UNIVERSITY OF CAPE COAST

IMPACT OF SUSTAINABLE RAINFED LOWLAND RICE DEVELOPMENT PROJECT ON THE LIVELIHOODS OF SMALL-SCALE RICE FARMERS IN THE ASHANTI AND NORTHERN REGIONS OF GHANA

GABRIEL OWUSU

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BY

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this University or elsewhere.

Signature …….. Date …….

Candidate's Name: Gabriel Owusu

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature ……. Date ……

Name: Prof. Festus Annor-Frempong

Co-Supervisor's Signature …….. Date ……

Name: Prof. Martin Bosompem

ABSTRACT

The Government of Ghana, through the Ministry of Food and Agriculture, collaborated with the Japan International Cooperation Agency in the Sustainable Development of Rainfed Lowland Rice Production project to meet the increasing demand for rice and improve the livelihood of smallholder farmers in the Northern and Ashanti regions of Ghana. However, no formal studies have been conducted to determine the impact of the project on the livelihoods of farmers. The study used a cross-sectional convergent mixed method to collect data from 331 farmers, 12 AEAs, national MoFA staff and two regional Department of Agriculture staff. A structured interview schedule, document review, interview and focus group guides were used to collect the data. Statistics such as means, standard deviations, frequencies, and percentages were used to describe the data while Pearson Product Moment correlation, dependent sample t-test, Chi-square test and Ordinary Least Squares multiple regression were used to find relations or differences in the data. The study revealed that the farmers perceived the SDRLRP project to be highly effective. The adoption of technologies in both regions was very high, but higher in Northern Region compared to the Ashanti Region. The income status and livelihood of the majority of the farmers improved after participating in the project. The educational status, farming experience, participation, perceived effectiveness, knowledge and skills influenced the livelihood outcomes of the farmers in the project. The study recommends that MoFA should implement more agricultural technology training programmes to improve the livelihoods of farmers and use the existing rice farmer groups as trainers to reach other rice farmers in Ghana.

KEYWORDS

Impact evaluation

Livelihood outcomes

Rainfed lowland rice production

Sustainable development

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DEDICATION

To my lovely wife, Her Honour Agnes Opoku-Barnieh, and my dear children,

Claudia, Gabriella, Ann-Marie, and Analisa.

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LIST OF ACRONYMS

ACDEP:	Association of Church-based Development
AEA:	Agricultural Extension Agent
CA:	Conservative Agriculture
CO:	Carbon Dioxide
CSA:	Climate Smart Agriculture
DAEE:	Department of Agricultural Economics and Extension
DAES:	Directorate of Agricultural Extension Services
DoA:	Department of Agriculture
DOI:	Diffusion of Innovation
EPA:	Environmental Protection Agency
FAO:	Food and Agriculture Organisation
FASDEP:	Food and Agricultural Sector Development Policies
FBO:	Farmer Based Organisation
FGD:	Focused Group Discussion
GDP:	Gross Domestic Product
GHC:	Ghana Cedis
JICA:	Japan International Cooperation Agency
KASA:	Knowledge, Attitude, Skill, Aspiration
MoFA:	Ministry of Food and Agriculture
NGO:	Non Governmental Organisation
NRDS:	National Rice Development Strategy
PCU:	Project Coordinating Unit
SD:	Sustainable Development
SDG:	Sustainable Development Goal

SDRLRP:	Sustainable Development of Rainfed Lowland Rice Production
SEE:	Social, Economic, Environmental
SLF:	Sustainable Livelihood Framework
SPSS:	Statistical Package for Social Sciences
ToC:	Theory of Change
TOP:	Total Outcomes of Programme
UNIDO:	United Nations Industrial Development Organization
USDA:	United States Department of Agriculture
YRW:	Young Rural Women

CHAPTER ONE

INTRODUCTION

Background to the Study

Agriculture continues to contribute significantly to the economies of many developing countries. The agricultural sector employed approximately 70% of the workforce and averagely contributed to 30% of the GDP in many developing countries (FAO, 2017). In Ghana agriculture employed about 45% of the workforce and accounted for 18.9% of GDP, which is valued at GHS29.6 billion (USD 7.1bn). Over 76% of the GDP in 2016 is attributed to the crop subsector (Diao, Hazell, Kolavalli & Resnick, 2019).

The crop subsector, excluding cocoa, is dominated by cereals such as maize, rice, sorghum and millet production and market. The maize crop dominates the domestic cereal crop market in Ghana, accounting for 55% of cereal output. This is followed by rice with 23% of the total cereal crop market share (Berkeleyme Investors Club, 2019). However, rice has a progressively higher demand in Ghana among the cereals (Campbell, Schiff, Snodgrass, Neven, Downing & Sturza, 2009) due to population growth, consumer preferences, increase in income and increasing urbanisation (Balasubramanian, Sié, Hijmans & Otsuka, 2007).

Rice is a food security crop in Ghana. However, local production and imports are not able to meet local demand. For example, Ghana recorded a shortfall of 354,762 tonnes of rice in 2011. In 2017, Ghana's rice production surged upward to 721,610 tonnes, but demand, at 1.3 million tonnes, far outstripped production, leaving a 580,300-tonne deficit (Modzakah & Angelucci, 2019). Since 2011, the rice deficit has increased. The deficit

increased from 354,762 tonnes in 2011 to 503,875 tonnes in 2013, then peaked at 608,602 tonnes in 2015 before falling to 577,910 tonnes in 2016. Meanwhile, domestic rice production increased from 44% to 47% of total consumption in 2017, slightly reducing the import burden. Despite a 27% increase in total domestic rice production between 2013 and 2017, from 569,500 tonnes in 2013 to 721,610 tonnes in 2017, the national rice deficit remained high (Oxford Business Group, 2019).

Domestic rice production was able to meet 40% of domestic demand in 2019 and at a rate sufficient to allow the country to double its output. However, the forecast shows that this was unlikely to reduce the country's reliance on rice imports (Ghana Export Promotion Authority, 2019).

According to the Ghana Export Promotion Authority (2019), the Ghana government spends 331 million dollars annually on rice imports, which accounts for 60% of the country's rice consumption needs, with only 40% produced locally. As a result, rice imports increased at a 14 per cent annual rate on average over the last decade.

Rice imports in 2019 were estimated at 0.7 million tonnes, while domestic production was estimated at 0.47 million tonnes. The national demand for rice in 2019 on the other hand, was 1.2 million tonnes, with an average consumption per capita of 38 kg (Ouédraogo Bockel, Abedi, Arouna & Gopalet, 2021). This reflects a high demand for rice and lower local production.

The high local demand for rice and the low levels of rice production have prompted national and international efforts to increase production in the country (Boansi & Favour, 2015). Therefore, rice production interventions by

the government through MoFA and or in partnership with development partners have taken place in various parts of Ghana. One such intervention is the Sustainable Development of Rain-fed Lowland Rice Production project (SDRLRP). Implemented between 2009 and 2014 by MoFA in collaboration with the Japan International Cooperation Agency (JICA), SDRLRP targeted 1,000 smallholder rice farmers but it doubled to 2221 before the project ended in five districts in the Ashanti Region and four in the Northern Region of Ghana.

The SDRLRP project aimed to increase rice productivity and farmer income through interventions such as strengthening farmer organizations, farming management capacity, post-harvest technologies, credit utilisation, and marketing capacity. The project also sought to build the capacity of extension workers and farmers. The project was expected to improve the extension systems with well-planned extension activities within an effective and efficient extension methodology. Specific activities in the project included 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, and introduction of rice agronomic practices and farming management systems (MoFA, 2020). All the activities were geared towards improving productivity, reducing poverty and enhancing food security in the two regions.

The SDRLRP, like all other public (agricultural programmes), was designed and implemented to reach certain goals and beneficiaries. The goal is linked directly or indirectly to livelihood outcomes (physical, natural, social,

financial and human capital) of rural farmers, who are the beneficiaries of the programmes.

Statement of the Problem

Given that a huge investment has been made into the implementation of the SDRLRP, impact evaluation to determine the value for money and impact on livelihoods is a major policy concern. According to Onwuegbuzie and Hitchcock (2017), impact evaluation is a rigorous and systematic analysis of the long-term changes (positive or negative and intended or unintended) of programmes or projects in the lives of a person, group, or community that stem from an observable set of actions. Impact evaluation also assesses the mechanisms by which beneficiaries are responding to the interventions. These mechanisms have been found to include links to the market or improved social networks (Mumuni et al., 2013).

Policy makers require data from impact evaluation to decide whether programmes are generating the expected effects; promoting accountability in the allocation of resources to public programmes and filling gaps and understanding what works and what does not; and measuring changes in well-being attributable to a particular programme of policy intervention (Khandker, Koolwal & Samad, 2009). No formal and empirical impact evaluation on the SDRLRP project had been conducted to inform policy and guide future planning and implementation of similar interventions. The question is, has participation and adoption of the SDRLRP project tenets positively affected the livelihoods of the participating farmers through improvement in livelihood outcomes?

Rigorous studies employing impact evaluation frameworks and theories such as Bennett's framework and theory of change to evaluate the impact of sustainable rice production interventions such as SDRLRP are rare in Ghanaian agricultural literature. Many impact studies of rice production projects in Ghana (Abdul-Rahaman et al., 2021; Bannor et al., 2017; Donkor et al., 2016; He & Sakurai, 2019a; Lu et al., 2021) have failed to explore how the inputs and activities are combined to achieve the project's goal. Also, the studies failed to determine how the participation, reaction (KASA change) and perceived effectiveness of the projects affect the level of adoption and the subsequent impact on the livelihoods of the beneficiaries. Thus, an information gap exists as to how inputs and activities of the SDRLRP are combined to achieve the project goal. This gap has to be bridged to provide rich empirical data to guide policymakers and project implementors to revise and improve project implementation to achieve the targeted outcomes efficiently and effectively. One way to account for the dearth of information on the holistic rice production project impact in Ghana is by using impact evaluation frameworks and the theory of change to study the impacts of the SDRLRP.

Practitioners of extension frequently use Bennett's Hierarchy for planning and evaluation (Bennett, 1976). It aids in the holistic evaluation of agricultural programmes, from inputs to overall impact (Doss, 2006). The Hierarchy provides a sequence of stair-step levels of proof of program impacts, starting with "inputs" (the allocation of resources to a program) and moving to "end-results" at the top (measuring impacts of a program on long-term goals or conditions). The tool's use presupposes that the evaluations conducted at each step are of equivalent quality and that the evidence of program impact at each ascending phase is progressively more substantial even though it is more challenging, expensive, and time-consuming to quantify. Bennett (1976) claims that compared to "lower level" evaluations, "higher level" evaluations offer more convincing proof of impact. At the bottom of the hierarchy, an Extension practitioner measures and reports on the amount of money

allocated to a project as an indicator of program success (level 1: Inputs). While these statistical data are relatively easy to obtain, they do not reveal much about "what difference" the program makes. However, Extension practitioners higher in the Hierarchy measure changes in the target audience's knowledge, attitude, skills, aspirations, and behaviours as a result of their program. The highest level of Bennett's Hierarchy depicts a process toward a long-term goal or desired condition (level 7: End Results) (Morford et al., 2006).

The theory of change, on the other hand, enables researchers to link project inputs to the project's overall goal. According to Reinholz and Andrews (2020), a theory of change specifies a project's underlying rationale and sets the roadmap for evaluation. Findings from evaluations guided by a theory of change provide rich information to revise and support the planning, implementation, and assessment of the same or similar project. Moreover, a strong understanding of the theory of intervention is a prerequisite for a meaningful assessment of whether the (delivered) intervention remained consistent with its underlying theory (Moore et al., 2015). Given the cause-and-effect focus of impact evaluation research, a theory of change is imperative for specifying the research questions in the evaluation design (Gertler et al., 2016). It is against this backdrop that this study evaluated the impact of the SDRLRP project in the Ashanti and Northern regions using the Bennett Hierarchy of evaluation and theory of change.

General Objective

The general objective of the study is to assess the impact of the sustainable development of the rainfed lowland rice production project on the livelihoods small-scale rice farmers in the Ashanti and Northern regions of Ghana.

Specific Objectives

The specific objectives of the study are to:

1. describe the resources invested in the SDRLRP project.
2. assess the level of participation of the small-scale rice farmers in the implementation of the sustainable development rainfed lowland rice production project.
3. examine the perceived effectiveness of the SDRLRP project from the stakeholders.
4. determine the change in knowledge, attitude, skills and aspirations of smallholder rice farmers from participation in the SDRLRP project.
5. examine the level of adoption of the technologies disseminated through the SDRLRP project by the smallholder rice farmers.
6. assess the livelihood outcomes (natural, financial, physical, social and human capital) of the smallholder farmers engaged in the SDRLRP project.
7. determine the factors contributing to the livelihood outcomes of small-scale rice farmers involved in the SDRLRP project.

Research Questions

The study was guided by the following research questions:

1. What is the nature of the resources invested in the SDRLRP project?
2. What is the perceived effectiveness of stakeholders regarding the SDRLRP project?
3. What is the level of participation of the small-scale rice farmers in the implementation of the SDRLRP project in the Ashanti and Northern regions?

4. What are the changes that have occurred in the knowledge, attitude, skills and aspirations of smallholder rice farmers who participated in the SDRLRP project in the two regions?
5. What is the level of adoption of the technologies disseminated through the SDRLRP project by the smallholder rice farmers who participated in the project?
6. What is the impact of livelihood outcomes (natural, financial, physical, social and human capital) of smallholder rice farmers who participated in the project?
7. What are the livelihood outcomes of small-scale rice farmers?

Hypotheses

1. H_0: There is no statistically significant effect of KASA on the level of effectiveness of SDRLRP project activities.

   H_1: There is a statistically significant effect of KASA on the level of effectiveness of SDRLRP project activities.
2. H_0: The sex of the smallholder rice farmers who participated in the SDRLRP project has no statistically significant influence on the level of adoption intensity of the SDRLRP project technologies.

