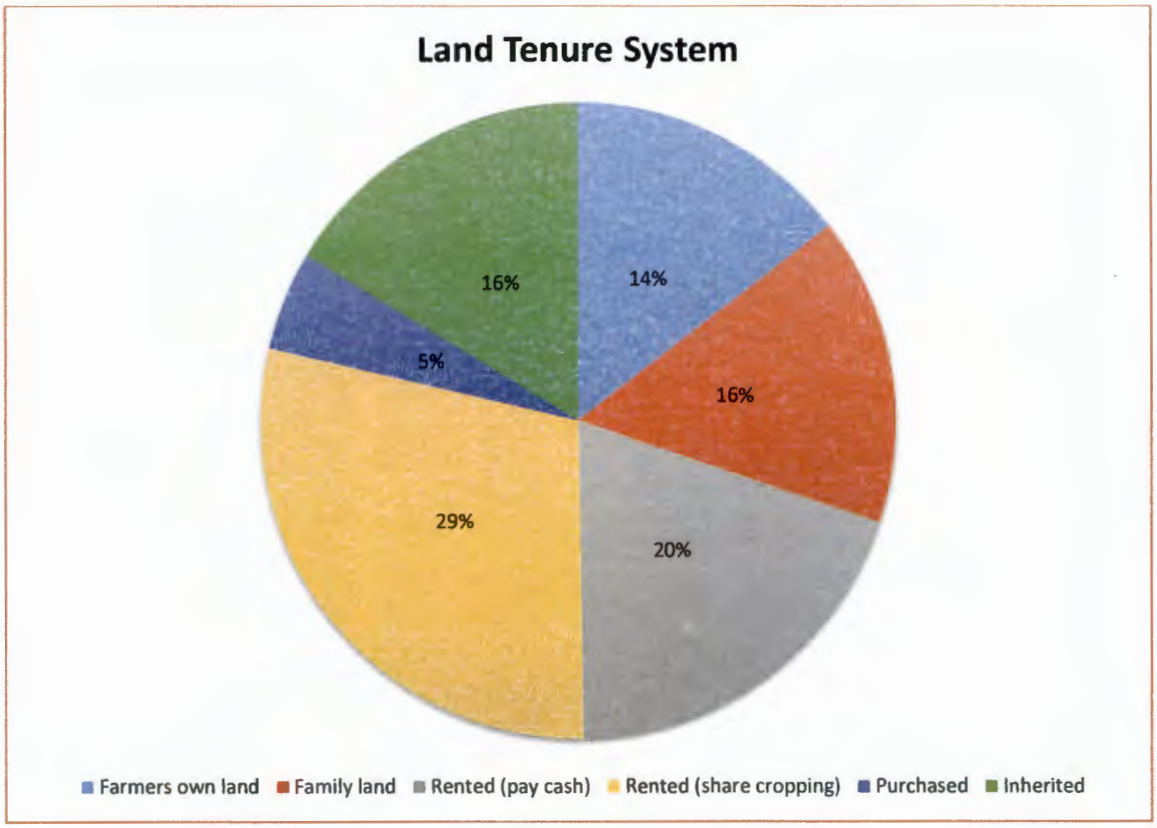
Some of the female respondents interviewed intimated that roles and responsibilities were assigned to each gender pushing females to the postharvest, processing and marketing aspects of the rice value chain. This shows how the division of labour and the activities trend of the rice production process and largely the agricultural environment operate. According to the AEAs, encouraging many women to be part of the project was a conscious activity they undertook because women plays a key role in the household economies and expenditure management though the number was still not good enough.

Due to their energy levels men are more involved at the primary production stage of rice cultivation. The findings from Ghana's NRDS (2009) which is the policy framework for rice reveals that issues of land tenure, access and ownership prevented a lot of Ghanaian women from engaging in agriculture and rice farming in especially when they are proven to be more credit worthy. Share cropping system or rent to pay in kind was the dominant method of acquiring land for rice production in the study areas with 29% of respondents followed by rented (paying in cash) with 20%. Acquisition through family and inheritance indicated 16% response each (Figure 4.1) and the lowest method was owned land and outright purchase for use. Interestingly, respondents who acquired their lands through family, inheritance and owned land were all indigenes and others were largely migrants who relied on rice cultivation as a major livelihood option.

Regarding the level of education of respondents, most of the farmers (36%) interviewed had primary educational qualifications (Table 4.1) with very few continuing to secondary and tertiary

levels. Antwi (2014) argues that the educational background of respondents is an essential tool in promoting a sustainable economy, households and the society. Education may have a long term effect or influence on agricultural productivity.

Figure 4.1 Land tenure holding of respondents (N=300)



(Source: Field Survey, 2014)

Though the project did not implement any formal educational initiative apart from technical agricultural training, the earnings or profits from their harvest were used to finance the education of their children. Most of the farmers claimed they were better equipped economically than before to fund their children's education. The informal trainings offered directly by the project exponentially improved their human capital development and agricultural management in general. Topics including house expenditure management, records keeping, farming calendar

management in addition to the typical agronomic practices was taught to the farmers which generally are part of informal educational trainings. Some of the respondents who were educated were selected as key farmers or leaders for the groups and the demonstration plots according to the farmers.

Labour issues were seen as challenging for farmers but for those with many dependents they could rely on the family for support. Table 4.1 further reveals that average rural farmers are now controlling their family sizes due to increasing household expenditures and other responsibilities. For the male household dependents, 52% of them had 1-3 dependents, and 47% of the female households had the same 1-3 dependents (Table 4.1). For these dependents, a significant representation of 52% were involved in farming either on their own or supportive to the respondents.

The adoption levels of extended technologies by the project on yields as shown in Table 4.2 reveals that majority of the respondents (42%), had from 2.9-3.9ton/ha of rice paddy which is quite above the national average yield of 2.5ton/ha reported by MOFA, (2012).

Table 4.2 Average yields/Ha of rice produced by the respondents

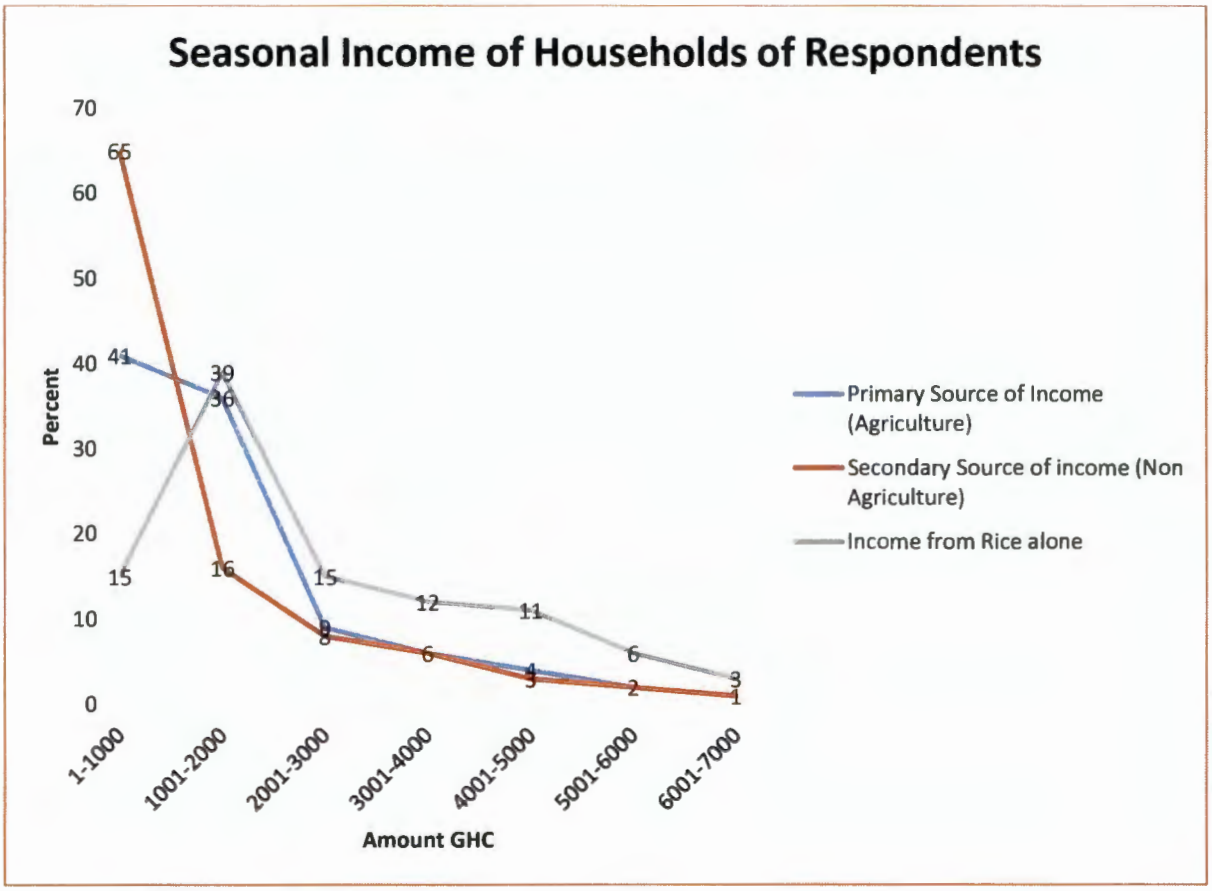
Yield (Ton/Ha)	Frequency	Percentage (%)
1.5 - 2.8	98	33
2.9 - 3.9	125	42
4.0 - 4.9	58	19
5.0 - 5.9	11	4
6.0 - 6.9	8	3
Total	300	100

(Source: Field Survey, 2014)

The increase in yields for the period translated to their household seasonal incomes from rice in particular. From Figure 4.2., the incomes of respondents for rice alone were evenly spread with

the majority of farmers (39%) earning within 1000-2000GHc per season followed by 15% earning 2000-300 GHC 12%, and 11% of farmers earned over 3000GHC and 5000GHC respectively. The significant part of it is that since they are not only producing rice but cultivate other crop commodities and postharvest jobs, their total seasonal are improved. Moreover, the earnings put together could be classified as not poor according to World Bank 2014 poverty benchmark.