   H_1: The sex of the smallholder rice farmers who participated in the SDRLRP project has a statistically significant influence on the level of adoption intensity of the SDRLRP project technologies.
3. H_0: Perceived effectiveness of the SDRLRP project does not statistically significantly affect the smallholder rice farmers' adoption intensity of the SDRLRP project's technologies.

H_1: Perceived effectiveness of the SDRLRP project statistically significantly affects the smallholder rice farmers' adoption intensity of the SDRLRP project's technologies.

4. H_0: There is no statistically significant improvement in the smallholder rice farmers' knowledge, attitude, skills and aspiration before and after participating in the SDRLRP project.

   H_1: There is a statistically significant improvement in the smallholder rice farmers' knowledge, attitude, skills and aspiration before and after participating in the SDRLRP project.

5. H_0: The smallholder rice farmers' knowledge, attitude, skill and aspiration have no statistically significant influence on the adoption intensity of the SDRLRP technologies.

   H_1: The smallholder rice farmers' knowledge, attitude, skill and aspiration have a statistically significant influence on the adoption intensity of the SDRLRP technologies.

6. H_0: There is no statistically significant difference between the livelihood outcomes (social, human, physical, natural and financial capital) of the smallholder rice farmers before and after participating in the SDRLRP project.

   H_1: There is a statistically significant difference between the livelihood outcomes (social, human, physical, natural and financial capital) of the smallholder rice farmers before and after participating in the SDRLRP project.

Significance of the Study

The implementation of sustainable development of rain-fed lowland rice production projects in Ghana was crucial in improving the livelihood of the beneficiaries in particular and contributing to the economic development of Ghana. However, empirical data on the impact of the sustainable development of rain-fed lowland rice production projects on the livelihoods of smallholders in the Ashanti and Northern r-egions of Ghana was limited. This study has provided empirical evidence of the contribution of agricultural interventions to the economic development of the beneficiaries and the nation. This is useful for evaluating rice-related interventions for economic development.

Furthermore, the findings of this study can be useful to the government, through the Ministry of Food and Agriculture, and the donor community-supported agriculture, in terms of feedback from project beneficiaries and how future projects could be implemented to benefit farmers. The use of the project resources, the level of farmers' participation in the SDRLRP project, the KASA change of farmers, the adoption intensity of the project technologies and the livelihood outcomes of the farmers who participated in the project serve as important information to the aforementioned stakeholders. The information can be used to revise and improve implementation strategies of similar projects as well as a motivation for implementing similar projects in the future.

Again, the study has generated information that highlights the role of institutional arrangements in the successful implementation of projects. The recommendation on the relationship between MoFA, beneficiary farmers and

other relevant stakeholders could be used to determine how the synergy of the various stakeholders accounts for the success or failure of agricultural projects and their implication on farmers' livelihood, government policy and economic development. Moreover, the findings of the study have provided evidence of the appropriateness of project structure for rice development projects which can inform the design of similar projects in the future.

The findings on the performance of the SDRLRP project are imperative because they can assist managers to evaluate, control, budget, motivate, promote, celebrate, learn, and improve on the implementation process of future projects.

Limitations

The data on the yield of farmers as well as the number of inputs used depended on the extent to which they could recall because farmers could not keep proper records. Reliance on memory recall is often tainted with add-ons since farmers often anticipate the number of resources. Farmers' recollections could have an impact on the quality of data

The number of key informants targeted was low. There was no record to trace them because some of the Ghanaian project counterparts had gone on retirement and others had been transferred to other regions and districts of operation.

Delimitation

The selection of communities in the districts and respondents in these regions for the study is considered based on the following criteria; 1) the community is dominated or known to be a hub for rice cultivation; 2) the farmers have been provided with the SDRLRP project interventions (training,

technological packages on rice production) by either the public or private extension service providers; 3) the respondent must be a rice farmer for at least six (6) years. The study, therefore, considered all farmers who met these criteria. This allowed the researcher to solicit information from only the farmers who could provide information and answer questions related to the SDRLRP project.

Definition of Key Terms

Impact: The resultant effect of the SDRLRP project on the beneficiary rice farmers in the study areas. It comprises the change in KASA and improvement in the smallholder rice farmers' wellbeing (income, rice yield, etc) as a result of participation in the SDRLRP project.

Smallholder/scale scale rice farmers: They are those farmers who use manual and traditional tools to cultivate their farms of 1-2 hectares of land, mainly on family-run farms, and took part in the SDRLRP project.

Resources: A service or other asset (physical materials) used to produce goods and services that meet human needs and wants. In this study, the resources used to implement the SDRLRP project include funds, humans, equipment and extension services.

Participation: It is the process of involving people or stakeholders in information sharing and life-changing decisions. Participation in this study refers to small-scale rice farmers' involvement in all stages of the SDRLRP project implementation.

KASA change: KASA is an acronym that stands for knowledge, attitude, skills, and aspiration. KASA change refers to changes in the scores of validated measures of knowledge, attitude, skills, and aspirations, as well as

participants' perceptions of the extent of change in their knowledge, attitude, skills, and aspirations. In this study, KASA change is defined as the difference between before and after participation in the SDRLRP project activities in the scores of a validated measure of the participating small-scale rice farmers' knowledge, attitude, skills, and aspirations.

Perceived effectiveness: It is the subjective likelihood that a message will have a persuasive impact. In this study, it refers to the measures of the small-scale rice farmers' perceptions of how effective the promoted rice production agronomic practices are.

Intensity of adoption: It refers to the current level of use of the SDRLRP project technologies by the beneficiary small-scale rice farmers.

Livelihood outcomes: They are what the small-scale rice farmers achieve through their livelihood strategies gauged against their perceived effectiveness and adoption of the SDRLRP project technologies. They include more income, increased well-being, reduced vulnerability and improved food security.

Organization of the Study

The study is organised into five (5) chapters with each chapter further divided into several sub-sections. Chapter One focused on the general introduction to the study with a focus on the background to the study, statement of the problem, general and specific objectives, hypotheses and research questions. A subsection of the Chapter included the significance of the study, delimitations and limitations of the study, the definition of terms, and the organization of the study.

Chapter Two dealt with the review of related literature which included the theoretical framework, review of concepts and empirical works of some earlier researchers related to the study. The Conceptual Framework that guided the study is also included in the Chapter. Chapter Three is devoted to the research methodology. It includes the research design, study area, sampling procedure, data collection instruments, data collection procedures, data processing and analysis.

The fourth Chapter presented and discussed the results of the study. The last chapter (Chapter Five) summarized, concluded and made recommendations based on the study's key findings.

Chapter Summary

The chapter described the context of the study as well as the problem the study addressed. The chapter also described the general and specific objectives that guided the research. Furthermore, the chapter stated the research question that the study answered to achieve the study's objectives. Furthermore, the study's research hypotheses have been captured in this chapter. Finally, this chapter defined the study's limitations and delimitations, as well as the definitions of key terms relevant to the study.

CHAPTER TWO

LITERATURE REVIEW

This chapter reviews the theoretical framework, concepts and empirical works of some research on the study and conceptual framework adopted by the author. The concepts of rice production, livelihoods, innovations, adoption of new technologies and extension delivery services as well as training interventions on economic outcomes and food security are reviewed. The theoretical framework focuses on the Diffusion of Innovation Theory of Change and Bennett's Model of Evaluation. The chapter also reviews the barriers to rice productivity among rice farmers, the means through which these barriers can be addressed, and the influence of group dynamics, institutional arrangement, and management factors on the sustained performance of rice farmers.

Theoretical Framework

This study is grounded in two theories. These theories are the Theory of Change and the Diffusion of Innovation theory. The theories are complemented by Bennett's hierarchy of evidence and the sustainable livelihood framework to reveal the broader picture of evidence of the impact of the project on all the livelihood capitals. The theories, Bennett's hierarchy of evidence and the sustainable livelihood frameworks are detailed in the forgoing paragraphs.

Theory of Change

The theory of change emanated from the field of theory-driven evaluation popularised in the 1990s (Reinholz & Andrews, 2020). Weiss (1995) defines a theory of change as a theory that depicts how and why an

initiative works. Building on the work of Weiss, Connell and Kubisch (1998) view a theory of change as a systematic and cumulative study of the links between inputs, activities, outcomes, and contexts of an initiative. The theory of change shows a sequence of events that lead to outcomes; it looks into the conditions and assumptions that must be met for the change to occur, clarifies the programme's causal logic, and maps programme interventions along logical causal pathways (Hernandez & Hodges, 2003).

Gertler, Martinez, Premand, Rawlings and Vermeersch (2016) add that a theory of change describes how an intervention is supposed to deliver the desired results while Shakman and Rodriguez (2015) state that a theory of change explains how and why a particular programme, programme modality, or design innovation will achieve its desired goals. A theory of change, therefore, assists in separating an intervention's inputs and activities, the given outputs, and the predicted behavioural changes or effects of the intervention among beneficiaries. The theory of change has been applied in many fields of study to evaluate projects and programmes. For example, Cattaneo et al. (2009) used a theory of change to investigate the impact of Piso Firme housing improvements on health and welfare.

According to Ghate (2018), a theory of change is composed of basic elements of needs (the initial problem being addressed), inputs (resources), outputs (intended activities) and outcomes (desired changes for service users). It also includes the specification of implementation outcomes at practice, organisation, or system levels as well as the mechanisms of change, (Weiss, 1997). All these are prerequisites for producing the intended outcomes for ultimate beneficiaries.

According to Reinholz and Andrews (2020), a theory of change is project-specific, related to evaluation and makes the underlying rationale of a project explicit to support planning, implementation, and assessment of the project. Moore, Audrey, Barker, Bond and Bonell (2015) are of the view that 'a strong understanding of the theory of intervention is a pre-requisite for a meaningful assessment of whether the (delivered) intervention remained consistent with its underlying theory. Given the cause-and-effect focus of impact evaluation research, a theory of change is imperative for specifying the research questions in the evaluation design (Gertler et al., 2016).

Researchers have generally approached the theory of change in two ways: first, some scholars have focused the theory on how a project or programme causes an effect. Second, the theory has been used to investigate how change occurs in general and analyze what that means for the role that a specific organization or program can play. The first approach focuses on articulating the programme logic: defining the long-term changes that organizations want to bring (often beginning with the overall vision), mapping back to identify changes that need to happen at other levels (the pre-conditions); and the interventions that will cause each change to happen, making explicit the rationale behind them. This approach ranges from simple logic models that just identify inputs, outputs, and outcomes while attempting to explain the model's rationale, to more elaborate flow charts and diagrams that trace change paths and contain precise indications at each stage.

The second approach takes a more comprehensive and systemic approach to development, arguing that even when the programme logic is meticulously worked out, other circumstances beyond the control of

organizations might lead a program to fail. Before examining how an organization or program contributes to change, these studies typically entail a broader, contextual investigation of how change occurs — which may include investigating other players and identifying their roles in change (James, 2011). The first strategy was chosen for the objectives of this research. This is because the researcher wants to see and describe how the SDRLRP's inputs, activities, and outputs interacted to produce the project's overall goal.

Connell and Kubisch (1998) indicate that the major strength of the theory of change approach is its inherent common sense and its major competitive advantage is the inability of other currently available approaches to do the job. Ghate (2018) enumerated the benefits of using a theory of change to evaluate an intervention as follows: it allows the evaluability of the programme—both for implementation and outcomes—to be facilitated, by signposting appropriate metrics. Further, it reveals the original intentions of the programme developers, and make them available for critique.

Furthermore, developing a theory of change brings out the underlying logic of the assumptions, for example, that undertaking a certain activity will lead to a particular outcome, which can be scrutinized. Moreover, the realism of the assumptions made by the programme developers can be checked against wider evidence of 'what works', to assess the likelihood of the programme being successful.

Again, with a theory of change, the commissioners can check the programme meets their needs; and providers and practitioners delivering the programme can check their own assumptions and the alignment of their expectations against the original intentions of the programme developers and

allows the key parameters or boundaries (e.g., who is the programme for, and under what specific circumstances) to be set out, reducing the likelihood that the programme is used inappropriately or ineffectively (Ghate, 2018).

Rooted in the theory of change is the result chain, which links an intervention's outcomes to the outputs, activities and inputs (resources) of the intervention. According to Gertler et al. (2016), the results chain establishes the causal logic from the initiation of the program, beginning with resources available, to the end, looking at longer goals. It lays up a logical, reasonable framework for how a series of inputs, actions, and outputs for which a program is directly responsible, interact with behaviour to generate pathways via which impacts are realized; because evaluation cannot do away with the result chain, it is necessary to explain the components of the chain.

The results chain maps the following elements: inputs, activities, outputs, outcomes and outcomes. Inputs These are the resources at the disposal of the project, including staff and budget. Activities comprise the actions taken or work performed to convert inputs into outputs. Outputs represent the tangible goods and services that the project activities produce; these are directly under the control of the implementing agency. Outcomes are the results likely to be achieved once the beneficiary population uses the project outputs; these are usually achieved in the short to medium term and are usually not directly under the control of the implementing agency. Outcomes, on the other hand, are the final results achieved indicating whether project goals were met, which can be influenced by multiple factors and are achieved over a longer period (Gertler et al., 2016).

The results chain covers both implementation and results. Implementation concerns the work delivered by the project, including inputs, activities, and outputs. These are the areas under the direct responsibility of the project that are usually monitored to verify whether the project is delivering the goods and services as intended. Results consist of the outcomes and outcomes, which are not under the direct control of the project and which are contingent on behavioural changes by program beneficiaries (Gertler et al., 2016).

Although the benefits are clear, a theory of change is not without criticism and many scholars have expressed their concern regarding the pitfalls of the theory. For example, according to Mulgan (2016), most theories of change aren't really theories, and they don't always promote systematic thinking (although one might add, they may certainly give the impression of systematic thinking). Attempts to simplify what is likely to be a complicated reality are unquestionably dangerous. The distillation of theory, as vital as it is, is problematic, according to Hawe (2015): 'Logic modelling for basic, linear interventions is distinct from models that aim to integrate complexity.' This is significant because a simple model applied to a complex scenario risks exaggerating the intervention's causal significance.