Figure 4.2 Seasonal income of household of respondents



(Source: Field Survey, 2014)

Government through the project provides the farmers some agricultural inputs including; fertiliser, weedicides, pesticides and certified seeds which they pay back at the end of each

farming season. Almost all the farmers (99%) benefited from the government support and 68% from input dealers (Table 4.3). The farmers saw their group system (FBOs) as one of the source of support to themselves from their own contributions after every harvest. Even though only 7% (Table 4.3) of the total number of respondents were receiving inputs from FBOs, it is encouraging to know that, they made efforts to support each other.

Table 4.3 Source of farming inputs

Source	Frequency	Percentage
Government (MOFA)	296	99
Input Dealers	203	68
FBOs	20	7
NGOs	6	2
Others	2	1

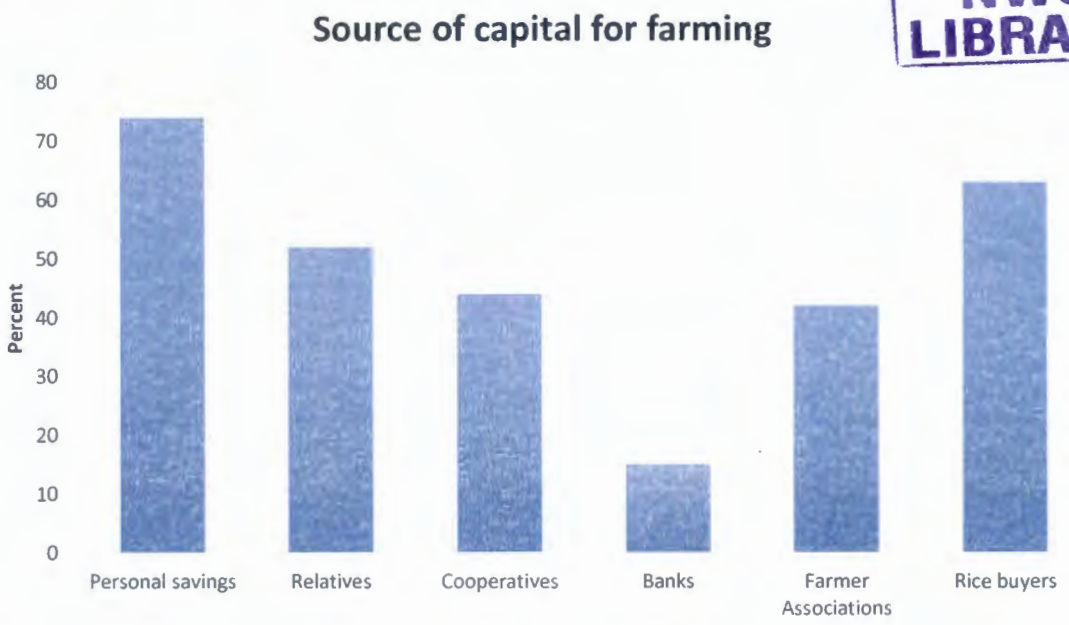
(Source: Field Survey, 2014)

Sourcing funds from banks recorded very low responds (15%) from the respondents for farming activities compared to their personal savings (74%). This could be attributed to the agricultural sector being considered as a high risk area for credit by the financial institutions. Rice buyers from the farms and milling facilities were the highest source of credit support to the farmers for their farming activities with 63% (Figure 4.3). Relatives, cooperatives and farmer associations followed with 52%, 44% and 42% respectively. They benefited from relatives, cooperatives and farmer associations because of the increased and higher collective action taught them by the project.

Enquiring why the banks were not given farmers credit some of them intimated that *'they expect so much from us and we cannot always meet their requests and besides that our occupation is seen as bad and risky businesses'*. However, the 15% of the farmers who received funding from the banks was seen as an improvement and achievement from the Agricultural Extension Agents (AEAs) perspective. The officers intimated that, developing rice production as business habits,

records keeping techniques, income and expenditure planning and forecasting were some of the trainings received by farmers that improved the percentage and allowed banks to allocate funds to the 15% of the 300 respondents (Figure 4.3) as well as from the cooperatives.

Figure 4.3 Source of capital for farming



(Source: Field Survey, 2014)

The study also revealed a significant finding, that is, rice buyers serving as a source of funding for rice farmers in the study areas. 63% of the 300 respondents were depended on the buyers to support them with capital during the start of the season. This confirms Angelucci *et al.,* (2013) assertion that rice buyers plays a significant role in the production, milling and marketing of the rice commodity in Ghana as they provide capital as well as inputs for farmers to use and pay back with their harvested rice. The challenge with this provision is that, the farmers are always at lost since the payback will be at the period of glut with low prices of rice and other commodities. A good marketing skills and entrepreneurial abilities of the farmers could help them negotiate better with the rice buyers and input dealers to earn more which could reverse the pre-financing system.

The results from the probit model in Table 4.4 shows that the coefficients for some selected variables were significant, these are area; ready market (t=-2.194), contact with extension officers (t=2.418), ready market (t= -2.194), natural capital after (t=1.664), social capital after (t= 1.838), physical capital before (t=2.87), physical capital after (t= -6.158). The sign for each coefficient is consistent with the expectation; thus, the probability of entrepreneurial activities increases if availability of ready and established increases and accessible to farmers and if contacts with extension officers' increases. Also, the probability of increased in entrepreneurial capacities of farmers increases with an increase in natural, social and physical capitals of farmers

Table 4.4 Probit Model Analysis of entrepreneurship activities as dependent

Parameters	Estimate	Std. Error	Z	Sig.
Farming experience	0.001	0.002	0.518	0.604
Income	0	0	-27.066	0.00
Ready market	-0.065	0.03	-2.194	0.028
Extension contact	0.051	0.021	2.418	0.016
Established market	-0.143	0.028	-5.157	0.00
Human capital before	0.006	0.001	3.969	0.00
Human capital after	-0.001	0.002	-0.741	0.459
Natural capital before	0.007	0.004	1.789	0.074
Natural capital after	0.005	0.003	1.664	0.096
Social capital before	0	0.002	-0.223	0.824
Social capital after	0.005	0.003	1.838	0.066
Financial capital before	0.002	0.007	0.225	0.822
Financial capital after	0.006	0.005	1.278	0.201
Physical capital before	0.013	0.005	2.87	0.004
Physical capital after	-0.02	0.003	-6.158	0.00
Positive psychological capital before	0.004	0.002	1.488	0.137
Positive psychological capital after	0.002	0.003	0.533	0.594
Intercept	-1.133	0.192	-5.895	0
Chi-Square	13319.44			
df	280			
p	0			

(Source: Field Survey, 2014)

4.3 ANALYSIS OF ACCESS TO NATURAL AND PHYSICAL CAPITAL BY RICE FARMERS BEFORE AND AFTER THE SUSTAINABLE DEVELOPMENT OF RAIN-FED LOWLAND RICE PRODUCTION PROJECT

4.3.1 Variable indicators for natural capital of respondents

As shown in figure 4.1 earlier (land tenancy holding), share cropping and rented lands accounted for the majority of the land ownership which suggests that access and utilisation of arable land for farming becomes challenging. The indicators for natural capital in Table 4.5 show that land access and utilization increased from 43% to 73%, water utilisation increased from 38% to 82%, tenancy arrangement from 31% to 70%, and fertility management of lands from 44% to 66% after the project. This increase could be attributed to the importance the project attached to vegetation, land and water management approaches and techniques to improve not only the yields of farmers but also improve on the unsustainable state of the water and productive lands.

Water availability and its usage is a critical element in rice production (Tran, 1997) and its availability and access is valuable to the production process. As water loving plants, inadequate access to water and good fertile soils can inhibit the yields process and farmers' incomes for rice production. All the variables indicated in (Table 4. 5) reveals a positive change as the scores by farmers were mostly low before the project, but all increased to high scores after the project introduced their technical package or interventions related to land and water management. However, majority of the respondents who accessed the lands through sharecropping system intimated their vulnerabilities especially when it comes to fertile lands with available and accessible water for rice farming. Once the values of the lands have been improved and the fertility statues maintained, owners of the lands usually threaten to take back the lands even though the contractual agreement were still inforce. This is linked to the human livelihood capital as the experienced farmers with the requisite trainings and exposures are able to select good

fertile valleys with available and accessible water as well as maintain the soil to support plant growth.

Table 4.5 Access to Natural capital among beneficiaries before and after project (N=300)

Natural capital	Before the Project		After the Project	
	High	Low	High	Low
Variables				
Land access and utilisation	128(43)	172(57)	218(73)	82(27)
Water utilisation	114(38)	186(62)	245(82)	55(18)
Land tenure arrangement	92(31)	208(69)	211(70)	89(30)
Payment for land if rented	189(63)	111(37)	223(74)	77(26)
Land quality and fertility of soil	131(44)	169(56)	198(66)	102(34)
Watershed development and conservation facilities	118(39)	182(61)	157(52)	143(48)
Water streams	164(55)	136(45)	155(52)	145(48)

(Source: Field Survey, 2014)

4.3.1.1 Wilcoxon Sign-Rank Test for difference in Natural capital before and after the project

Wilcoxon test applies to two-sample designs involving repeated measures and matched pairs, in this case for beneficiaries before and after the impact or differences on their livelihoods. As shown in Table 4.6, N refers to the total number of respondents the researcher interacted with, interviewed and observed; the Z values are indications of significant changes in the respective livelihood measuring variables among participants from before and after the rain-fed rice project. The Z statistic is used to report the Wilcoxon signed-ranks test; while the probability-value (p-value) is a measure of the asymptotic significance (2-tailed). The Table also shows the changes

or otherwise of variable indicators measuring the livelihoods capital (natural and physical) of participants after their participation in the sustainable development of rain-fed lowland rice project.