Mowles (2014) claims that there are no such things as simple (or even "complicated") programs, only complex ones. According to Rogers (2008), logic models (in particular) may instill a false sense of confidence because real-world social interventions are complex and multi-level (or at the very least, occur within complex systems), whereas logic models are purposefully simplified, compressing rather than fully representing complexity. Logic

models, in particular, should be thought of as diagrams rather than equations. While the broad theory of change remains the same regardless of delivery location or setting, it's possible that in scaled-up interventions (where multiple sites implement the same intervention), slightly different summary logic models will be required to capture the variation in local delivery conditions (Ghate, 2018). ToC guided the impact evaluation of the SDRLR project by helping the researcher to determine how the project's rationale, inputs, activities and outputs linked to the project's outcomes.

The theory of change for the SDRLRP project for this study

The low local rice production outpaced by local demand, coupled with the low income of smallholder rice farmers in Ghana, necessitated the implementation of the SDRLRP project. The goal of the SDRLRP project was to increase rice production to improve the productivity and income of rice farmers in the Ashanti and Northern Regions of Ghana. The project was implemented by the government of Ghana through MoFA, in collaboration with JICA. SDRLRP was proposed because a 2007-2008 survey by MoFA and JICA indicated the low rice production was a result of a semi-intensive rice production system adopted by approximately 80% of rice farmers in Ghana. The SDRLRP project was, therefore, deemed as an appropriate rice production system that can increase rice production and rice farmers' income.

The project's result chain is clear. The low rice production and low rice farmers' income led to the implementation of the SDRLRP project in which two thousand, two-hundred and twenty-one (2221) rice farmers were selected from Ashanti and Northern regions of Ghana. In addition to the human resource (smallholder rice farmers), funds and equipment were

invested in the project activities. The governments of Japan and Ghana jointly provided the inputs for the project which included extension officers and experts in rice technology from Ghana and Japan, project supervisors and officers from Ghana, equipment, machinery and vehicles, and a fund of GHC 1,749,488.42 (USD 1,354,752.75501 in 2009; NB: USD 1 was equivalent to GHS 1.291371) by the Japanese governments.

The technologies comprised ploughing, bund construction, nursery management, preparation of rice seedlings, and harvesting techniques, among others. The outputs of the projects were the technical package of improved rain-fed lowland rice production, methodology to improve farming support systems for sustainable rain-fed lowland rice production and extension and dissemination procedures of the model for sustainable rain-fed low land rice production are developed.

To achieve these outputs, a study on the actual situation of the rain-fed lowland rice production in the project areas was conducted, based on which model sites were selected followed by experiments on the good practices of rainfed lowland rice production and subsequent improvement of the model when the need arises. In addition, suitable locations and key farmers for demonstration of the model for sustainable rain-fed lowland rice development were selected and key demonstration fields were set up on the key farmers' fields. Furthermore, manuals on the technical package for rain-fed lowland rice production were developed to guide the dissemination of the technology. Moreover, the rice production experts conducted training on strengthening farmer groups on the model sites as well as verifying the approach to enhance farmers' access to agricultural inputs, extension services and market

information and dialogue among farmers and other stakeholders in market access in the model sites. The inputs, activities, outputs and outcomes of the SDRLRP project are expected to address the low rice production and rice farmers' income challenge. This is further expected to result in the achievement of the overall goal of the project, which is to increase rice production and smallholder rice farmers' income in the Ashanti and Northern regions of Ghana(Figure 1).

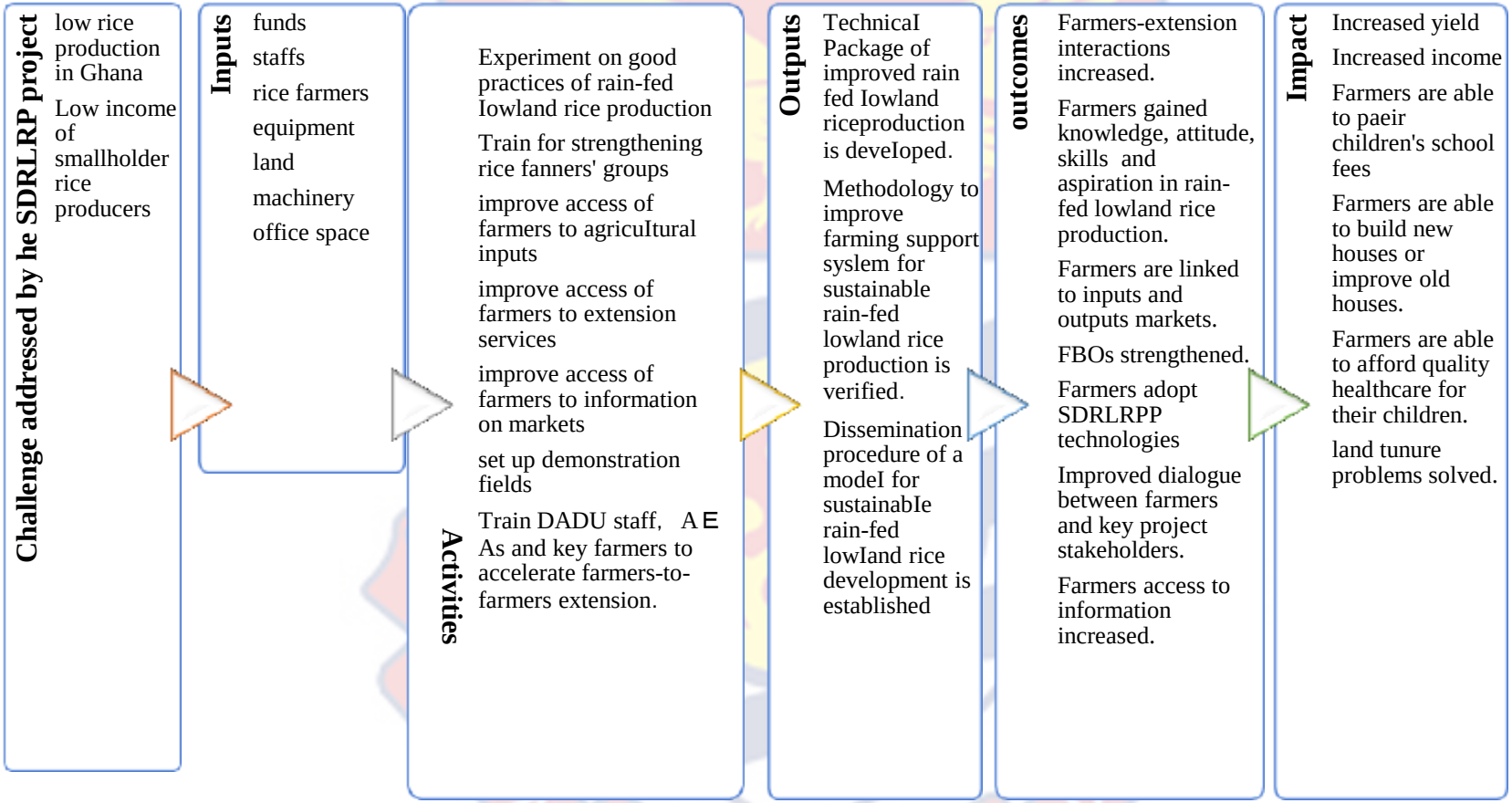

Figure 1: Theory of Change for the SDRLRP project

Source: Author's construct

The Diffusion of Innovation Theory

Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system and the Rate of adoption is the relative speed with which an innovation is adopted by members of a social system (Rogers, 1983). The theory focuses on the five (5) main variables that determine the rate of adoption namely (a) Perceived attributes of the innovation, (b) the type of innovation-decision, (c) the nature of communication channels diffusing the innovation at various states in the innovation-decision process, (d) the nature of the social system in which the innovation is diffusing, and (e) the extent of change agents' promotion efforts in the innovation diffusions (Rogers, 1983), as displayed in Figure 2.

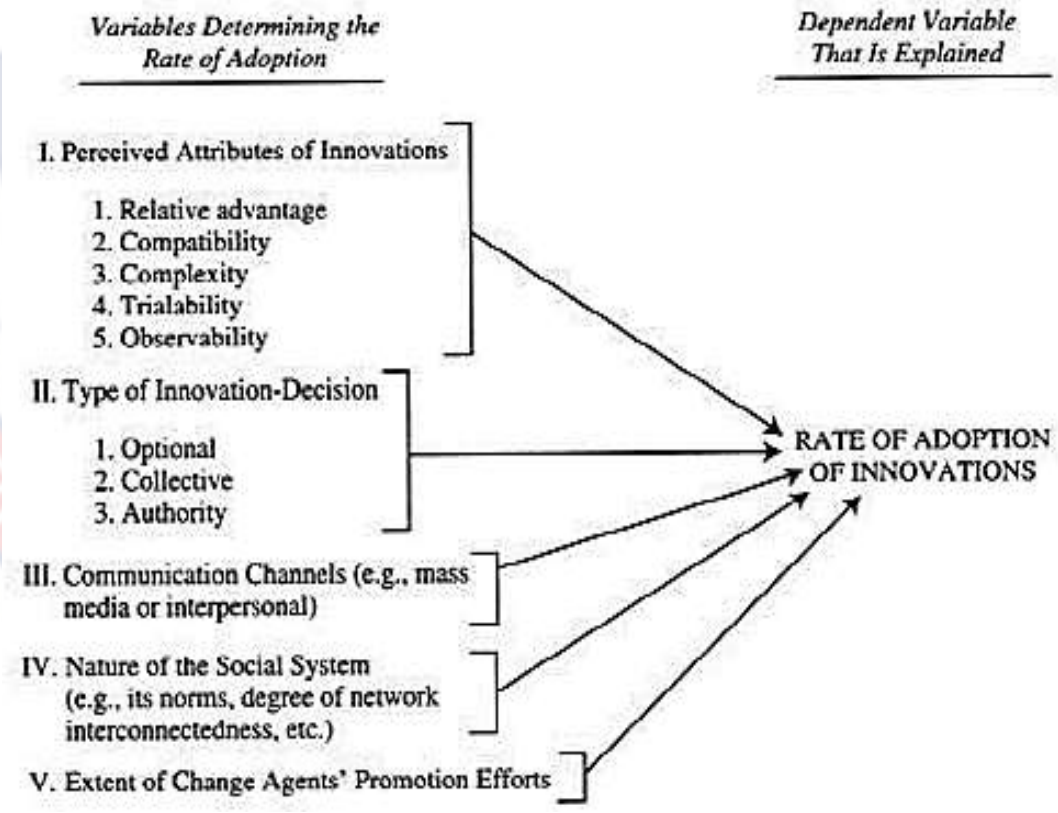

Figure 2: Diffusion of Innovation Theory

Source: Roger (1983).

However, Rogers (1983) noted that because most adoption studies have shown that between 49 to 87 per cent variance in the rate of adoption of innovations has been explained by 'Perceived attributes of the innovation', the other four (4) aforementioned variables have not received much attention by most diffusion scholars.

Hence, the DOI theory has focused on Perceived attributes of innovation (namely: relative advantage, compatibility, complexity, trialability, and observability) to explain the variance in adoption. Adoption decision or intention is, therefore, driven by the five attributes of innovation discussed earlier. The rationale for using the DOI theory in this study lies in the fact that the perception of rice farmers about the attributes of the SDRLRP technology will determine whether they will adopt the technology or not. Hence, this theory will help to measure the farmers perceived attributes of the intervention to be used to gauge their intensity of adoption of the intervention. In this study, Roger's DOI framework is modified, as shown in Figure 3 below:

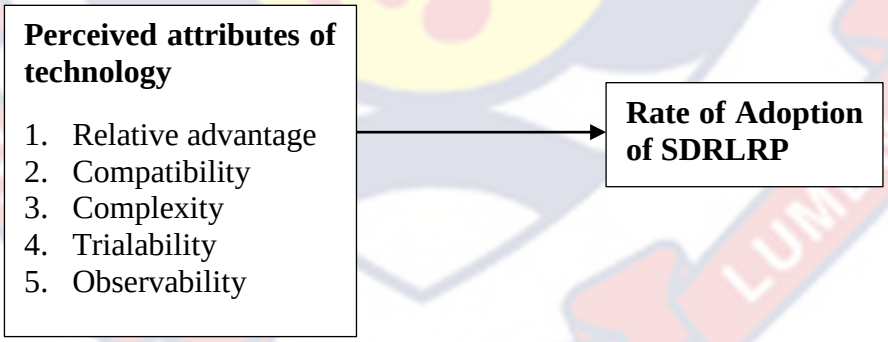

Figure 3: Framework for the adoption of SDRLRP adapted from Roger's Diffusion of Innovation Framework

Source: Adapted from Roger (1993)'s Diffusion of Innovation Framework

In this study, the researcher measured the intensity of adoption instead of the rate of adoption because the former was of interest. The intensity of adoption helps to know how many of the SDRLRP technologies are in use by

how many farmers. The assumption is that those technologies being used currently have passed through the farmers' adoption decision-making process over a period and thus are maintained. Hence, the adoption intensity reveals those technologies that have been carefully examined by the farmers given the technologies' characteristics and are judged worthy of adoption. The adoption intensity can, therefore, inform stakeholders about the technologies that are practised currently, and the number of farmers practising them, for further decision-making.

Bennett Model (Hierarchy) of Evaluation

Bennett's Hierarchy, developed by Claude Bennett in 1975, has functioned as the Cooperative Extension Service's evaluation model ever since (Bennett & Rockwell, 2003). Bennett's comprehensive model has served as the platform for impact studies, national assessments, and numerous evaluations (De los Santos & Norland, 1990; Forest & Marshall, 1978; Long, 1987). In addition, several training materials have been developed based on the model (Sawer, 1984; Youmans, 1986). The choice of Bennett's hierarchy for this study is informed by the fact that the researcher seeks to evaluate the SDRLRP project from the inputs committed to the implementation of the project to the overall goal of the project.