The results as presented in Table 4.6 shows that the p values at $p<0.05$ for all the variable indicators considered were statistically significant. There are land access and utilisation ($z=-10.22$ $p<0.05$), water utilisation ($z= -14.82$ $p<0.05$), land tenure arrangement ($z= -15.06$ $p<0.05$), land quality and fertility ($z= -9.2$ $p<0.05$) and water streams ($z= -10$ and $p<0.05$). The number of farmers with negative mean ranks were higher than those with the positive ranks after the participating in the project. These are indications that farmers' natural livelihoods improved after participating in the project, which rejects the null hypothesis of the study that there were no differences in the farmers' livelihoods capital after being part of the project. This implies that some of the project farmers acquired significant abilities in managing their natural resources for rice production as well as acquiring physical resources or assets after participating in the rain-fed project Again, it shows an improvement in the land tenancy process in both regions which could be attributed to their improved negotiating skills and good land and water management practices that allow land owners to release out lands to them for rice farming.

Table 4.6 Wilcoxon Signed Ranks Test for natural capital

Natural Capital	Ranks	N	Mean Rank	Sum of Ranks	Z	Asymp. Sig. (2-tailed)
Land access and utilisation	Negative Ranks	20	89	1780		
	Positive Ranks	157	89	13973	-10.222	0.000
	Ties	123				
	Total	300				
Water utilisation	Negative Ranks	7	246	1722		
	Positive Ranks	242	121.5	29403	-14.829	0.000
	Ties	51				
	Total	300				
Land tenure arrangement	Negative Ranks	11	218.73	2406		
	Positive Ranks	260	132.5	34450	-15.065	0.000
	Ties	29				
	Total	300				
Payment for land if rented	Negative Ranks	5	78.5	392.5		
	Positive Ranks	151	78.5	11853.5	-11.609	0.000
	Ties	144				
	Total	300				
Land quality and fertility of soil	Negative Ranks	50	128.85	6442.5		
	Positive Ranks	195	121.5	23692.5	-9.2	0.000
	Ties	55				
	Total	300				
Watershed development and conservation facilities	Negative Ranks	61	120.91	7375.5		
	Positive Ranks	120	75.8	9095.5	-4.311	0.000
	Ties	119				
	Total	300				
Water streams	Negative Ranks	34	98	3332		
	Positive Ranks	191	115.67	22093	-10.4	0.000
	Ties	75				
	Total	300				

*N: respondents, *Z: Z Statistics/scores, *Asymp. Sig. (2-tailed): p. values= the probability value (p-value)

which is a function of the observed samples or variables measuring farmers' livelihood capital.

Source: (Field Survey, 2014)

4.3.2 Physical capital of the rice farmers

The scores for the indicator variables physical capital of the respondents showed low scores before the project and increased after the participation of farmers on the project. However, farm roads leading to their farms did not improve as only 24% believed it increased from 18%, while 76% said it was still low or did not improved after participating in the project. This could be linked to a mandate out of the scope of the project which was basically targeting yields and incomes of the farmers with very little structural investments. Access to markets changed from 43% to 71%, rice processing facilities (mills) changed from 57% to 78 (Table 4.7). This indicates that it improved as farmers could easily sell their paddy and milled rice as well as even negotiates for upward price adjustment due to their paddy quality and their bargaining skills improvement. More so, processing facilities such as one pass rice mills obtained a strong response after the project with a rise from 57% to 78% (Figure 4.5) as most farmers were able to acquire the mills for their rice processing.

Farmers were able access health and housing facilities which they could not access earlier. A change from 39% to 51% of the variable indicators shows that respondents could afford and access health facilities with valid health insurance memberships in the study areas, whilst 64% from 43% (table 4.7) acquired houses through outright purchases and others through rent after the project. Elements of physical livelihood capital help to improve the living standard of the people as well as drastically reduce poverty and improve on their health status (OECD, 2011). According to the United Nations Human Rights Council (UNHRC) charter on Universal Human Rights, shelter (housing) and health are human rights issues for every human being to enjoy peace, privacy, wellbeing and security.

Agricultural machinery, farm sheds and silos also reveal a change after the farmer's participation in the programme obtaining 49%, 78% and 48% respectively. The scores are higher than before the start of the project. This suggests that the level of farmer's drudgery development of land, storage of their rice paddy and farming tools in the farms could reduce and rather improve their farming enterprise.

Table 4.7 Access to Physical capital among beneficiaries before and after project (N=300)

Physical Capital	Before the Project		After the Project	
Variables	*High*	*Low*	*High*	*Low*
Road and Transport to the farms	53 (18)	247 (82)	73(24)	227(76)
Market access	128(43)	172(57)	212(71)	88(29)
Silos/storage facilities	125(42)	175(58)	145(48)	155(52)
Farm sheds	171(57)	128(43)	235(78)	65(22)
Agricultural machinery	133(44)	167(56)	147(49)	152(51)
Irrigation infrastructure	116(39)	184(61)	156(52)	144(48)
Netting scare crows	128(43)	172(57)	189(63)	111(37)
Processing facilities (mills)	171(57)	129(43)	235(78)	65(22)
Housing facilities	128(43)	172(57)	191(64)	109(36)
Health facilities	118(39)	182(61)	153(51)	147(49)
Telephone access	128(43)	172(57)	201(67)	99(33)

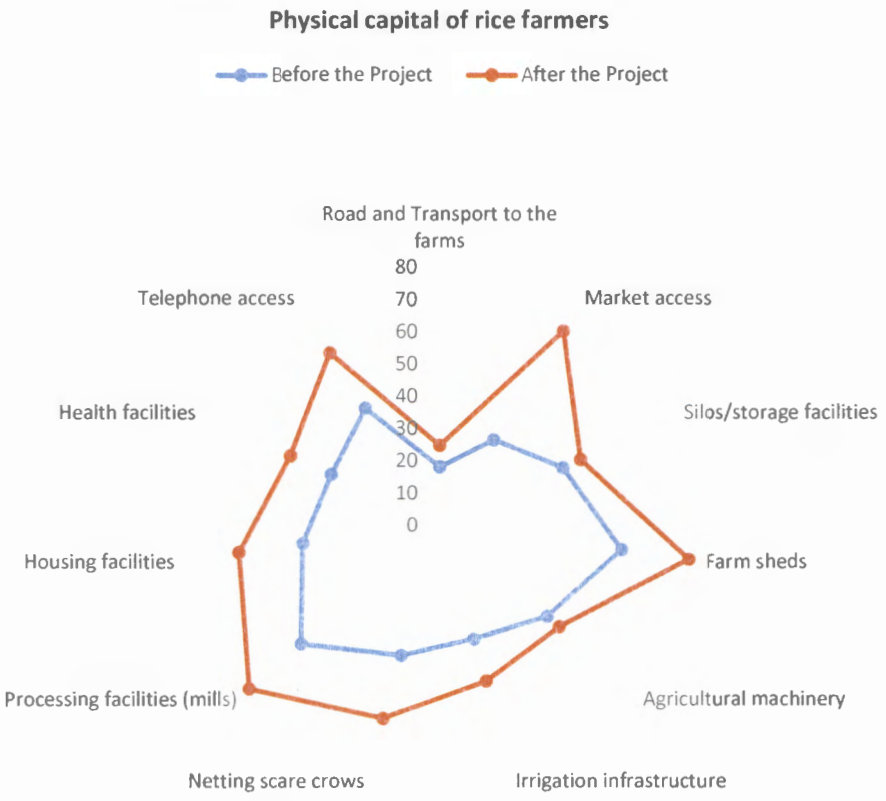
(Source: Field Survey, 2014)

Reducing postharvest losses is critical to food security among farming households. The results in Table 4.7 show an improvement on the use of nets to control birds and other pest in the paddy fields, from 43% before the project to 63% after the project.

> *"According to some farmers, this practice of using nets to control birds and other pests has saved them lots of expenditure, time wasting and sparing their children to go to school who hitherto would have been assisting them in the field"*

The irrigation infrastructure and access to telephones (mobile phones) improved after participating in the project. The use of the earth to construct bunds, water canals, weirs and dykes for off-farm and on farm water management improved from 39% to 52% (Figure 4.5) after the project. In addition to this, telephone density or penetration after the project was a significant increase from 43% to 67% after the project. This served as a communication medium for their farming activities and to link them to the extension officers.

Figure 4.4 Physical capital of respondents



(Source: Field Survey, 2014)

Some of the concerns raised by the farmers were usually resolved through communication on mobile phone with the agricultural officers. This confirms Lee-Martin and Abbott, (2011)

argument that the use of the mobile phone by rural small scale farmers in Uganda helped them in coordinating access to agricultural inputs, market information for their produce, monitoring financial transactions, and consulting with agricultural experts or workers. Overall, it improves their wellbeing and fosters closeness to the world through ICT as well as sharpening their decision making skills in terms of agricultural activities.

4.3.2.1 Wilcoxon Signed Ranks Test for difference in Physical capital before and after the project

The results in Table 4.8 show if there was any change in the participants' livelihood aspirations and access after participating in the project and it led to an overwhelming statistical significant difference in the physical capital farmers. The *p value* of all the indicator variables measuring the physical capital of the farmers were all significant at $(p < 0.05)$ before and after the taking part in the project (Table 4.8). These include, agricultural machinery ($z= -4.376$ $p<0.05$), irrigation infrastructure ($z= -5.581$ $p<0.05$), telephone access ($z= -2.354$ $p<0.05$), housing ($z= -5.045$ $p<0.05$), health facilities ($z= -3.072$ $p<0.05$) and net scare crows ($z= -5.328$ $p<0.05$) scores. This thus implies that the project improved on farmers' access to this livelihood capital which is very critical to their wellbeing and life. Thus rejecting the null hypothesis of the study that there is no significant difference in the physical capital before and after the participation of farmers or the respondents in the rain-fed rice project.

The higher mean ranks also suggest that a significant number of the farmers had their physical capital improved after participating in the project. The positive change in the mean ranks (Table 4.7) could indicate that farming productivity will increase because of improved irrigation infrastructure and water management structures. This will increase because of good health as a result of access to health facilities, interaction and sharing ideas through ICT telecommunication.

It can also improve their productivity apart from minimizing farm postharvest losses through the use of scare crows, processing mills to improve storage.

Table 4.8 Wilcoxon Signed Ranks Test for physical capital

Variables		N	Mean Rank	Sum of Ranks	Z	Asymp. Sig. (2-tailed)
Road and Transport to the farms	Negative Ranks	158	34.85	5506.3	-5.958	0.000
	Positive Ranks	82	28.5	2337		
	Ties	60				
	Total	300				
market access	Negative Ranks	156	29.1	4539.6	-6.171	0.000
	Positive Ranks	84	28	2352		
	Ties	60				
	Total	300				
Silos/storage facilities	Negative Ranks	144	33.17	4776.5	-4.130	0.000
	Positive Ranks	48	30.5	1464		
	Ties	108				
	Total	300				
Agricultural machinery	Negative Ranks	162	32.74	5303.9	-4.376	0.000
	Positive Ranks	39	39.23	1529.97		
	Ties	99				
	Total	300				
Irrigation infrastructure	Negative Ranks	162	35.68	5780.2	-5.581	0.000
	Positive Ranks	55	37.73	2075.2		
	Ties	83				
	Total	300				
Farm sheds	Negative Ranks	198	38.34	7591.3	-6.524	0.000
	Positive Ranks	52	35.5	1846		
	Ties	50				
	Total	300				
Netting scare crows	Negative Ranks	195	37.01	7216.9	-5.328	0.000
	Positive Ranks	33	47.32	1561.6		
	Ties	48				

	Total	300				
Processing facilities (mills)	Negative Ranks	65	35.87	2331.5		
	Positive Ranks	8	46.19	369.5	-5.904	0.000
	Ties	27				
	Total	100				
Housing facilities	Negative Ranks	195	34.14	6657.3		
	Positive Ranks	27	57.33	1547.9	-5.045	0.000
	Ties	81				
	Total	300				
Health facilities access	Negative Ranks	123	25.38	3121.7		
	Positive Ranks	36	32.54	1171.4	-3.072	0.002
	Ties	141				
	Total	300				
Telephone access	Negative Ranks	102	24.25	2474.5		
	Positive Ranks	51	29.5	1504.5	-2.354	0.019
	Ties	147				
	Total	300				

(Source: Field Survey, 2014)

Another good attribution that could be assigned to the significant difference is the improvement in respondents' seasonal agricultural incomes from rice and other crop commodity production. This impacted their economic wherewithal to acquire these physical capital that will improve on their livelihoods and over all standards of living. This is confirmed by Obrist et al (2007) who argues that problems of accessibility, including long distances to nearest dispensary or health centres, challenging transport system serves as a huge access barrier that exposes people in rural and farming communities to poor health care. This weakens their welfare system and they cannot afford basic livelihood resources to fend for themselves thereby making them more vulnerable.

4.4 ACCESS AND DEVELOPMENTS OF THE HUMAN CAPITAL OF FARMERS BEFORE AND AFTER THE PROJECT

Human capital in this context, critically looks at how the availability of rice farmers, rice processors, rice marketers, agro -inputs dealers, labour and agricultural technical officers use their skills, knowledge and abilities to undertake rice production as their livelihood option. The indicators measuring the level of human capital of the respondents relates strongly to their production and productivity levels as well as incomes. Interactions with the farmers with better human capital revealed that they were able to manage the vulnerabilities of the rice production processes.

The farmers' ability to select good seeds, prepare and keep good records of their income and expenditure incurred, appropriate agronomic practice on the life cycle of the rice plant and the right technique to reduce postharvest losses, will inure to a good yields and incomes. Education and family labour is an important form of human capital (Mahdi *et al.,* 2009). The findings from the study as shown in Table 4.9 reveals that extension services extended to farmers were very high from 46% to 68% after the intervention. These services range from different forms of trainings in relation to rice production, storage, processing and marketing. According to the FAO, human capital influences agricultural productivity directly through the use of inputs and farmers' technical know-how. Improvements in human capital affect acquisition, assimilation and implementation of information and technology. Human capital also affects one's ability to adapt technology to a particular situation or to changing needs.

Rice skills training:

The results in Table 4.9 show that technical and agronomic skills of respondents improved or increased tremendously from 33% to 89% after the project. The skills improvement were good seed selection criteria, split fertilizer application, timely water management, weed and disease

control as well as moisture determination for harvesting. The skills improvements are impressive as it helped them to improve their yields and incomes ultimately. Continuous education and skills training of farmers are critical for sustainable education. Balasubramanian, *et al.,* (2000) maintain that, it is necessary to make farmers understand scientific principles of crop management and other resources like soil and water management which can help their rice fields yield better and increased incomes.

Table 4.9 Access to Human capital among beneficiaries before and after project (N=300)

Human Capital	**Before the Project**		**After the Project**	
	High	*Low*	*High*	*Low*
Variables				
Extension services	137(46)	163(54)	203(68)	97(32)
Rice Skills training	113(38)	187(62)	267(89)	33(11)
Technical training	99(33)	201(67)	267(89)	33(11)
Land management training	135(45)	165(55)	187(62)	113(38)
Disease treatment	134(45)	166(55)	254(85)	46(15)
Water management	121(40)	179(60)	215(72)	85(28)
Soil management	127(42)	173(58)	220(73)	80(27)
Marketing skills	93(31)	207(69)	208(69)	92(31)
Level of education	167(56)	133(44)	166(55)	134(45)
Innovative and creative thinking	119(40)	181(60)	121(40)	179(60)
Knowledge of farm management	102(34)	198(66)	137(46)	163(54)
Record keeping	106(35)	194(65)	262(87)	38(13)
Health status	125(42)	175(58)	180(60)	120(40)
Trainings and other services	138(46)	162(54)	200(67)	100(33)

(Source: Field Survey, 2014)

- ***Extension service***

Interaction with the farmers on kinds of extension services revealed frequent communication with farmers, education and trainings and other advices related to rice cultivation and agriculture in general increased from 46% to 68% after the project (Table 4.9). The respondents believed that the project brought the AEAs closer to them than the main stream extension services

provided by the Ministry of Agriculture. The frequency of the AEAs visits to respondents' farms and homes were on daily basis which was exponentially higher than the usual. Respondents were happy about the visits of the officers and that it resulted in their greater adoption levels and exposure to rice cultivation and farming as a business.

- ***Land management trainings of farmers***

Land management skills improved from 45% to 62% (Table 4.9) after participating in the project. This increase in adoption and skills was attributed by the farmers to the good extension services and trainings provided by the project and the AEAs on land and water development techniques. Bown and Okedara (1981) maintain that good and better agricultural extension education and trainings enable farmers and their families to develop critical knowledge, skills and favourable attitudes. This thus empowers them to benefit from research and technology with the ultimate aim of raising efficiency to produce more and improve their lives.

- ***Marketing skills, innovation and creativity***

The findings in Table 4.9 show an improvement in the marketing skills of the farmers particularly the women farmers who are in charge of the sales of the harvest paddy. An increase from 31% to 69% after taken part of the project. The increase in this as a human capital for the farmers could mean that their ability to sell the rice paddy and milled rice would have improved with less difficulty and also help to enhance their incomes. As shown in Figure 4.4, 63% of the respondents said they will always negotiate with buyers for upfront funding of the production process in order to pay back after the harvest. This could be part of the marketing and innovation to sustain the rice cultivation as a livelihood option amidst the risk associated with it. The creativity and innovation revealed no change having undergone training with the project.

- ***Education and record keeping***

The level of education of the respondents revealed almost similar scores (56% to 55%) before and after the project respectively. Formal education acquired by respondents within the project period was tailored in the form of trainings received from the project and extension officers relating to all aspects of rice production and not necessarily from the classroom. Education and technical skills training in agriculture are extremely important and necessary for farmers to improve their productivity (Trede & Whitaker, 2000). Adesoji *et al.* (2006), argue that, successful and result-orientated agriculture requires the skill and knowledge of the farmers who are the main actors and this can only be achieved through various forms of technical trainings for the farmers.

Records keeping and management improved from 35% to 87% showing a drastic improvement. A happy farmer revealed that *"I can now record all my expenditure incurred from labour, inputs acquisition and other cost to the income I made and how I spent it to show whether or not I am making profit. I can also write down the period required for each activity from nursery preparation to harvesting and milling."* This shows the level of excitement and motivation of some of the farmers. Workshops, field trips and onsite trainings were some of the methods the farmers received their trainings. This is an indication that the projects achieved their target of increase profits of farmers and improve on yields. For example, Van Der Veen (2000) in Loevinsohn *et al.* (2000), affirms that extension officers normally carry out their trainings and demonstrations to farmers in the field (on station) and through workshops (leaflets and other materials) on how to apply specific practice or technical options. Again, since all five livelihood capital takes their strength from the human capital index, the increase in their farming ability and marketing would have trickledown effect on the other capital.