The hierarchy contains two major components namely *inputs* to a program and *outcomes* related to those inputs. Any possible variable in a program evaluation that is planned for or monitored can be assigned to one of the seven levels of the hierarchy in the two basic components.

In the input component, three distinctly ordered categories are found: inputs, activities, and people involvement/participation. Staff qualifications and time, money and other tangible resources, and any other input required to plan and implement activities are examples of inputs. Activities are defined as any events that occur during an educational program's life cycle, including its conception, planning, implementation, and evaluation. Marketing, teaching, and administration are examples of possible activities. The third level of a programme's *inputs* is the people's involvement or participation, which includes client demographics, numbers, and level of involvement.

It follows that if, in the hierarchy, properly planned and implemented level one leads to level two, and so on, then the three levels that comprise the inputs to a programme, as a group, should result in certain outcomes. Those outcomes have been classified into four levels, beginning with the most basic and universal outcome of any participation, people's reactions. Reactions include satisfaction with participation, suggestions for improving participation, and evaluation of the resources involved (staff, curriculum). Reactions, in essence, only deal with actual participation, not subject matter.

Reactions to an intervention's content/subject matter are classified as attitude, which falls under the next level of the outcomes, KASA. KASA stands for knowledge, attitude, skills, and behaviour aspirations. Remembering the model's hierarchical nature, positive reactions should result in improved KASA. According to this logic, a positive change in KASA should pave the way for success at the next level, behaviour or sustained practice change.

The hierarchy has only included individual experiences and changes up to the level of behaviour change. End-results, changes in a unit larger than an individual are hypothesized to occur at the top of the hierarchy. For example, the success of changes (in knowledge, attitude, skills, aspirations, and behaviour) made by individuals at lower levels of the hierarchy may have an impact on an entire community, ecological entity, or economic situation. The assumption about end-results is that they will occur only if enough people change their behaviour. The effect is cumulative in the sense that the greater the number of people who experience change as a result of the program, the stronger the relationship should be between lower levels and the final level, and end results (De los Santos & Norland, 1990).

The outcomes component of the model's hierarchical linkages among variables is postulated based on the work of Azjen (1980), whose theory of action models impose precursors to behaviours such as attitude, knowledge, and behavioural intentions (aspirations). Bennett's model categorises knowledge, attitude, and aspirations as possible independent variables in a model with behaviour as the dependent variable. The advantage of using Bennett's hierarchy to evaluate project interventions lies in the fact that it allows an intervention's inputs to be linked to its outputs to ascertain and attribute the realised impact to the intervention, as articulated by Coutts (2005) that "evaluation is a systematic collection and analysis of processes, outputs and outcomes to allow researchers to make statements, judgments, claims and conclusions which have the potential to impact on current and future decision-making."

Evaluation of agricultural interventions including SDRLRP aims at determining the impact of the interventions that not only affect the individual farmer participants but the overall impact of the community as a whole of which the farmers are part. The overall impact ranges from social to environmental and economic impact. Because most agricultural projects like the SDRLRP invest inputs that are converted into activities aided by farmers' participation, the activities performed in the projects are expected to result in some outputs, which, if the farmers react positively towards them, should lead to a change in their knowledge, attitude, skills, and aspirations (KASA). This change is further expected to influence the farmers to adopt and put the intervention's outputs to use which when sustained, should finally lead to not only an impact on the individual farmer but their communities.

According to Bennett's framework of evaluation, evaluation of any intervention that seeks to create an impact should begin from the inputs used through to the final level, SEE conditions to establish how the INPUTS convert to OUTCOMES. Following suit, the evaluation of the impact of the SDRLRP project on the beneficiaries begins from the inputs of the project to the final outcome (De los Santos & Norland, 1990) (Figure 4).

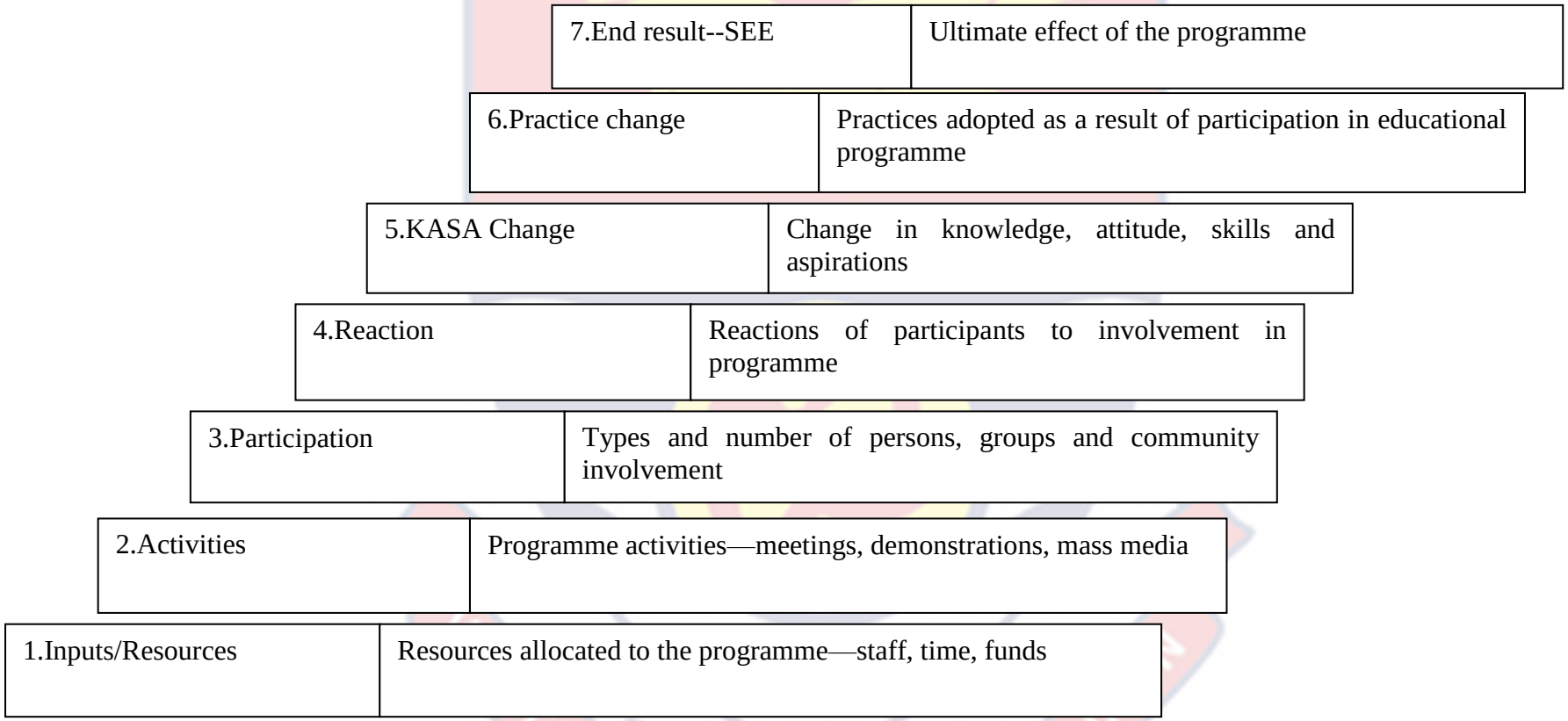

Figure 4: Bennett's Hierarchy of Evaluation

Source: Bennett (1975).

Sustainable Livelihood

The analysis of the SDRLRP project's impact on farmers' livelihoods is based on the DFID-developed Sustainable Livelihood Framework (SLF) (1999) (Figure 5). The SLF's primary focus is on household well-being. The framework assumes that households have varying levels of resource endowment and capability, that they are exposed to different scales of institutions and policies that affect the environment in which they operate, and that the interaction of these factors determines their livelihood choices and, as a result, the differences in livelihood outcomes for the household. In Figure 5, SLF characterizes people (farmers) operating in vulnerable situations. That is, farmers have little influence over the external environment in which they live and work. The framework also demonstrates that farmers' livelihood assets include community and basic material assets, as well as their ability to utilise these assets.

Furthermore, the framework maintains that in society, access to basic needs is determined by the acquired ability to attain life needs through exchange with own farm output and capabilities, subject to the mediating role of any prevailing institutions and processes that define the socio-economic order. This viewpoint consequently suggests that an individual's exchange entitlement is reliant on the volume of farm produce at the individual and household levels. This implies that farmers' ability to purchase basic living needs, which has ramifications for family or household well-being, is dependent on farm outputs that are exchanged in the absence of remittances (Colombo, Romeo, Mattarolo, Barbieri & Morazzo, 2018).

The SDRLRP Project is designed to encourage farmers to adopt innovative technology to improve farm outputs for the benefit of participating households (Sen, 1981) previously proposed that assets and capacities are the single most important component defining the life choices and strategies that decide an individual's welfare outcomes, ignoring the mediating function of the policy environment that conditions the existence of this entitlement. As a result, sustainable poor development based on the Sustainable Livelihood Approach produces the finest well-being outcomes. When assessing the success of the SDRLRP project, agricultural yields and household income are taken into account.

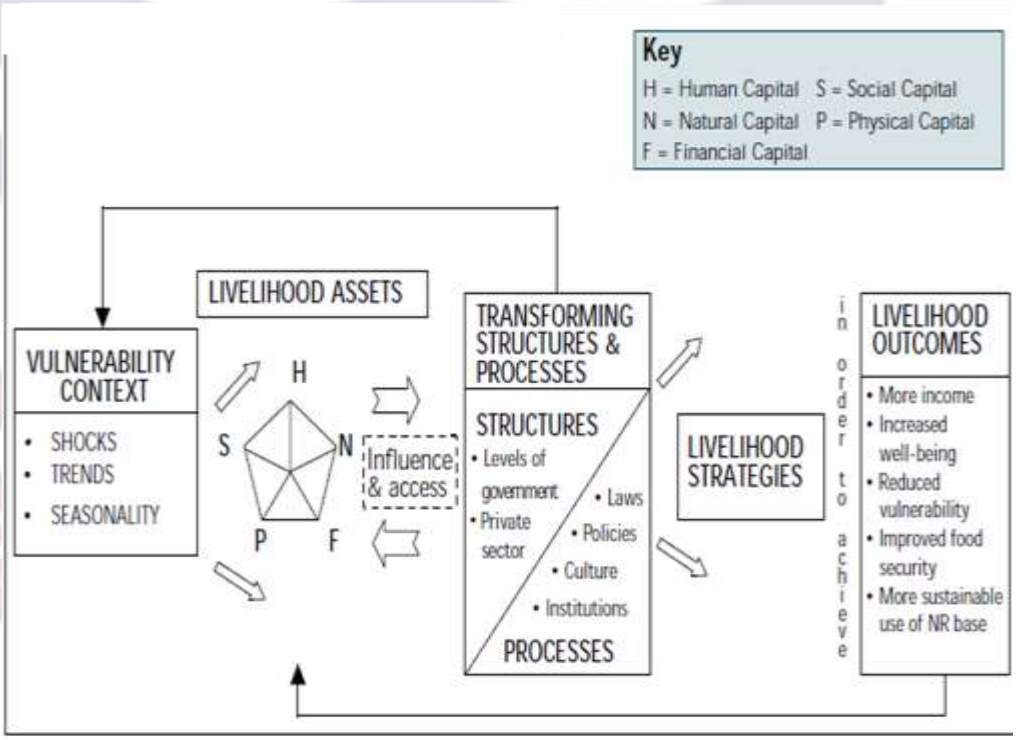

Figure 5: DFID's Sustainable Livelihoods Framework

Source: Colombo et al. (2018).

Concepts

Concept of adoption

Various authors define adoption in different ways. Adoption is defined by Loevinsohn, et al. (2013) as the integration of new technology into existing practice, which is frequently preceded by some degree of 'trying' and adaption. Bonabana-Wabbi defines adoption as a conceptual process that an individual goes through from first hearing about innovation through the final use of it (Bonabana-Wabbi, 2002). Adoption is divided into two categories: adoption rate and adoption intensity. The former, which is the rate at which farmers embrace an invention, incorporates the factor of 'time' as one of its pillars. The intensity of adoption, on the other hand, refers to the current level of use of technology (Mwangi & Kariuki, 2015).

Concept of agricultural technology

Technology is also defined in different ways by different authors. Technology is defined by Loevinsohn et al. (2013) as the means and methods of generating commodities and services, including organizational and physical techniques. According to these authors, new technology is either new to a specific location or group of farmers or reflects a novel application of technology that is already in use in that location or group of farmers. Technology is the knowledge/information that allows some jobs to be completed more quickly, a service to be provided, or a product to be manufactured (Lavison 2013) cited in (Mwangi & Kariuki, 2015). The goal of technology is to improve a situation or shift the status quo to a more acceptable level. It enables the applicant to complete tasks more quickly and

efficiently than he would without the technology, therefore saving time and effort (Bonabana-Wabbi, 2002).

Concept of technology adoption

Mwangi and Kariuki (2015) concede that it is difficult to define technology adoption because it varies depending on the technology. For example, according to Doss (2003), farmers were categorized as adopters of improved seeds in a CIMMYT survey if they were utilizing seeds that had been recycled for several generations from hybrid ancestors. Adoption was linked in other trials to following extension service recommendations to use only new certified seeds (Bisanda et al., 1998; Doss, 2003; Ouma et al., 2002). As a result, the first consideration in defining agricultural technology adoption by farmers is whether adoption is a discrete state with binary response variables or not (Doss, 2003). That is, the definition is based on whether the farmer is a technology adopter or not, with values ranging from zero to one, or the response is a continuous variable (Challa & Tilahun, 2014). The suitability of each strategy is determined by the situation (Doss, 2003). Many researchers employ a basic dichotomous variable approach in farmers' new technology adoption decisions, which is crucial, according to Jain, Arora and Raju (2009), because it indicates farmers' awareness and use of the new technology. In this study, agricultural technology adoption (the adoption of SDRLRP project technologies or activities) is defined as the use or not-use of the project activities. This is measured on the natural dichotomy with zero representing "not using" and one representing "already using".