4.4.2. Wilcoxon Signed Ranks Test for difference in Human capital before and after the project

The mean ranks for the human capital variables of the respondents shows their capital are likely mostly higher than before the rain-fed project implying that some of the respondents acquired different human capital skills and techniques after being part of the project. It also implies that, respondents had an improved self-development in rice production and household management skills. At $p<0.05$, the measuring indicators of farmers' human capital were all significant after they took part of the project. These include; extension services ($z= -12.655$, $p<0.05$), rice skills training ($z= -14.267$, $p<0.05$), land management training ($z= -15.229$, $p<0.05$), marketing skills ($z= -14.111$, $p<0.05$), water management ($z= -15.391$), knowledge of farm management ($z= -12.501$, $p<0.05$), record keeping ($z= -11.458$, $p<0.05$), and health status of respondents ($z= -14.978$, $p<0.05$) (Table 4.10).

Table 4.10. Wilcoxon Signed Mean Ranks Test for Human capital of the farmers

Human Capital		*N	Mean Rank	Sum of Ranks	Z	Asymp. Sig. (2-tailed)
Extension services	Negative Ranks	20	118	2360	-12.655	0.000
	Positive Ranks	215	128	27520		
	Ties	65				
	Total	300				
Rice Skills training	Negative Ranks	17	179.47	3051	-14.267	0.000
	Positive Ranks	252	132	33264		
	Ties	31				
	Total	300				
Technical training	Negative Ranks	11	141	1551	-15.391	0.000
	Positive Ranks	270	141	38070		
	Ties	19				
	Total	300				
Land management training	Negative Ranks	11	138.5	1523.5	-15.229	0.000
	Positive	265	138.5	36702.5		

	Ranks					
	Ties	24				
	Total	300				
Disease treatment	Negative Ranks	11	138.5	1523.5	-15.229	0.000
	Positive Ranks	265	138.5	36702.5		
	Ties	24				
	Total	300				
Water management	Negative Ranks	11	141	1551	-15.391	0.000
	Positive Ranks	270	161	43470		
	Ties	19				
	Total	300				
Soil management	Negative Ranks	16	138	2208	-14.593	0.000
	Positive Ranks	259	148	38332		
	Ties	25				
	Total	300				
Marketing skills	Negative Ranks	20	138	2760	-14.111	0.000
	Positive Ranks	255	138	35190		
	Ties	25				
	Total	300				
Level of education	Negative Ranks	11	132	1452	-15.098	0.000
	Positive Ranks	261	136.69	35676		
	Ties	28				
	Total	300				
Innovative and creative	Negative Ranks	14	124	1736	-13.977	0.000
	Positive Ranks	236	125.59	29639		
	Ties	50				
	Total	300				
Knowledge of farm management	Negative Ranks	20	114.5	2290	-12.501	0.000
	Positive Ranks	211	116.14	24506		
	Ties	69				
	Total	300				
Record keeping	Negative Ranks	17	154.09	2619.	-11.458	0.000
	Positive Ranks	178	192.64	34289.92		
	Ties	105				
	Total	300				

Health status	Negative Ranks	4	120	480	-14.978	0.000
	Positive Ranks	238	121.53	28923		
	Ties	58				
	Total	300				
Trainings and other extension services	Negative Ranks	14	131.5	1841	-14.667	0.000
	Positive Ranks	256	135.72	34744		
	Ties	30				
	Total	300				

(Source: Field Survey, 2014)

The results in Table 4.10 indicates that, significant differences exist in all the measured variables for the human capital of the rice farmers before and after participating in the rain-fed lowland rice production project. From the above analysis of the significant values of the human capital of farmers and the higher positive mean ranks after the project, it can thus be concluded that the null hypothesis for this study (that there is no significant difference in the human capital before and after the participation of farmers or the respondents in the rain-fed rice project) should be rejected.

4.5. CHANGES AND ACCESS TO THE SOCIAL AND FINANCIAL CAPITAL OF THE PROJECT FARMERS

4.5.1. Access to Social capital of farmers before and after project

- ***Relationship with relatives and neighbours; Labour networking (for farm work)***

The findings of the study revealed that the measuring variables for social capital of the rice farmers were even before the introduction of the project (Table 4.11). The relationship with relatives and neighbours had a score from 77% to 77% after the project. With no major change in scores after they participated in the project, a score of 77% was significant enough. Labour networking (for farm work) with the farmers increased from 54% to 61% after the project

indicating how labour is important to them be it from family sources or hired for farm works. This confirms Frayer *et al.,* (2009) argument that social capital provides glue and serves as bedrock with trust and reciprocity in shaping the relationship amongst farmers. The family and neighbours' cohesiveness helps them to seek labour assistance for their rice farms as well as financial support in times of need. As indicated in Figure 4.4 in this chapter, about 52% of the 300 respondents get their funding from family and relatives. This Michael Lipton, (1976) affirmed that farmers do revert to assistance from family and friends in order to avoid the high interest rate payment and the struggle to access it. Networking with farm labours is also a good source of capital for the farmers as they are able to negotiate for the reduction and availability of services with the farm workers. Hence the relationship helps farmers to annex the benefits which improved after their participating in the project. Edoka et al, (2014) adds that in Kogi State of Nigerian in particular, rural farmers constitute themselves into farmers' labour groups and networks in other to meet their farm and non-farm labour needs. Aside that, they opined that networking with other farmers and agricultural labour groups helps them develop managerial capability to handle their farm problems.

- ***Network with MOFA, AEAs and the District Assemblies***

From Table 4.11, farmers networking with the Ministry of Food and Agriculture, agricultural extension agents, district agricultural officers and the district assemblies improved tremendously after their participation in the project from 42% to 82%. The results indicate that farmers appreciate agricultural officers and the government as key partners and actors and that networking with them socially and technically beneficial to farmers and sustainable farming. Also, the interaction and networking with the actors, policy makers and the respondents, helps

farmers to share their needs, challenges and problems for the required intervention either at the local level or from the central government.

The use of RELC (research and extension linkage committees) to support farmers is an important and beneficial element for farmers in terms of relating with MOFA and the research institutions. These benefits from the networks conforms to Antoh, (2005) study, who found that networks and connectedness between individuals with shared interests increase people's trust and their ability to work together and expand their access to wider institutions, such as government agencies (MOFA, DA, NGOs) or civic bodies. More so, Nahapiet and Ghoshal 1998; Woolcock and Narayan, 2000 all maintain that the social network and cohesive interactions of farmers with relevant individuals, groups and institutions as well as the interpersonal interactions help sustain farmers' livelihoods and their welfare.

Table 4.11 Access to Social capital among beneficiaries before and after project (N=300)

Livelihood Capital	**Before the Project**		**After the Project**	
Social capital	*High*	*Low*	*High*	*Low*
Relationship with relatives / neighbours	231(77)	69(23)	230(77)	70(23)
Labour networking (for farm work)	166(55)	134(45)	187(62)	113(38)
Network with MOFA, AEAs and Assemblies	127(42)	173(58)	246(82)	54(18)
Network with financial institutions	64(21)	236(79)	140(47)	160(53)
Network with transporters	98(33)	202(67)	155(52)	145(48)
Network with shop owners and input dealers	103(34)	197(65)	154(51)	146(49)
Network with processors	125(42)	175(58)	197(66)	103(34)
Network with millers	135(45)	165(55)	248(83)	52(17)
Network with farmers' association (FBOs)	156(52)	144(48)	251(84)	49(16)

Network with other production group (NGOs and civic group	118(39)	182(61)	135(45)	165(55)
Network with Village committee	135(45)	165(55)	195(65)	105(35)

Source: (Field Survey, 2014)

- ***Network with financial institutions, transporters, shop owners and input dealers***

Financing is a key component when it comes to agriculture because of the cost of production and the investments required. Since the agricultural sector is considered a risky area by financial institutions, relating and networking with them is critical in order to improve funding to farmers. The results (Table 4.11), farmers' relationship and networking with the financial institutions i.e. saving and loans, credit unions, 'susu' collectors and the banks revealed a change from 21% to 47% after being part of the project indicates their financial capital improved. Since the majority of respondents do not get assistance from the financial institutions, a closer collaboration and networking can offer them the opportunity to understand the requirements of banks/micro-finance/cooperatives for funding and the institutions understanding of rice farming as a business.

The findings in Table 4.2. shows that 61% of the farmers had a yield between 2.9-5.9ton/ha which is very impressive and the transportation of the paddy from the valleys to their homes and milling centres will require a good relationship and networking with vehicle and transport owners in their various locations. Several FAO publications indicates that inadequate transport systems in developing countries as well as bad roads seriously contribute to postharvest losses of agricultural commodities such as rice are being left in the fields to deteriorate. Much more important too are the shop owners and input dealers for rice production. Input dealers in Table 4.3. reveals that 68% of the respondents were getting their farm inputs from the dealers who usually would give it to them on credit basis. Hence a social cohesive relationship with these service providers as shown in Table 4.11 will help consolidate their mutual benefits further.

- ***Network with processors, millers, FBOs and other groups***

Rice processors and millers are important actors in the rice value chain in Ghana. Respondents had an increase in their social capital of positively networking with millers and processors. With a score of 42% before the project, it rose up to 66% after the project. Networking with rice processors is an indication that they are now socially bonded than before and could be benefitting from this relationship when it comes to threshing, winnowing and drying. Furthermore, an increase in the ability and skills of respondents to network with millers increased from 45% to 83% (table 4.11) before and after participating in the rain-fed rice project indicates how important the farmers see the rice millers in their network. In capturing the importance of the millers in the rice industry in Ghana, Sakurai *et al.,* (2006) maintain that millers mill the paddy and charge a milling fee depending on the volume of milled rice. The producers later sell the milled rice to traders at the millers' shop. This process helps the farmers to improve on their rice quality for better prices.