Africa is one of the continents with the lowest levels of agricultural productivity in addition to high rates of poverty, despite the increment in agricultural growth rates in recent times. The greater proportion of this growth hinges on area expansion rather than improved productivity. Concurrently, productivity is increasingly vulnerable to climate change and desertification, which threaten progress toward decreasing poverty and hunger while maintaining environmental sustainability as part of the Sustainable Development Goals (SDGs) (Arslan, 2020). To overcome these challenges and harness the poverty-reducing power of agricultural growth, the continent needs to invest heavily in agriculture, particularly in the identification and promotion of improved agricultural technologies and practices (Christiaensen et al., 2011).

The adoption of innovations is complex and involves a mental process that highly depends on the innovativeness of the receiver (Rogers, 1983). This means that farmers' adoption of innovation depends on personal and social characteristics and the need for the innovation, among many other factors (Kamrath et al., 2019; Meijer et al., 2015; Rogers, 1995) as cited in (Olum et al., 2020).

Extant literature indicates that the first large-scale agricultural productivity increases in the developing world were achieved by the widescale adoption of agricultural technologies during the Green Revolution in the 1960s (Evenson, 2003; Stevenson et al., 2013). Since the Green Revolution technologies (including high-yielding crop varieties and chemical fertilizers) were distributed to increase productivity and decrease poverty, there have been attempts by economists to identify and analyse the determining factors of

technology adoption by farmers. Studies on agricultural technology adoption have been advancing since the Green Revolution to understand the drivers of and constraints to the spread of new technologies (Arslan, 2020).

Concept of livelihood

Existing literature and project reports abound with references to livelihood approaches, viewpoints, methodologies, and frameworks. The term "livelihoods" is frequently used in conjunction with other concepts to establish entire domains of development research and practice. These fields include locals (rural or urban livelihoods), professions (farming, pastoral, or fishing livelihoods), social distinctions (gendered, age-defined livelihoods), directions (livelihood pathways, trajectories), and dynamic patterns (sustainable or resilient livelihoods), and many others. Perspectives on livelihoods begin with how different people in different places live (Scoones, 2009).

Several definitions exist in the literature for a livelihood. For example, Chambers (1995) defines livelihood as “the means of gaining a living’ or “a combination of the resources used and the activities that are undertaken to live.” According to Chambers and Conway (1992), a livelihood comprises people, their capabilities and their means of living, including food, income and assets. This means of living is predicated on the tangible and the intangible assets people access, possess and utilise. Tangible assets are resources and stores, and intangible assets are claims and access. Scholarship on rural livelihood development portrays a complex web of activities and interactions that emphasise the diversity of ways people make a living. This may cut across the boundaries of more conventional approaches to looking at rural development which focus on defined activities: agriculture, wage employment,

farm labour, small-scale enterprise and so on (Scoones, 2009a). In the view of Ellis (1998), livelihood comprises the activities, the assets and the access that jointly determine the living gained by an individual or a household. All activities involved in finding food, searching for water, shelter, clothing and all necessities required for human survival at the individual and household level are referred to as a livelihood.

Approximately 90 % of rural households are involved in farming activities. In Africa, 70 % of the household income in rural areas is from farming activities. Among these rural populations, small-scale farming, fishing, raising livestock and non-farm activities are some of the common livelihoods that these populations survive on as a source of income (Davis et al., 2010).

Because of the strong advocacy for sustainable livelihood approaches in development since the 1990s, many development agencies have adopted livelihood approaches as central to their programming and even organizational structures (Ashley et al., 1999), as JICA has done in implementing the SDRLRP program to improve the sustainable livelihoods of rice farmers in Ghana, particularly in the Northern and Ashanti regions.

Concept of livelihood capitals

Based on the sustainable livelihood framework, Ellis (1999) cited in Mumuni and Oladele (2016) defines livelihood as "the activities, assets, and access that together constitute an individual's or a household's life." The framework identifies five kinds of livelihood capital namely, human capital, social capital, natural capital, financial capital and physical capital.

Human capital refers to the availability of farmers, rice processors, rice marketers, agro-input dealers, labour, and agricultural technical officers who have the skills, knowledge, and ability to utilize rice cultivation as a source of income. The type of knowledge and experience utilized on the rice pre/post scale is closely related to the outcomes. Again, experience, skill, and knowledge serve to mitigate the negative consequences of vulnerabilities to which production processes are susceptible. Farmers' ability to select good seeds, create and keep accurate records of their revenues and expenditures, proper agronomic methods on the rice plant's life cycle, and the right methodology to decrease post-harvest losses will result in a high yield and income. Furthermore, family labour is a valuable source of human capital that aids farmers in their rice production activities (Shivakoti & Schmidt-Vogt, 2009). When rice farmers employ social capital effectively, the quality of the rice produced improves, allowing rice millers and marketers to see a return on their investment because buyers get more for their money. This process will result in a sustainable livelihood process for all actors in the chain, including labour, who drives the activities of the manufacturing process and receives a guaranteed income.

Farmers' social capitals include their families, friends, trust, norms, communality, gatherings, and networks of farmer associations and other players such as agro-input dealers, land owners, and agricultural extension workers. All networking inside these knowledge communities is done for a common goal and interest. The availability and accessibility of rice production methods, as well as the rate of adoption by farmers, are all linked to their social capital. Social networks may have an indirect impact on agricultural

yield by influencing farming methods and households' propensity to adopt newer technologies through the distribution of information via these networks (Katungi, 2007; Liverpool-Tasie & Winter-Nelson, 2009). Farmers can learn from one another and rely on distinct individual capabilities for their gain as a result of their networking and membership. Farmers' adoption rates rise when they are persuaded by their colleague farmers rather than outsiders.

Membership in more formalised groupings (farmer-based associations) frequently follows mutually decided or widely acknowledged rules, norms, and consequences. With appropriate ways to manage the rice farming variabilities, they increase their yields and livelihood outcomes. Furthermore, labour, which is a larger agricultural capital, is primarily sourced from family and hired sources for rice production activities (Mumuni, Yaa & Olamide, 2013). Therefore, family plays an important role in the labour sources for rice production which helps them to reduce cost and cope with the intensification process and the vulnerabilities involved but can have an adverse impact if the bond and belongings are not there. The trust component of solidarity aids them in times of emergencies such as droughts, low yields, pest and disease outbreaks, and flooding by providing inputs and even labour on the affected members' farms.

The key drivers of agriculture include natural capital, which includes improved access to land, agricultural land acreage, fertile soils, water availability and accessibility. The availability and access to these components of natural capital are dependent on farmers' ability to acquire and utilize resources. Rice is grown successfully in fertile soils with ample water, relying on the farmer's best expertise and agronomic skills. The ability to preserve and

sustain the availability of natural capital is related to human capital efficiency and social capital shared values. Watershed management and maintenance, such as not polluting irrigation streams and canals, dredging of waterways, vegetation protection, and effective soil management, benefit farmers' production processes by increasing their coping mechanisms to shocks and vulnerabilities. Furthermore, maintenance aids in the preservation of capital for future use. Rice farmers' livelihood diversification of accessible natural resources might also assist them to cope with disasters and vulnerabilities. Vegetables can be planted during the off-season of production to increase household income and financial resources.

Rice farming is one of the livelihood sources with a higher return on investments in Ghana aside from cocoa (MoFA, 2015) which help farmers to acquire physical assets. This fact means that production (acreage and yield), rice milling machines, power tillers, land, tractors and many others may be accessible to these farmers who have a good return on their investment or otherwise good incomes. Farmers turn to invest more in housing, health care and education of their children (JICA, 2013). Access to irrigation facilities, roads, storage, and markets increases the physical capital of farmers and enhances their livelihood results. The income created by the production process provides cash to meet the majority of people in rural areas' expenses for clothing, housing, education, and other social amenities (Norman & Kebe, 2006). Whereas the lack of finance undermines these farmers' resilience and coping mechanisms during catastrophes or any unfavourable events such as bushfires and droughts.

The link and network between social and physical capital is the link and network between seed and other input suppliers, ice millers, and so on, which tends to be goodwill for the farmer and the other actors' concern. If the farmer's physical capitals are to be sustainable, his financial capital must be better and stronger (Mumuni & Oladele, 2016). Farmers' and processors' knowledge, innovation, and training, as parts of human capital, considerably contribute to a better-coping strategy and recovery amid difficulties and challenges. Government assistance in improving their resilience will include improved roads, easier access to processing and larger warehouses for their output, and easier land acquisition for rice farming.

Within the framework of sustainable livelihoods, financial capital is defined as the financial resources that people employ to attain their livelihood goals. This capital in agriculture is generated and converted from farmer's commodities into cash for household expenses as well as saving for hard times and bad seasons. Farmers can use formal and non-formal financial resources and institutions based on their training and help from extension officers. This form of livelihood strategy can guarantee the level of financial capital they can access or have access to.

JICA (2013) contends in their findings that farmers who are members of stronger farmer-based organisations (FBOs), which are a social capital component, have easier access to financial support from local banks and microfinance firms, as well as their contributions, than those who are not. It is assumed that FBOs with internally generated revenue and a savings culture have a higher level of social and financial capital (Akpabio, 2008). This viewpoint was previously supported by the World Bank's (1996) remark that

the most successful groups are those in which a greater proportion of loan capital is drawn from group members' savings. This will immediately boost their coping mechanisms during difficult times and increase their livelihood outcomes.

Aside from converting their produce into cash and receiving financial assistance, the farmer's labor and other diversified livelihood activities within the available period can result in strong financial capital for the farmers (Angelucci, Asante-Pok & Anaadumba, 2013). While gaining access to these rice farmers' strategies and coping mechanisms, as well as the expected outcomes of agricultural interventions and entrepreneurial leverage, it is necessary to examine the policy and institutional context within which these capitals exist, as advocated by (Scoones, 2009). While some capitals may be vulnerable to certain shocks, authorities may be able to intervene and mitigate any harm or provide reparations (Morse & McNamara, 2013). In this regard, the district assemblies' and government agencies' responses to external threats to farmers' livelihoods are essential.

Farmer participation in agricultural programmes

According to Farid, Mozumdar, Kabir and Goswami (2009), participation refers to playing a role or taking part in an activity usually with others. Participation also refers to the involvement of individuals and groups in development processes to ensure self-reliance and a better standard of living (Nxumalo & Oladele, 2013). The important relationship between farmers' participation in agricultural projects on one hand, and programme impact (economic development and poverty alleviation) on the other hand, cannot be over-emphasized. Nxumalo and Oladele (2013) point out that without

participation, there would be no programme and no development. Farmer's participation in agricultural projects can either be nominal, consultative, action-oriented or collegial (Etwire, Dogbe, Wiredu, Martey, Etwire & Robert, 2013).

Nxumalo and Oladele (2013) revealed that farmers are favourably disposed to participate in agricultural programmes. Uduji and Okolo-Obasi (2018) discovered that Young Rural Women (YRW) rarely participated in the e-wallet programme due to the cultural and traditional context, anchored in beliefs, norms and practices that breed discrimination, and women's vulnerability to poverty. According to Mubyazi and Hutton (2012), communities are involved in one or more stages of project cycles in many countries, including priority setting, resource allocation, service management, project implementation, and evaluation. In such situations, there is a tendency for communities to be informed to implement decisions that have already been made by elites or politicians, and in most cases, professionals dominate decision-making processes by downgrading the knowledge and skills of non-professionals or non-technical people. Similarly, research in Uganda's Mukono District found little public participation in priority settings due to factors such as ineffective planning, and socioeconomic, and cultural constraints (Kapiriri, Norheim & Heggenhougen, 2003).

Oyugi and Kibua (2006) discovered that community participation was low, with the majority of participation occurring during the project's identification and creation of "wish lists." Blackman (2003) claimed that despite the recent rise in the "bottom-up" approach to development, project beneficiaries are still not fully involved in the identification, planning,

implementation, monitoring, and evaluation of projects aimed at improving their situation. Even when "participation" is incorporated into projects, it is sometimes defined in terms of local labour investment rather than actual decision-making (Maraga, Kibwage & Oindo, 2010). A study of community participation in a demand-driven development project found that, except for the index on project proposal development, most of the remaining participation indices had a high mean score (2.66 - 2.87) indicating that most of the participation indices had a high level of community participation (Osore et al., 2018).

Farmers' or community members' participation in projects can be influenced by several factors. The most important factor is the educational status of farmers. According to Osore et al. (2018), high levels of illiteracy in coastal communities caused the community members to be unable to effectively participate in the project identification phase. As a result, their participation in the project planning phase was limited to assessing community needs and prioritization of community projects. The authors also argued that the low community participation in proposal development was a result of the lack of technical skills in proposal writing since over 60% of the respondents were literate.

Concept of sustainable development

Sustainable Development (SD) is a ubiquitous development paradigm—the catchphrase for international aid agencies, the jargon of development planners, the theme of conferences and academic papers, as well as the slogan of development and environmental activists (Ukaga et al., 2010). To understand the concept of sustainable development, it is imperative to first

understand the two concepts (sustainability and development) making up the concept and then define them as a single concept.

First, development is defined as 'an evolutionary process in which the human capacity increases in terms of initiating new structures, coping with problems, adapting to continuous change, and striving purposefully and creatively to attain new goals (Mensah, 2019). It can also be understood as a social condition within a nation, in which the needs of its population are satisfied by the rational and sustainable use of natural resources and systems (Reyes, 2001). In their view, Todaro and Smith (2006) as cited in Mensah (2019), defined development as a multi-dimensional process involving social, structural, attitudinal, and institutional changes, as well as the growth of the economy, reduction of inequality, and eradication of absolute poverty.