Networking with Farmer Base Associations and groups (FBOs) and other organisations within their catchments showed some improvement in that regard, from 52% to 84% increase after the project. The farmers revealed that interventions of the project required that they were in groups (10 persons per group) for easy access and delivery of technologies to them in the fields. They developed good bonds in the groups which increased tremendously with trust, solidarity, reliability with each other and lending support when need to each other. Roslan *et al.,* (2010a: 2010b); Balogun and Yusuf (2011) study confirms that the solidarity component with 'trust and values' helps farmers in times of droughts, poor yields, pest and disease outbreaks and flooding by supporting each other with inputs and even labour in the affected member's farms. Hence the association and support to each other as farmer groups or FBOs in times of hardships is a strong

social capital that helps them in particular to cope with the vulnerabilities or disasters and also improve on their rice production and general living conditions.

4.5.2. Wilcoxon Signed Ranks Test of respondents' social capital

As explained above with the change in the social capital levels of respondents, the *mean ranks* in Table 4.12 indicates that the networks within and outside of the farmer groups improved with positive ranks higher than before the inception of the project. Relationships with neighbours and family for instance, had a mean rank of 89.65 from N (158 respondents). With such higher mean rank score for members of the households-family, Abenakyo, et al. (2007) confirms this finding by maintaining that households with medium and high social capital expressed an enhanced problem solving skills, had increased ability to help other farmers solve their agricultural problems and had increased capacity to conduct research to test different technologies and bargain with middlemen for better prices.

Also, networking with other production groups such as NGOs and other civic agricultural related groups in the study areas showed that a positive mean score of 74.58 from N (115) respondents. This suggests that there was a change in that dimension. However, N (154) of them indicated that they experienced a tie with no change or improvements having participated in the rain-fed rice project (Table 4.12). Furthermore, networking with financial institutions revealed respondents experienced change (155) in that skill and with many of them also positing a no change ties of 134. This suggest that, most of the respondents still do not have the capabilities and skills to deal with the financial institutions for the funding of their agricultural activities.

Table 4.12. Wilcoxon Signed Ranks Test of respondent's Social capital

Social capital	Ranks	N	Mean Ranks	Sum of Ranks	Z	Asymp. Sig. (2-tailed)
Relationship with relatives / neighbours	Negative Ranks	31	122.29	3791		
	Positive Ranks	158	89.65	14164	-7.552	0.000
	Ties	111				
	Total	300				
Labour networking (for farm work)	Negative Ranks	47	115.37	5422.5		
	Positive Ranks	163	102.65	16732.5	-7.153	0.000
	Ties	90				
	Total	300				
Network with MOFA, AEAs and Assemblies	Negative Ranks	16	95	1520		
	Positive Ranks	184	100.98	18580	-11.706	0.000
	Ties	100				
	Total	300				
Network with financial institutions	Negative Ranks	11	77	847		
	Positive Ranks	155	83.96	13014	-10.927	0.000
	Ties	134				
	Total	300				
Network with transporters	Negative Ranks	20	79.5	1590		
	Positive Ranks	138	79.5	10971	-9.388	0.000
	Ties	142				
	Total	300				
Network with shop owners and input dealers	Negative Ranks	36	106.32	3827.5		
	Positive Ranks	163	98.6	16072.5	-10.205	0.000
	Ties	101				
	Total	300				
Network with processors	Negative Ranks	19	96.5	1833.5		
	Positive Ranks	176	98.16	17276.5	-8.395	0.000
	Ties	105				
	Total	300				
Network with millers	Negative Ranks	24	88	2112		
	Positive Ranks	157	91.46	14359	-11.201	0.000

	Ties	119				
	Total	300				
Network with farmers' association (FBOs)	Negative Ranks	17	74.5	1266.5	-9.849	0.000
	Positive Ranks	164	92.71	15204.5		
	Ties	119				
	Total	300				
Network with other production group (NGOs and civic group	Negative Ranks	31	69.5	2154.5	-10.628	.000
	Positive Ranks	115	74.58	8576.5		
	Ties	154				
	Total	300				
Network with Village committee	Negative Ranks	17	57	969	-7.053	0.000
	Positive Ranks	122	71.81	8761		
	Ties	161				
	Total	300				

(Source: Field Survey, 2014)

An interesting observation from the study was the fact that, farmers had better and cohesive networks with village committees and other opinion leaders (chiefs, assembly men, pastors and imams) within their communities with a z score of (-7.053) at $p<0.05$ (Table 4.12). This suggest that their ability to gel and bond with community members improved significantly and that they appreciated the fact that, coexisting with one another gives them peace of mind, comfort, trust and sometimes communal labour to carry out their rice farming. This confirms Abenakyo, *et al.,* (2007) study who found that increase in knowledge and skills of farmers could be attributed to interactions within and between the existing networks of farmers and the community which facilitates knowledge and information sharing and as well enhancing bonding and bridging. For all the variable indicators of social livelihood capital, the z score showed a statistically significant differences at $p < 0.05$ (Table 4.12). This suggest that there is a significant positive change or difference in all the social capital of the farmers who participated in the project. These findings indicate that the null hypothesis of this study should be rejected because there is

significant difference in the social capital of respondents after their participation in the rain-fed rice project in the study areas.

4.5.3. Financial capital of the project farmers

Financial capital explains the wherewithal of respondents and their levels of financial abilities to manage their production activities and household expenditure. From Table 4.13, the farm incomes of respondents increased exponentially from 59% to 73% after taking part in the project. The farm incomes according to the farmers included every income they make from agriculture and not rice farming alone. '*All the skills and techniques taught by the project are extended to managing other crops like maize and cocoa, so our agricultural incomes are increasing'*, a farmer explained. However, the increase in the farm income of respondents never affected the non-farm income streams as it also improved from 34% to 58% after taken part in the project, which meant that they were engaged in other beneficial income activities aside the farming activities.

Table 4.13 Access to financial capital among beneficiaries before and after the project (N=300)

Livelihood Capital	Before the Project		After the Project	
Financial capital	*High*	*Low*	*High*	*Low*
(i) Sources of Income				
Farm incomes	178(59)	122(41)	219(73)	81(27)
Non -farm income/revenues	102(34)	198(66)	174(58)	126(42)
(ii) Savings				
Savings	133(44)	167(56)	189(63)	111(37)
Self-help groups savings	108(36)	192(64)	156(52)	144(48)
(iii) Credits				
Relatives and friends	191(64)	109(36)	179(60)	121(40)
Access to bank credits	50(17)	250(83)	116(39)	184(61)

Self –help groups loan (FBOs)	83(28)	217(72)	238(79)	62(21)

(Source: Field Survey, 2014)

The increase suggests that respondents developed entrepreneurial skills of making money outside agriculture such as investing their incomes in to transport business (*trotro buses and motor kings*). According to the AEAs, other respondents became suppliers of nets used to cover their paddy fields against birds, suppliers of tarpaulins for threshing and others as a source of the respondent's non-farm incomes. Savings from the sale of their harvested rice and other crop commodities also increased from 44% to 63%, (Table 4.13) This indicates that the surplus income could be re-invested in their farming business, could be re-invested in to their children's education, health and even shelter which hitherto would have been difficult to achieve.

One stronger financial capital skill and ability developed by respondents was self-help group (farmer groups) savings where each group member contributes a token to the group saving for the hardship or rainy days. This was facilitated through the social cohesive bonds they all shared through the group system advocated by the project for technology dissemination which increased from 36% to 52% (Table 4.13) after their participation in the project.

Access to farm credit mostly need is as critical to farmers as the yield of their crops. Access to bank credit facilities marginally increased from 17% to 39%. The marginal increase could be attributed to the improvement in farmer's record keeping, technical skill and networking with the financial institutions. Loans from their own farmer groups formed increased from 28 to 79% respectively (Table 4.13). This type of farmer based organisation or groups loans are normally interest free and at worse will like a token interest that makes it easy for them to repay. Machete *et al.,* (2004) argue that one of the most critical problems threatening the viability of smallholder agriculture is the absence of credit. Hence the improvement in their credit sourcing after the project could help lessen their funding problem.

4.5.3.1. Wilcoxon Signed Ranks Test of the financial capital of respondents

The *mean ranks* captured in Table 4.14 show that the financial livelihood capital of the respondents are higher than before the start of the project, implying that a significant number of the respondents developed significant financial strengths and skills in managing their rice farming and household needs. Savings needed in times of difficulties and welfare improvement had a good positive mean rank (89.02) from N=118 respondents and 128 (ties) maintained that they did not experience any change in their savings ability after participating in the project. In terms of self-help groups savings N=148 gave a positive mean rank score of 87.38 and N=29 provided a negative mean rank scores with N=123 claiming to have ties. Availability and access to banks for financial support improved as well with N=124 respondents giving a mean score of 82.47. The general higher positive mean ranks for the financial capital of respondents showed an increase in their economic capability in terms of incomes, savings and access to credit for their farming. Affirming this argument, Brody et al, (2013) and Lucy van, (2013) opined that, savings are critical to farmers during challenging times and they are more economically powered if they form their own saving or credit groups to assist themselves instead of relying on the commercial banks which may not be available.