Sustainability on the other hand literarily refers to the capacity to maintain some entity, outcome or process over time (Basiago, 1999). In most development literature, the concept of sustainability connotes improving and sustaining a healthy economic, ecological and social system for human development. According to Stoddart (2011), sustainability is the efficient and equitable distribution of resources intra-generationally and inter-generationally with the operation of socio-economic activities within the confines of a finite ecosystem. Ben-Eli (2015) considers sustainability as a dynamic equilibrium in the process of interaction between the population and the carrying capacity of its environment such that the population develops to express its full potential without producing irreversible adverse effects on the carrying capacity of the environment upon which it depends. Adding to the above definition, Thomas (2015) opines that sustainability brings into focus human

activities and their ability to satisfy human needs and wants without depleting or exhausting the productive resources at their disposal.

Sustainable development, therefore, is the development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs (Schaefer & Crane, 2005). Sustainable Rainfed Lowland Rice Development on the other hand encompasses the use of improved and lasting technologies to enhance rice productivity and profitability among rice farmers in rainfed lowlands to satisfy the needs of present rice farmers without harming the environment and compromising the ability of the future rice farmers to meet their livelihood needs.

Concept of impact evaluation

An impact evaluation relies on rigorous methods to determine the changes in outcomes which can be attributed to a specific intervention based on cause-and-effect analysis. Impact evaluations often serve an accountability purpose to determine if and how well a program worked. Impact Evaluations can also help answer program design questions to determine which, among several alternatives, is the most effective approach (Kirsten, 2015).

Impact evaluation is done based on specific reasons. According to Gertler et al. (2016), impact evaluation is needed if it is an innovative intervention scheme, such as a pilot program; if the intervention is to be scaled up or replicated in a different setting; if the intervention is strategically relevant and will require many resources; if the intervention is untested; and if the intervention results will influence key policy decisions.

Measuring the intensity of adoption

Binary/dichotomous (yes/no) options have been widely used to measure the intensity of adoption (Agbamu, 2006; Doss, 2006; Feder et al., 1985; Knowler & Bradshaw, 2007; Ovwigho, 2013). A dichotomous response, according to Jain, Arora and Raju (2009), may merely reflect the status of awareness rather than real acceptance. In their review, Feder et al. (1985) found that adoption decisions should not be viewed as binary in statistical analysis, but rather as a more wide spectrum of responses and the intensity of technology usage. Brown, Nuberg and Llewellyn (2017) argue that using dichotomous replies leads to limited insights and incorrect conclusions.

Agbamu (2006) suggests that several methods for measuring adoption be considered: (i) developing an adoption index using Sigma scoring of frequency counts; (ii) calculating the percentages of adopters for various technologies; (iii) assigning numerical values to adoption stages; (iv) using Likert scales; and (v) using mean scores for disaggregated levels of adoption. Iwueke (1990) classified the stages of adoption on the Likert scale as follows: unaware, aware, interest, evaluation, trial, adoption, reject, and discontinuation.

Abubakar, Kolo, Yabagi and Garba (2016), on the other hand, employed descriptive statistics (frequency and percentages) to categorize the levels of rice farming technology adoption into low, medium, and high. Tegegne (2017) also divided farming villages into four groups based on their adoption status. Farmers were classified based on (i) technical orientation (information but not implemented), (ii) technology fledglings (new participants), (iii) technology adopters (sustained adoption), and (iv)

technology dropouts using an adoption index, which is a measure of the extent to which a particular technology is used per recommended unit (withdrawn interest).

Even though valid scholarly arguments have been offered to indicate which measure is more appropriate, a lack of consensus among researchers on which measure of adoption is most appropriate has resulted in a plethora of methods for measuring it. Also, the seemingly popularly preferred Likert Scale measure of adoption as employed by Iwueke (1990) has a sore limitation in that it refuses to exclude the number of respondents who are not aware of calculating the percentage adoption for the remaining stages (Ovwigho, 2013). Owing to this limitation, the researcher contends that rather than relying just on popular and current perspectives, the choice of a measure for the intensity of adoption should be based on how adoption is defined—as an adoption rate or adoption intensity. In this study, the researcher measures intensity of adoption on a binary level (yes/no).

One –way Analysis of variance

Analysis of variance is so-called because it is employed to compare the variance (variability in scores) between the different groups (believed to be due to independent variable) with the variability within each of the groups (believed to be due to chance (Pallant, 2001). An F ratio is calculated which represents the variance between the groups, divided by the variance within the groups. A large F ratio suggests that there is more variability between the group (caused by the independent variable) than there is within each group (referred to as the error term) (Gujarati et al., 2012; Gupta & Gupta, 2004). A significant F test indicates that the null hypotheses which state the population

means are equal are rejected they emphasized. They also indicate however that, it does not tell which of the groups differ and that if there is a need for this, then the posthoc test should be conducted.

Correlation

Different correlation coefficients (Spearman's rho, Rank Biserial (rrbi), biserial (rbi) and Phi correlation coefficients) were used to explore the relationships among the independent variables and the level of adoption of SDRLRP technologies depending on the level of measurements of the independent variables (sex, educational level, farm size, etc.) against the dependent variable (level of adoption). Biserial correlation coefficient (rbi) is used when measuring the degree of association between artificial dichotomy nominal variable and ratio or interval level scale. This is almost similar to the Point Biserial correlation (rpbi) but the nominal dichotomy must be a naturally occurring variable (e.g. Sex). Rank Biserial (rbi) is used when measuring the degree of association between any nominal dichotomy and ordinal or ranked level measurements (e.g. Level of education).

Content analysis

According to Cole (1988), content analysis is a method of analysing written, verbal or visual communication messages. Historically, it was first employed as a method for analysing hymns, newspaper and magazine articles, advertisements and political speeches in the 19th century (Harwood & Garry, 2003). As a qualitative research analytical tool, Elo and Kyngäs (2008) assert that it is a systematic and objective means of describing and quantifying phenomena as well as analysing documents. According to Bengtsson (2016), content analysis is an analytical tool that helps to reduce the volume of text

collected, identifies and groups categories and seeks some understanding of it. This way, the analytical tool enables the researcher to attempt to "stay true" to the text and achieve trustworthiness. The analytical method is best used for verbal

The content analysis in this study was used to analyse the qualitative objectives of the study which sought to determine the extent to which the SDRLRP project implementation processes have delivered the planned outputs, to examine the relevance, design, implementation structure and what went well or not in the project, to identify the critical factors that may have supported or impeded the project in realising its expected outcomes and to identify the key challenges and gaps that may have affected the attainment of the project objects. For the researcher to be able to use content analysis to do the analysis, he first must plan which sample size, unit of analysis and data collection method (s). The sample for content analysis is commonly drawn from 1 to 30 informants (Fridlund & Hildingh, 2000). This is, however, not a rule of thumb, as (Krippendorff, 2018) states that the sample size should be determined based on informational needs so that the research question can be answered with sufficient confidence. So, it lies at the discretion of the researcher to choose the appropriate sample size that will give him the needed information with the depth he wants. The unit of analysis refers to the sample, which can be either men or women or both (Patton, 2002). The data collection method used when one wants to apply ranges from deep interviews, focus group interviews, observations of situations, films and videos and a single-question interview (Bengtsson, 2016). For this study, indebt interviews,

observations and focus group interviews were employed as data collection methods.

The content analysis method can be divided into two namely, quantitative content analysis and qualitative content analysis. Quantitative content analysis has its origin in media research, while qualitative content analysis has its roots originally in social research. In quantitative content analysis, facts from the text are presented in the form of frequency expressed as a percentage or actual numbers of key categories. This method summarizes rather than reports all details concerning a message set, and the researcher seeks to answer questions about "how many" (Krippendorff, 2005).

The qualitative content analysis method allows data to be presented in words and themes, which makes it possible to draw some interpretation of the results. The choice of analysis method depends on how deep within the analysis the researcher attempts to reflect the informants′ statements about a subject. Within qualitative content analysis, there are manifest analysis and latent analysis. In a manifest analysis, the researcher describes *what* the informants say, stays very close to the text, uses the words themselves, and describes the visible in the text. In contrast, latent analysis is extended to an interpretive level in which the researcher seeks to find the underlying meaning of the text: what the text is talking about (Berg, 2001; Catanzaro, 1988). It is appropriate to use qualitative content and all the two methods within it because the set objectives of the study demand the data to be presented in words other than in frequencies and percentages. Also, the manifest analysis method is imperative in this study some of the data required to be presented in the informants' own words for emphasis whereas latent analysis also became

important for the researcher to be able to identify for example the challenges faced in the implementation of the SDRLRP project from the key informants' points of view. These views need to be interpreted to aid in identifying such challenges.

Stages of qualitative content analysis

A critical review of the literature reveals four stages of data analysis in qualitative content analysis which include decontextualization, the recontextualization, the categorisation, and compilation.

Stage 1: decontexualisation

This stage requires familiarity with the data and reading through the transcribed text to obtain a sense of the whole. That is, it requires the researcher to learn "what is going on?", before breaking it down into smaller meaning units, that contain some of the insights the researcher needs. and it is the constellation of sentences or paragraphs containing aspects related to each other, answering the question set out in the aim (Catanzaro, 1988; Graneheim & Lundman, 2004). Each identified meaning unit is labelled with a code, which is supposed to be understood concerning the context (Berg, 2001).

Stage 2 The recontextualisation

Recontextualization follows after the meaning units have been identified, and here a check must be conducted to ascertain whether all aspects of the content have been covered concerning the objective (s) of the study (Burnard, 1991). The original text is re-read alongside the final list of meaning units. Coloured pencils can then be used to distinguish each meaning unit in the original transcript. The researcher must then consider whether or not the unmarked text should be included. If the unmarked text gives some answers to

the research question, it should, therefore, be included in the analysis; otherwise, this "dross" can be excluded

Stage 3 The categorisation

In the categorization process, themes and categories are identified. According to Graneheim and Lundman (2004), a theme is an overall concept of an underlying meaning on an interpretative latent level, and it answers the question "How?" Categories or subcategories or sub-headings are the smallest units based on meaning units. In a manifest analysis, sometimes these are the same as the codes of the meaning units. Krippendorff (2005) and Patton (2002) caution that identified themes and categories should be internally homogeneous and externally heterogeneous, which means that no data should fall between two groups nor fit into more than one group.

Stage 4 The compilation

This is the final stage of the analysis and is concerned with the analysis and writing up process begins. Appropriate meaning units are chosen and presented in the running text as quotations. The summary of themes, categories/sub-themes and sub-categories/sub-headings identified in the transcribed data is presented as a table to allow a quick overview of the results. It is possible to add information by performing some quantification in which sub-categories and categories are counted. This is done especially when all the informants have had the opportunity to speak on the same theme being studied or the question being asked (Berg, 2001; Morgan, 1993).

However, the findings must be ensured that they correspond with the literature and the result is reasonable and logical. To validate the outcome and to strengthen the validity of the study, the investigator can perform a

respondent validation, a member check, which requires that the researcher goes back to the informants and presents the results to achieve agreement (Burnard, 1991; Catanzaro, 1988).

World rice production: Global and regional perspectives

Rice is a staple food for most populations on the earth and it is widely consumed by around 3 billion people (Krishnan et al., 2011; Yu et al., 2012), making it one of the most widely consumed grains in the world. Rice is the seed of two Oryza grass species, one from Asia and one from Africa. Rice has been cultivated for centuries, although it is a labour-intensive crop that requires a lot of water and warm, humid weather to grow. After sowing seed, the most popular technique of farming rice is to flood fields (commonly referred to as paddies) with water to give hydration and repel pests and weeds. Rice may be produced almost anywhere where the weather conditions are suitable, including on a steep hill or mountain using water-controlling terraces. With approximately 761.5 million tonnes (1,000 kilograms) produced in 2018, rice is the agricultural commodity with the third-highest global production.

Rice is produced in about 120 nations worldwide, although China (about 214 million tonnes) and India (about 173 million tonnes) account for more than half of global rice output. Southeast Asia is home to nine of the top ten and thirteen of the top twenty rice-producing countries in the world. Rice cultivation in the United States has previously been concentrated in the lowland regions of South Carolina and Georgia. However, in the present period, the majority of American rice is grown in the Mississippi Valley states of Arkansas, Mississippi, and Louisiana (World Population Review, 2022).

Rice is a key commodity for food security in West Africa (Balasubramanian et al., 2007; Norman & Kebe, 2006). Rice consumption has grown rapidly since the 1960s, owing to population increase, rising per capita consumption, and urbanization (Mendez del Villar & Lançon, 2015; Soullier et al., 2020). Annual per capita rice consumption climbed significantly from 10 kg in 1961 to 54 kg in 2017 (USDA, 2018). Between 2009 and 2013, West Africa consumed more rice than any other region of the continent. Guinea, Guinea-Bissau, Liberia, and Sierra Leone had the highest rice consumption rates (more than 90kg per capita per year), followed by Senegal, Benin, Côte d'Ivoire, and The Gambia, and Mali (more than 50kg per capita per year). Furthermore, rice consumption increased rapidly in Nigeria (2.3 per cent per year) and Ghana (1.8 percent), the two most populous West African countries. As a result, rice has become an increasingly important source of calories in West Africa. Rice is thus an important product for addressing food insecurity in the region. Rice output in West Africa has risen significantly since independence (He & Sakurai, 2019).