Table 4.14 Table Wilcoxon Signed Ranks Test of financial capital of respondents

Financial Capital		N	Mean Rank	Sum of Ranks	Z	Asymp. Sig. (2-tailed)
Farm incomes	Negative Ranks	61	82	5002		
	Positive Ranks	102	82	8364	-3.211	0.001
	Ties	137				
	Total	300				
Non -farm income/revenues	Negative Ranks	37	50	1850		
	Positive Ranks	69	55.8	3821	-3.475	0.001
	Ties	194				
	Total	300				
Savings	Negative Ranks	54	81	4374		

	Positive Ranks	118	89.02	10504	-5.250	0.000
	Ties	128				
	Total	300				
Self-help groups savings	Negative Ranks	29	97.26	2820.5	-8.248	0.000
	Positive Ranks	148	87.38	12932.5		
	Ties	123				
	Total	300				
Friends and Relatives	Negative Ranks	24	71	1704	-8.493	0.000
	Positive Ranks	129	78.12	10077		
	Ties	147				
	Total	300				
Access to bank credits	Negative Ranks	39	80.5	3139.5	-6.710	0.000
	Positive Ranks	124	82.47	10226.5		
	Ties	137				
	Total	300				
Self –help groups loan (FBOs)	Negative Ranks	55	75.98	4179	-2.646	0.008
	Positive Ranks	91	72	6552		
	Ties	154				
	Total	300				

(Source: Field Survey, 2014)

The results in Table 4.14 shows that at $p < 0.05$, the measuring indicator variables for the financial capital of respondents including farm incomes *(z*= -3.211*)*, non-farm income/revenues *(z*=-3.475), savings *(z*=-5.250*)*, self-help groups savings *(z*=-8.248*)*, self –help groups loan (FBOs) *(z*=-2.646*)* before and after the taking part of the project (Table 4.14) were all highly significant, thus rejecting the null hypothesis for this study that there is no significant difference in the financial capital of the respondents after participating in the project by the farmers. Simonyan and Omolehin (2012) posits that farmers net farm incomes and general financial capital significantly improved after taking part of the FADAMA II Project in Kaduna State compared to other farmers who were not part of the project.

4.6. CHAPTER SUMMARY

This chapter has provided a detailed overview of how the data was analysed. It used the descriptive statistics to explain the personal characteristics of respondents and the five thematic livelihood capital; physical, natural, social, human and financial capital of respondents (farmers).

The Wilcoxon sign rank test as the test statistics were used to measure the change or difference in the livelihood capital of rice farmers who took part in the project. The next chapter is summary conclusion and recommendations.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter provides an overview and summary of the entire study, a conclusion and recommendation for stakeholders. It focusses on the objectives of the study (the five livelihood capital) in order find out if there were changes or differences in the livelihood capital of respondents after participating in the rain fed rice project. The summary covers the objectives of the study, sampling techniques, sample size, data collection method and analysis.

5.2 SUMMARY

The objective of the study was to; identify and describe the personal characteristics of the beneficiary rice farmers, analyse the difference in the natural and physical capital of rice farmers involved in the project, examine the impact levels and developments on the human capital of the respondents and finally to analyse the change of social and financial capital of farmers involved in the project.

It critically reviewed sustainable agricultural livelihoods, livelihoods frameworks, livelihood assets and rice production as a sustainable livelihood option, innovation diffusion theory, participatory approach theory and beneficiary assessment after participating in projects. The study was conducted in the Ashanti and Northern regions of Ghana. It randomly sampled 300 respondents from a total number of 2221 farmers using proportions and probability sampling.

The data was largely quantitative in line with the specific objectives of the study. Primary data obtained from interviewing with key informants (project farmers and other stakeholders such as

AEAs and project counterparts) through structured questionnaires and field direct observations. Participatory approach was utilised in the field with the farmers to obtain additional information from farmers. Descriptive statistics such as frequency distribution and percentages to describe the personal characteristics of respondents were used. Tables and graphs were used to enhance the readability of the results. The Wilcoxon sign rank test was used to determine the change or differences in the livelihood capital of the respondents and the test statistics (t-test) too was used to determine the level of significance changes.

5.3 FINDINGS OF THE STUDY

Significant findings were made on the personal characteristics and livelihood capital of respondents. The findings reveal that 35% of respondents were within the 31-45-year range followed by the 15-30 age group and 29% and 36% of respondents were within the 46 -60 and 61-75 years of age group respectively. Many of the respondents (53%) had 1-10 years of rice cultivation experience while 42% had 11-20 years of production experience. In terms of land tenure and holding system, the farmers used the share cropping system more (29%), rent with cash (20%) and family/inheritance (16%). In terms of level of education, 36% of respondents had primary education and only 4% could get to secondary education level. The study also showed that respondents had increased yields with 42% obtaining yields within 2.9 - 3.9ton/ha which is higher than the national yield average of 2.5ton/ha. The study also showed that the increase in yields resulted in the increase in incomes by the farmers. Thirty-nine percent (39%) of the 300 respondents earned between 1000-2000GHc per season from rice alone followed by 15% earned 2000-300 GHC, 12% earned 3000GHC and 11% earned over 5000GHC with source of funding coming from their personal savings (74%) and rice buyers or financiers (63%). Their farm inputs large depended on government subsidy (99%) and input dealers (68%).

In terms of the natural capital of respondents, the findings revealed that usage and access of water utilisation was 82% after taken part in the project, land access and utilisation 73%, tenancy arrangement 70% and fertility management of the lands/soil was 66%. All the variables indicated very high levels of significance with the test statistics (t-test) at $p<0.05$ which include; water utilisation *(z= -15.39)* land access and utilisation (z= -10.222), tenancy arrangement and fertility management of the lands/soil. It further revealed that the mean ranks of farmers also changed or improved with availability and usage of water streams of respondents obtaining a positive mean rank score of 121.5 from N (242), land access and utilisation mean rank score of 89 from N (157), land tenure arrangement of respondents receiving a higher positive mean rank score of 132.50 from N (260). Watershed development and conservation facilities had a negative mean rank of 120.91 from N (61) and a positive mean rank score of 75.8 from N (120). In all, the natural capital of respondents as summarised significantly changed after their participating in the project.

The physical capital of respondents also had some remarkable changes aside farm roads with a score of (18% to 24%) where 76% of the farmers experienced no differences. Market access (31% to 71%), processing facilities (mills) (57% to 78%), housing facilities (43% to 64%), health (39% to 51%), irrigation infrastructure (39% to 59%), farm sheds (57% to 78%) and net scare crows (43% to 63%) all showed some levels of change before and after the project. The Wilcoxon sign rank test and test statistics the physical capital also revealed significant differences in the indicator variables of the farmers' physical capital including irrigation infrastructure (z= -5.581), processing facilities (z =-5.904), housing facilities (z= -5.045), market access (z= -6.171), telephone access (z= -2.354) after taken part in the project.

The human capital of respondents showed similar trends. The changes observed in the study include rice skills training which increased from 38% to 89%, extension service from 46% to 68%, land management trainings of farmers improved from 45% to 62%. Marketing skills improved from 31% to 69% before and after the project, whilst farmers' innovation and creativity ability experienced no change thus from 40% to 40%. However, though many of respondents experienced the change and improvements, some farmers claim they did not experience any changes in their human capital. The test statistics revealed significant differences in all the measured variable indicators at a *p value ($p<0.05$)* for the human capital of farmers.

The findings also revealed that respondents' skills in networking with MOFA and AEAs was very good as well as relationship with relatives and neighbours, labour networking (for farm work), network with financial institutions, network with farmers' association (FBOs) and networking with input dealers by farmers had a strong p value ($p<0.05$) from the (t-test) and higher mean ranks with the Wilcoxon sign rank test showing a strong improvement on social capital.

Furthermore, the study showed that farmers' access to bank loans and loans from farmer groups increased from 17% to 39% and 28 to 79% respectively. Aside the higher positive mean ranks of the measured variables, the z- scores at a p value of ($p<0.05$), showed significant changes and relationship; farm incomes ($z=-3.211$), non -farm income/revenues ($z=-3.475$), savings ($z=-5.250$), self-help groups savings ($z= -8.248$), and self –help groups loan (FBOs) ($z=-2.646$), an indication of a highly significant difference and change in their financial livelihood capital on in terms of income, savings and credit.

5.4 CONCLUSION

From the objective of the study and the discussion presented above, it could be concluded that rice is a poverty reduction crop that that can exponentially improve people's livelihoods.

Access to land/valleys with an appropriate tenure system, trainings and longer years of experience in rice farming lead to higher yields in terms of rice produced and ultimately increase farmers' income. It can also be concluded that labour is mutually shared by both males and females in the rice production process (land preparation, weed control, fertilizer application and harvesting) and post production (threshing, drying and cleaning). The natural capital of farmers changed and they adopted a stronger ability to manage and use land, agricultural water and sources better than before the project as revealed in the findings. The physical capital of farmers significantly changed after their participation in the rice project. It therefore can be concluded that their livelihood capabilities in acquiring nets against birds, farm structures, irrigation structures and housing improved considerably. Similarly, significant difference and impacts were experienced by famers in their financial capabilities and liquidities, better management and use of available natural resources for their benefit, improved living conditions and the elevation of their status. It could also be concluded that the human capital index of farmers measured showed a significant change on their self-developments (trainings, understanding of rice technologies disseminated and experiences) to cope with rice production challenges and obligations.

Networking among farmers, group dynamics and networking with other stakeholders such as processors, transporters, chiefs, MOFA, district assembly, and community leaders as a social capital improved considerably after the project. It is therefore concluded in the study that the null hypothesis of the study should be rejected because of the significant and correlative impacts on farmers' livelihoods and welfares. Thus interventions such as the rain-fed rice project played a significant role on the household food security status of the farmers.