Rice production in West Africa has steadily increased from approximately 2.2 million tons in 1962 to 12.7 million tons in 2018 (USDA, 2019). West Africa produced an average of 10.1 million tons of rice per year from 2009 to 2019, accounting for 65.6 per cent of overall Sub-Saharan African production (Soullier, Demont, Arouna, Lançon & Mendez del Villar, 2020). Furthermore, rice output is increasing. Rice output has grown at a 10.1 per cent yearly rate during the last decade. Nigeria, Senegal, Mali, Ghana, and Côte d'Ivoire contributed the most to this growth, with annual production increasing by 9.1 per cent to 19.4 per cent. This rise was driven by an increase

in rice plantings (7.5 per cent per year). On the contrary, yield gains did not contribute significantly to increased production due to poor adoption of improved varieties and a scarcity of high-quality seeds, low use of inputs and low adoption of good agricultural practices (Arouna et al., 2017). However, West Africa faces a structural rice deficit, and the region increasingly relies on imports. The share of imported rice in total consumption increased from 20% in the 1960s to 46% in 2009 (USDA, 2019).

Soullier et al. (2020) examined the evidence of rice millers' post-crisis investment in semi-industrial and industrial milling technology, contract farming, and vertical integration from 2009 to 2019. According to their findings, upgrading is more dynamic in nations with high rice production and import bills, as well as a limited comparative advantage in demand. However, scaling up is fraught with difficulties in terms of vertical coordination, technology, financing, and policies (Soullier et al., 2020).

Rice production interventions in Ghana

The Government of Ghana for the past years has made a conscious effort to promote rice production to address food security and poverty reduction through National Policies, Strategies and Initiatives as captured in Food and Agricultural Sector Development Policies I & II (FASDEP I & II). Given the importance of rice to food security and livelihood improvement in Ghana, the Ghanaian government has made a concerted effort to increase domestic rice output through collaboration with international, regional, and national partners. Firstly, the Ministry of Food and Agriculture has facilitated the revision of the National Rice Development Strategy (NRDS) to reach self-sufficiency by 2024 to secure the sustainability and complete development of

the rice crop. The NRDS is intended to function as a reference for all projects and interventions in Ghana's rice industry.

Again, the Ministry of Food and Agriculture and the United Nations Industrial Development Organization (UNIDO) have collaborated to develop a project titled "Improving the Technology and Quality Control System for Higher Addition in Post-Harvest Processes of Rice Value Chain" to address some of the teething problems that impede the smooth operation of the post-harvest portion of the rice value chain.

Furthermore, The Government, through its current flagship programme “Planting for Food and Jobs” (PFJ) Campaign, which takes its roots from “Investing for Food and Jobs”, has rice as one of the focus crops which is being promoted. The overall objective of the “Planting for Food and Jobs” campaign being implemented by the Ministry of Food and Agriculture, is to provide enough food and employment to the jobless. To ensure that the Campaign succeeds, the programme is anchored on five pillars, an approach that is new, inclusive and holistic.

1. the provision of subsidized improved seeds to farmers,
2. supply of subsidized fertilizers to farmers,
3. provision of dedicated extension services,
4. marketing strategy to mop up produce and the infusion of
5. electronic platform in undertaking all activities in food and agriculture (e-Agriculture)

To emphasize the importance of rice in the National economy, the government also introduced the Special Rice Initiative which sought to bring improved rice seeds to farmers at the district level (MoFA, 2022).

The role of agricultural extension services

Agricultural extension delivery services have been linked to increased agricultural production and farmer livelihoods all over the world. In general, agricultural extension is the primary channel for the spread of knowledge on-farm technology, rural adult learning, and the development of farmers' farm technical and managerial skills in nations that rely largely on agriculture for economic prosperity. This increases the demand for agricultural extension program delivery because it is intended to improve farmers' livelihoods by improving farm productivity and revenue while reducing poverty and food insecurity (Danso-Abbeam et al., 2018).

Agricultural extension plays a major role in promoting agricultural productivity, increasing food security, improving rural livelihoods, and promoting agriculture as an engine of economic growth (Dasaba et al., 2019). Additionally, it supports and motivates farmers to increase/improve agricultural production and the livelihoods of a nation by enhancing the efficiency of adoption techniques by the farmers (Maponya & Mpandeli, 2013).

Food and Agriculture Organization (FAO) (2010) defines extension as "systems that should facilitate the access of farmers, their organizations and other market actors to knowledge, information and technologies; facilitate their interaction with partners in research, education, agribusiness, and other relevant institutions; and assist them to develop their own technical, organizational and management skills and practices". According to this definition, an extension is an important tool for ensuring the effectiveness of agricultural activities as well as other economic activities to improve people's

ability to meet their needs. Extension is also a policy tool used to increase agricultural product safety and quality. Agricultural extension is widely recognized as an important component of technology transfer because it primarily strives to improve farmers' knowledge of rural development. Agricultural extension is thus an important factor for boosting development, as it plays a significant role in agricultural and rural development efforts (Bonye et al., 2012).

Scholars, such as Bonye et al. (2012) strongly believe that extension serves as a source of information for farming communities. It informs these communities about new technology that, if implemented, can improve farmers' produce, income, and standard of living. Agricultural extension service providers convey innovations to farm households as their mode of operation, and they also stimulate adoption rates, manage change, and strive to sustain diffusion by preventing those who attempt to halt the diffusion process (Alemu et al., 2016). Extension officers reach out to farmers through demonstrations of new technologies, focusing mostly on early adopters because laggards frequently learn from early adopters. Extension officers assist in the identification of problems and the conduct of further research into those problems for policy guidance.

According to Swanson (2008), extension service encompasses general community development by developing human and social capital, improving skills and knowledge for production and processing, facilitating access to markets and trade, organizing farmers and producer groups, and working with farmers to achieve sustainable natural resource management.

Farmer-based organisations (FBOs) and their influence on the adoption of agricultural technologies and farmers' welfare

Farmers in groups, known as Farmer-based organizations (FBOs), have been identified as important channels for information and technology dissemination to farmers. The effect of these groups on the adoption decisions of farmers has important implications for agricultural production and welfare outcomes in many developing countries (Ahmed, 2019). The terms farmer groups, farmers' associations, farmers' cooperatives and farmers' societies can be used interchangeably (Asante et al., 2011; Nakazi et al., 2017) and it refers to a group of farmers with a common interest who share experience to enhance their common objective (s). From a layman's perspective, a farmer-based organization is an organization owned and controlled by the members (farmers) and aimed at providing services for the mutual benefit of all its members.

Several organizations, including governmental and non-governmental, support the development of FBOs in Africa on the premise that FBOs enhance access to credit, extension services, marketing of produce and farm inputs (Barham & Chitemi, 2009; Bernard et al., 2008; Bernard & Spielman, 2009). Ahmed (2019) points out that many governments encourage the establishment of FBOs to enhance poverty reduction and promote economic growth, improve rural access to extension delivery and credit as well the to enhance the welfare of farmers. One key expectation from farmer groups is to facilitate the adoption of improved agricultural technologies which in turn is expected to increase agricultural productivity, commercialization and market access (MAAIF, 2010) as cited in (Ahmed, 2019).

Empirical Review

This section reviews fundings of previous studies that related to the current study. Specifically, literature was reviewd on topics such as impacts of projects of livelivehoods, perceived effectiveness of agricultural interventions among beneficiaries, relationship between perceived effectiveness and adoption of agricultural interventions and the effects of participation on the intensity of adoption of programme technologies. Other topics covered under the empirical review include effect of agricultural programme interventions on participnts' (farmers') KASA and their impact on the intensity of adoption of agricultural interventions, relationship between the socio-demographic characteristics of farmers and the intensity of adoption of agricultural interventions, relationship between perceived project effectiveness and project impact, relationship between KASA and perceived project effectiveness and rice training interventions and their effects on farmers' livelihoods. Furthermore, the intensity of adoption of agricultural technologies, perceived technology attributes that influence the intensity of adoption of agricultural technologies, factors influencing the adoption intensity of agricultural technologies and effect of FBOs on the intensity of adoption of agricultural technologies and farmers' welfare were also reviewed as emprirical literature for the study.

Impact of projects on livelihood

Projects have been used widely as a means of improving well-being, reducing poverty and improving the 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-bum activities that were widely practised in the states of Chiapas and Oaxaca from where the project's 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 a high tendency 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, a significant direct improvement in farm family livelihoods of the beneficiaries was made according to Pariyar et al, (2005). After participating in the initiative, their revenue increased, their production costs decreased, their animal rearing skills and animal health improved, and their general well-being improved. This progress was made possible because the beneficiaries were eager to participate and were actively involved in the planning and execution of the project, which captured their requirements. This reveals that programmes and improved access to new skills, tools, and services, can assist the rural poor in making long-term changes in their livelihoods.

Similarly, Boris et al. (2006) found that participants had considerably higher yields and farm prices, net income, and general livelihood capabilities than control-site farmers. This implied that the project's activities, technology package, and interventions had a considerable positive impact on the net returns of project-site farmers. Guijt and Woodhill (2002) in their 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 relief to beneficiaries while enhancing the technical capacities and livelihoods of both beneficiaries and project implementers, as presented in Table 1.

Table 1: Contributions of categories agricultural projects to food security and poverty reduction

Categories	Provision of private goods and services	Provision of goods and services with externalities
Direct impact	▪ Food production ▪ Income generation ▪ Employment opportunities	▪ Poverty alleviation within households ▪ Food security within households
Indirect impact	▪ Surplus labour provision ▪ Savings for investment ▪ The market for industrial goods ▪ Export earnings ▪ Raw materials for agro-processing industries	▪ Poverty alleviation (spillover) ▪ Food security (spillover) ▪ Environmental externalities ▪ Out-migration control ▪ Buffer in times of economic shocks ▪ Culture Formation

Source: Guijt and Woodhill (2002).

Concerning the impact of agricultural programmes on all five livelihoods, Mariyono (2018) discovered that farmers who participated in the Farmers' Field School for vegetable production indicated highly favourable

impacts on all five categories of livelihood assets. Similarly, Ngoma (2018) found that farmers' partial adoption of minimum tillage resulted in an average yield gain for maize, groundnut, sunflower, soybean, and cotton, despite having no significant effects on crop income (from sales and for subsistence) of households in the short term. Ngoma (2018) attributed the insignificant income gains to the partial adoption of the technology by farmers in the short term. According to the literature, agricultural projects have a significant positive impact on the livelihoods of farmers who participate in them; consequently, such projects must be implemented regularly, and farmers must be encouraged to join to enhance their livelihood.

Perceived effectiveness of agricultural interventions among beneficiaries

The perceived effectiveness of projects or interventions is an important characteristic that programme evaluators or implementors look at to determine the impact and extent to which projects have achieved their intended goals. This is most commonly used in agricultural project evaluation because it informs agricultural programme donors about the impact their contributions have on the lives of project participants. As a result, researchers from numerous disciplines have been analysing programmes and interventions. Because agricultural techniques are typically packaged, researchers are most interested in knowing which components of the projects achieved the desired outcome from the perspective of the participants. Donkoh et al. (2019) assessed the perceived success of agricultural technology transfer strategies used in Northern Ghana, and find that demonstration, farmer-to-farmer, and household extension methods were the most effective.

Fischer and Vasseur, (2002) investigated smallholder farmers' opinions of agroforestry projects in Panama and discovered that, in terms of environmental implications, farmers' responses indicated a slight decrease in slash-and-burn agriculture and an increase in tree-planting activities. Farmers also reported certain environmental benefits, such as reduced soil erosion, enhanced soil fertility, and improved quality and quantity of water supplies. Similarly, Warriach et al. (2018) discovered that increased extension services led to increases in milk output, improvements in animal health (body condition and morbidity), and labour efficiency (time savings) among farmers.

However, the perception of farmers about agricultural programmes is not always positive. Maake and Antwi (2022) found that public extension and advisory services in Gauteng were perceived as ineffective by farmers, with Three socio-education levels, age and farm/plot size significantly influencing farmers' perceptions towards public extension and advisory services. In implication, there are mixed results regarding the perception of farmers about the effectiveness of agricultural programmes.

Relationship between perceived effectiveness and adoption of agricultural interventions

The effectiveness of an agricultural intervention is the degree to which the intervention is regarded to be able to achieve its goal. It represents the perception that farmers, in particular, have of the technology or intervention that they have used. The perceived effectiveness of a technology is viewed as a primary motivator for farmers to adopt the technology. For example, Aphunu and Otoikhian (2021) found a significant association between the effectiveness of extension agents and the adoption of technologies by farmers.

Similarly, Azumah et al. (2018) discovered that more than 50% of farmers adopted improved production techniques as a result of their perception (effectiveness) of the technologies. The literature suggests that farmers' perception of technology plays a major role in their decision to adopt a technology.

Effect of participation on the intensity of adoption of programme technologies

Participation in the agricultural programme is believed to improve the adoption of the programme's practices (Uduji & Okolo-Obasi, 2018). Participation, according to Nwankwo, Peters and Bokelmann (2009), is a key factor that determines the adoption of project activities. Wollni, Lee and Thies (2009) found that participating in organic markets and farmer-based organizations has a positive effect on the number of soil conservation methods employed (adoption intensity) on the farm among small-scale farmers in Honduras. Amadu, McNamara and Miller (2020) investigated the adoption of climate-smart agriculture in southern Malawi and discovered that programme participation had a positive and statistically significant effect on the adoption of climate-smart agricultural practices.

Thompson and Sinha (2008) found that higher levels of brand community participation improve the likelihood of a new product being adopted. Posthumus, Gardebroek and Ruben (2010) examined how participation influenced farmers' decisions to adopt soil conservation methods. They discovered that participation has a strong causal effect on soil conservation practice adoption. In agreement, Kumar, et al. (2020) maintain that participation in agricultural training and farm visits significantly increases

the adoption of improved technologies and practices. Abdallah et al., (2021) also revealed that farmers' participation in the Planting for Food and Jobs enhanced their adoption of practices to improve productivity which in turn resulted in a positive influence on maize commercialization. Amadu, Miller and McNamara (2020) found a positive and statistically significant yield effect of CSA program participation and the intensity of agroforestry fertilizer trees: maize yields increased, on average, by 20% for participation. The rice farmers' participation in the SDRLRP project is therefore expected to positively influence the intensity of adoption of the SDRLRP project technologies.