5.5 RECOMMENDATIONS

From the exploratory analysis above, the researcher would like to make the following key recommendations:

- More of such interventions by government and donors should be tailored towards small scale farmers to assist them improve further their rice production drive and involvement;
- Irrigation infrastructure and farm roads should be improved by government as physical capital for long benefits of agriculture in the country;
- More training should be provided to farmers to effectively and sustainably manage water as well as conserve it for production. This will consolidate their natural, physical and human capital. More input will be needed to improve some aspects of their financial capital (access to loans from financial institutions) in subsequent projects.
- More women should be targeted in subsequent interventions subsequently so as to empower and improve their livelihood capital as well; and
- MOFA can sustainably use the existing farmer groups as training of trainers to impact and benefit other farmers throughout the country.

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APPENDIX

APPENDIX I. QUESTIONNAIRE

Dear Respondent,

I am a PhD student with the North West University, Mafikeng Campus in South Africa, requesting your assistance in completing this questionnaire. The study is based on the "***Impact of rain-fed lowland rice production project on the livelihoods of beneficiaries in Ghana.***" Any information provided will be treated as confidential as possible with all privacy issues handled according to the University's ethical standards. I will be grateful if you could spare some of your valuable time in responding to these questions. Thank you for your anticipated cooperation.

A. FARMERS' PERSONAL DATA/CHARACTERISTICS OF FARMERS

1. Name of village .....
2. Gender: Male ..... Female .....
3. Age of Farmer .....
4. Educational level: No Education .....Informal (Adult Education) .... Formal.....
5. If formal, indicate highest level attained:
   Primary .....Secondary .....Tertiary.....Other (Specify) .....
6. Marital status: Single .....Married .....Divorced .....Widowed .....
7. Household composition: Male..... Female.....
8. No of dependents involved in farming.....
9. Religion; Christianity .....Islam ...Traditional Religion ...Others (Specify) .....
10. Sources of capital for farming;

- Personal savings GHC.....
- Relatives GHC.....
- Cooperatives GHC.....
- Bank GHC.....
- Farmers association GHC .....
- Others (specify)GHC .....

11. Farming experience? ..... Years.

12. Please complete the following table;

Occupation	**Amount realised last year**
Primary ..... Secondary	....

13. How did you acquire your land for farming?

- Own land .....
- Family land .....
- Bought land .....
- Rented .....
- Inherited .....
- Others (Specify).....

14. If rented, how do you pay for the use of one piece of land you are farming on?

Cash ..... Sharecropping.....

15. Please indicate the quantity and amount spent on each input listed below during the last farming season.

Input – use	Quantity used (kg/bag)	Price/unit	Amount GHC
Repairs works on power tiller (mechanics) Seeds			

Fertilizer Hired labour - Men cost per hour and how many hours per day - Or cost per operation on the farm - Women - Children Family labour what is the cost if payments are to be made - Men - Women - Children Fuel – Diesel per operation or per day for ease of quantification Agrochemicals Spare parts Ropes line			

16. Yield of rice obtained kg/ha..... Current market price per unit GHC.....

17. What are the sources of your farm inputs?

- Through Government.....
- Through MOFA (Extension Agents) .....
- Through Friends.....
- Through Farmer's Cooperative Society....
- Open market, Input dealers, NGO.....

18. How long have you been cultivating rice……

19. Why are you cultivating rice……

- Available and fertile land.....
- Experience with rice.....
- Good income.....
- Good yields and other reasons…….

20. Is there a ready market for rice in this area? Yes No

21. How much income do you get in a season from rice?.....

22. Why did you not choose other crops? .....

23. What motivates you in rice production in the Ashanti Region?.....

- Easy to cultivate/produce....
- Available land/valleys.....
- Good/fertile soil.....
- Good income, market accessibility.....
- Project coverage.....
- Other reasons.....

24. Have you received any training related to the project? Yes ☐ No ☐

25. If yes, please specify the kind of training received.....

26. Have you received a loan from any institution? Yes ☐ No ☐

27. If yes, specify the source and the amount: Banks, NGOs, Project officers and others....

28. How much did you receive from each source?..... Yes ☐ No ☐

29. Do you communicate and regularly meet with extension officers? Yes No

30. If yes, how often? Regularly..... Occasionally .....Rarely..... ...

31. How did you hear about the rice intensification Programme/projects?

MOFA Extension Officer, TV, Cell phone, JICA, Radio, Project officer, Fellow farmer Internet Newspapers, Input dealers Others (specify) .....

32. Do you have an established market for your product? Yes ☐ No ☐

33. If yes, please specify.....

B. EVALUATING THE "BEFORE" AND "AFTER" IMPACT OF THE PROJECT ON THE LIVELIHOOD OF BENEFICIARIES IN THE STUDY AREAS

Please indicate the level of impact by marking an "X".

Human capital	Before the project		After the project	
Level	High	Low	High	Low
Vocational training				
Extension services				
Skills training				
Technical training				
Project management training				
Land management training				
Disease treatment				
Water management				
Soil management				
Employment				
Marketing skills				
Packaging skill				
Level of education				
Innovative and creative thinking				
Knowledge of farm management				
Ability to sell product				
Gross income				

Record keeping				
Financial management training				
Price determination training				
Natural capital				
Land access				
Land utilisation				
Water utilisation				
Land tenure arrangement				
Water				
Payment for water				
Payment for land if rented				
Social capital				
Networking with financial institutions				
Networking with other farmers				
Networking with government relevant ministry				
Networking with transporters				
Networking with store or silos				
Networking with processors				
Networking with millers				
Networking with farmer's association				
Networking farmers' cooperative				

Networking with other production group (NGOs and civic group				
Networking with professional organization				
Networking with trade unions				
Networking with village committee				
Networking with religious groups				
Networking with cultural associations				
Financial capital				
Access to banks				
Access to cooperative				
Money lender				
Personal savings				
Access to Government subsidies				
Government grants				
Relatives				
Physical capital				
Transport				
Established Market				
Auction				
Road accessibility				
Electricity availability				

Storage facilities availability				
Netting scare crows				
Processing facilities				
Irrigation infrastructure				
Packaging infrastructure				
Seed supply				
Telephone infrastructure				

C. ATTITUDES OR PERCEPTION OF BENEFICIARIES TOWARDS THE PROJECT

Please indicate by marking with an "X". Guide: SA-Strongly Agree, A-Agree, U-Undecided, D-Disagree, SD-Strongly Disagree.

COMPONENTS	SA	A	U	D	SD
Standard of living has improved					
Food security has been enhanced					
Project improved your educational level					
More youth is involved in the project					
Unemployment has been reduced by the project in the surrounding area					
Technical training has been provided					
Management skills has improved					
Project has enhanced the quality of lives of					

beneficiaries					
Project has improved the social environment					
Project improved financial skills of beneficiaries such as book keeping, savings					
Health management skills has been given					
Strategic partner/mentor has improved accessibility to market					
Diversification of livelihood has been enhanced					
Project are politically oriented or coloured					
The project is bureaucratic					
Leadership skills has improved					
Technical knowledge has improved					
communication with extension /project officer has improved					
The project has improved your Capacity building					

a. Constraints faced by farmers

Marketing constraints		**Tick**
	Market information	
	Market price	
	Transportation	

	Processing	
	Preservation	
	Packaging	
	Lack of marketing skills	
Financial constraints	Lack of access to financial institutions	
	Lack of financial surety	
	Volatile interest rates	
	Lack of income	
	Low profit viability	
	Lack of financial skills	
Production constraints	High inputs cost	
	High implements cost	
	Lack of production skills	
	Lack of production knowledge	
	Climate change	
	Shortage of water	
	Pest	
	Water availability	

B. Entrepreneurial activities

Please indicate if you carry out any of these activities;

Entrepreneurial activities			**Willingness to engage in activities**	
	Yes	**No**	**Yes**	**No**
Product design				
Distribution/Sales/Service				
Manufacture new products				
Promotion				
Obtaining resources				
Research and development				
Protecting intellectual property				
Obtaining raw materials				
Identifying a market opportunity				
Drive and energy				
Self-confidence				
High initiative and personal responsibility				
Internal locus of control				
Tolerance of ambiguity				
Low fear of failure				
Moderate risk taking				
Long-term involvement				

Money as a measure not merely an end				
Use of feedback				
Continuous pragmatic problem solving				
Self-imposed standards				
Clear goal setting.				
High need for achievement				
Self-authority				
Independent thinkers				
Intuitive and resourceful working style				
Business failure is personal failure				
Belief in the ability to control outcomes				
Risk takers				
Self-motivated				
Dissatisfaction with present status of achievement				
Work experience				
Life path interruption				
Invention/ Creativity				
Technology changes				
Change in property				
New capital				
Unique Employees				

Secure resources				
Secure markets				
Employ and develop capabilities				
Perceiving opportunity of Un-met market need				
Perceiving opportunity of Under-deployed resources				

b. PREVENTION AND CONTROL OF STORAGE PESTS OF GRAINS

Are you aware of the following prevention and control of storage pests of grains?

1. Indicate the use or non-use of the following non-chemical prevention and control of storage pests of grains.
2. What is your perception of the application of these methods in your farm?

Prevention and control methods	Awareness		Use		Perceived applicability	
	Yes	No	Yes	No	Yes	No
Light						
Pheromones						
Food						
Probe traps						
Cartons						
Water						
Phostoxin						

Methyl bromide						
Cribs						
Granaries						
Hermitic bags						
Silos						
Roof tops						
Metal drums						
Plastic drums						

- What is the current rate of grain loss in your farm?

  Less than 10% 10- 20%, 21- 30%, 31 – 40% above 40%

- Which methods of prevention and control of storage pests of grains are commonly used in your country? (A) Chemical (B) Non-chemical

THANK YOU FOR YOUR TIME AND COOPERATION