Effect of agricultural programme interventions on participants' (farmers') KASA, and their impact on the intensity adoption of agricultural interventions

Agricultural programmes are generally implemented to expose farmers to technologies that can increase productivity and income. Programme packages are expected to cause a positive change in the knowledge, attitude, skills and aspirations (KASA) of the farmers to facilitate their adoption of the practices enshrined in the intervention. One important role agricultural programmes play in enhancing KASA change in farmers is that it opens up the mind of farmers about modern technology and changes in the external world and their relevance to their farming and life in general (Fu & Akter, 2016). Meena and Singh (2019) confirmed this assumption when they observed in their study to determine the impact of training for efficient water management in agriculture, a significant change in acquiring knowledge, developing

participatory skills, changing attitudes and fulfilling aspirations towards scaling-up up water productivity in agriculture.

To investigate the effect of programme interventions on KASA, Fu and Akter (2016) asked the farmers who had participated in the KHETI project (a system that comprises village assistants called *Munnas* who use smartphones to create Short Dialogue Strips (SDSs) to facilitate communication between small/marginal farmers and agricultural experts) two questions: first, "whether they think that their exposure to and experience of the use of KHETI would make them try more new technology for agricultural production" and second, "whether they think the experience of using KHETI make you [farmers] try more new technology and new ways of life in the future". The researchers indicated that about 99.4% of the farmers replied 'yes' to the first question and 99.1% replied 'yes' to the second question.

It has been discovered that change in farmers' KASA affects the adoption of agricultural programme practices. For example, Karki and Karki (2019) found out that agricultural educational events increase the acquired knowledge and skills, attitude and behaviour of farmers, and that this change has a positive impact on, technology adoption. Similarly, Gerbi and Megerssa (2020) observed that knowledge has a significant and positive relationship with the adoption of agricultural programmes. This informed their conclusion that an increase in farmers' knowledge favours their adoption. additionally, Chuang, Wang and Liou (2020) indicated that knowledge and attitude are positively associated with the adoption of agricultural interventions and significantly influence the same.

Aspirations impact economic behaviour, as well as political and societal engagement, according to Nandi and Nedumaran (2021). As a result, they could have a big impact on agricultural output, livelihoods, and rural welfare. Aspirations play a role in influencing short and medium-term decisions and can have a significant impact on technology adoption (Mausch, Harris, Heather, Jones, Yim & Hauser, 2018).

The literature suggests that programme implementation causes a positive KASA change in farmers and this change is significantly and positively associated with the adoption of agricultural interventions.

Relationship between the sociodemographic characteristics of farmers and the intensity of adoption of agricultural interventions

Socio-demographic variables are often included in adoption studies. Arslan (2020) identified eleven (11) determinants that are positively related to the adoption of improved agricultural practices. Four of these relate to policy tools (access to extension, access to information, farmer group participation, access to credit); five are related to wealth (land size, livestock assets, off-farm income, overall income and wealth index); one is exposed to high temperatures, and the final one is secure land tenure. Education, income, and the social category of farmers are regarded as important sociodemographic factors that affect adoption (Ali, 2012).

Education is expected to positively influence technology adoption because new technologies require an understanding of the expected returns from new technology. However, there is no consensus among scholars on its effect on the adoption of agricultural interventions, as varied observations have been made by scholars. Caffaro and Cavallo, (2019) reported a

significantly negative effect of education on the adoption of agricultural interventions, while Filippini, Marescotti, Demartini and Gaviglio (2020) found no significant association between farmers' educational level and their adoption of smartphone use.

With regards to age, it is expected to negatively relate to adoption, because younger farmers are hypothesized to be more innovative and risk-taking; however, older farmers may adopt some technologies faster if the technology is labour-saving and the household is labour constrained or if it is a modified version of a traditional practice they have experienced. household size is expected to increase adoption, as it is used as a proxy for labour availability in places with labour market imperfections, though the exact effect depends on whether the technology is labour saving or increases labour needs (Huffman, 2020).

The sex of farmers has no significant influence on adoption (Filippini et al., 2020) whereas farm size is positively associated with the adoption of agricultural interventions (Caffaro & Cavallo, 2019). Group membership has differing effects on the adoption of agricultural interventions. For example, Mwaura (2014) discovered that members who belonged to a group were less likely to adopt improved maize seeds than those who did not belong to a group.

Relationship between perceived project effectiveness and project impact

Findings show that farmers' positive perceptions were positively correlated with higher maize yields. Farmers' positive perceptions significantly increased the likelihood of a farmer adopting no-till CA (Ntshangase, Muroyiwa & Sibanda, 2018).

Relationship between KASA and perceived project effectiveness

Farmers' knowledge of agricultural technologies is positively associated with their perception of project effectiveness (Pan, Smith & Sulaiman, 2018). Somanje, Mohan and Saito (2021) point out that farmers' knowledge directly influences how they perceive the effectiveness of agricultural interventions.

Rice training interventions and effects on rice farmers' livelihood

Agriculture is predominantly a rural phenomenon and characteristically small-scale in production in most developing countries including Ghana (Anang & Awuni, 2018). However, it is established that the majority of small-scale arable crop producers in many developing countries including Ghana demonstrate low technical know-how which has impeded agricultural production in these countries (Wiggins, 2000).

Training is a human capital variable that human capital theory stipulates enhances the skills of individuals, which contributes positively to output and productivity (Lucas, 1993). In addition, human capital accumulation leads to sustained long-term economic growth. Several empirical studies reveal the positive effects of education and training on productivity growth. In comparison with education in general, training has additional benefits that are more obvious (Ismail et al., 2011) Anang and Awini (2018). Training instils specific skills and competencies that translate into higher business productivity.

The role of human capital in promoting productivity growth has attracted researchers since the middle of the twentieth century, and improving human capital is positively associated with productivity enhancement in all

sectors of production (Girgin, 2011 in Anang & Awuni, 2018). This has resulted in a greater emphasis placed on quality education, training and extension advice to producers all over the world. Existing literature, for example, (Anang & Awuni, 2018; Pardey et al., 1992; Rosegrant & Evenson, 1992) also supports that an increment in productivity can be a product of investment in human capital.

Human capital is defined as either formal or informal training and education that enhances business productivity and output by promoting economic growth. Research into firm operation points out that human capital variables such as education, extension, training and technology require much investment. By affecting how resources are utilized and combined by farmers, human capital directly influences farmers' productivity. It also affects how information is acquired and implemented as well as producers' ability to adapt to new technologies. This implies that endeavouring to improve human capital through education, access to information and training is essential for enhancing productivity (Anang & Awuni, 2018).

Existing literature establishes evidence of the role of training in enhancing productivity. For instance, Colombo and Stanca (2014) studied the impact of training on productivity and found that training had a positive and significant impact on productivity. In their study to examine the impact of training on technology adoption and productivity of rice farming in Tanzania, Nakano et al. (2015) observed that training enhanced the adoption of improved varieties and farmers' yield. Another study by Gautam et al. (2017) examined the impact of training vegetable farmers in integrated pest management in Bangladesh and found that garden egg farmers who received training achieved

higher crop yield and gross margin. Further, Wordofa and Sassi (2018) found in their study on the impact of Farmers' Training Centres in Eastern Ethiopia that there was a significant average gain in farm income by participants who received training.

The intensity of adoption of agricultural technologies

Some studies have determined the intensity of adoption of agricultural programmes implemented in different parts of the world to demonstrate how many project participants still use agricultural technologies after they are transferred to farmers. These studies have found that although it is usually not likely to find all project participants using the technologies after the end of the project, quite an appreciable number of the participants practice either all, the majority or a good number of the project technologies. For example, in East Africa, Ochieng et al. (2019) measured the level of adoption of improved amaranth varieties and good farming practices. According to Ochieng et al. (2019), 37 per cent of Kenyan farmers and 10% of Tanzanian farmers used certified amaranth seed, 88 per cent of Kenyan farmers and 85 per cent of Tanzanian farmers used seedbed preparation (the most widely used technology), 21% of Tanzanian farmers and 59 per cent of Kenyan farmers used line sowing (which was much lower), and about half of the farmers applied compost or used basal fertilizer dressings, with 45 per cent applying a top dressing and 7% applying a top dressing. Simple irrigation techniques such as watering cans were used by 46 per cent of Kenyan farmers and 96 per cent of Tanzanian farmers; nursery practices and transplanting were used by 26 per cent of Tanzanian farmers and 36 per cent of Kenyan farmers. Chemical insecticides, fungicides, and biopesticides were used by 18 per cent of Kenyan

farmers and 18 per cent of Tanzanian farmers (16 per cent in Tanzania and 35 per cent in Kenya).

Kimaru-Muchai, Ngetich, Baaru and Mucheru-Muna (2020) discovered that overall, all (100%) of the farmers adopted the Zai pits for improved farm productivity while Vecchio, Agnusdei, Miglietta, and Capitanio (2020) noted that 28.7% of the respondents adopt PF technologies. This indicates that there is a greater variation in the overall adoption intensity among farmers who participate in agricultural interventions. Out of the farmers who adopted the Zai pits, animal dung was used as a soil fertility amendment by 95% of the farmers who had adopted Zai pits. Only 2.1 per cent of farmers used a combination of animal dung and mineral fertilizer as an input. At least 17.1% of farmers used Zai pits in conjunction with green manure, while just 4.3 per cent used mineral fertilizer only in Zai pits. A combination of animal manure and crop residue was also used 27.9% of the time.

Kumar, Takeshima, Thapa, Adhikari, Saroj, Karkee and Joshi (2020) found that cultural practices were adopted by 56 per cent of beneficiary households, soil fertility management by 37 per cent, and irrigation management by 24 per cent in their study of the adoption and diffusion of improved technologies and production practices in agriculture. Less than 15% of the beneficiaries embraced the remaining technology. Raised bed lines (26 per cent), improved nurseries (26 per cent), crop staking (20 per cent), integrated pest management practices (14 per cent), terrace and land improvements (14 per cent), soil solarization (13 per cent), and crop mulching were among the farming practices adopted by more than 10% of the

beneficiary households (13 per cent). Beneficiary households had improved their farming methods in general. Vecchio, Agnusdei, Miglietta, and Capitanio (2020) also noted that 28.7% of the respondents adopt PF technologies.

Perceived technology attributes that influence the intensity of adoption of technology

The diffusion of innovation theory by Rogers (1983) identifies five (5) attributes or characteristics of an innovation that affect the likelihood of its adoption namely: (a) relative advantage (usefulness), (b) compatibility, (c) complexity, (d) trialability, and (e) observability.

Relative advantage: It is the degree to which an innovation is perceived as being better than the existing ones. The degree of relative advantage is mostly expressed in economic profitability and social prestige. The nature of the innovation determines what specific type of relative advantage (economic or social,) is important to adopters. The initial cost of innovation may affect its rate of adoption since it can affect the profit levels of farmers (Rogers, 2004).

Compatibility: According to Rogers (2004), compatibility is the degree to which an innovation or technology is perceived as consistent with the existing values, past experiences, and needs of potential adopters. If innovation is more compatible, the uncertainty of its adoption is less because it fits more closely with the individual's situation. Innovation can be compatible or incompatible with (1) socio-cultural values and beliefs, (2) previously introduced ideas, and/or (3) client needs for the innovation. The more innovation is incompatible with existing deeply embedded cultural values, the less its adoption. Also, the compatibility of innovation with preceding ones can either speed up or retard its rate of adoption. Rogers (2004) opined that old and

existing ideas are the main mental tools that clients use to assess new ideas and give them meaning. Hence, previous practices serve as standards or benchmarks against which innovation is interpreted. Therefore, a positive experience with one innovation can lead to more adoption while a negative experience with one innovation can prevent the adoption of future innovations (Innovation negativism). *Innovation negativism* is the degree to which an innovation's failure conditions a potential adopter to reject future innovations (Rogers, 2004). However, Rogers (2004) cautioned that a positive experience parse does not necessarily lead to an increase in the potential adoption of new technologies. Sometimes**,** the perceived compatibility of the new idea with previous experience can lead to the adopters utilizing the innovations incorrectly. Another dimension of incompatibility is the degree to which an innovation is perceived as meeting the felt needs of potential adopters. The emphasis is on 'felt needs' since potential adopters may not recognize that they have a need for an innovation until they become aware of it or its consequences. The more an innovation meets the felt needs of potential adopters, the faster its rate of adoption (Rogers, 2004).

Complexity (ease of use): According to Rogers (2004), is the degree to which an innovation is perceived by potential adopters as relatively difficult or simple to understand and use compared to the existing ones. Perceived ease of use means the degree to which a farmer believes that the use of, for example, SDRLRP technologies would be free from effort. Hence, innovation can be classified on the complexity-simplicity continuum. The complexity of innovation, as perceived by adopters, is negatively related to its rate of adoption. Rogers (2004), however, noted that the complexity of innovation,

though important for adoption, may not be as important as a relative advantage or compatibility for many innovations.

Trialability: It is the degree to which an innovation may be experimented with or tried on a limited basis. Innovations that can be tried on a limited basis are likely to be adopted more rapidly than innovations that are not divisible. Trying innovation helps potential adopters to see how it works under the context and conditions of the individual adopter. The trialability of innovation, as perceived by the farmers, is positively related to its rate of adoption. However, trying an innovation may result in re-inventing – customizing it more closely to the individual's adopter needs which can be positive or negative to the adoption and use of the original technology (Rogers, 2004).

Observability: It is the degree to which the results of an innovation are visible to others. Some ideas are easily observed and communicated to other people, whereas other innovations are difficult to observe or describe to others. Moore and Benbasat (1991), however, demonstrated that observability could be divided into two different constructs: results demonstration and visibility. According to Rogers (2004), the observability of innovation, as perceived by potential adopters, is positively related to its rate of adoption.

Factors influencing the intensity of adoption of agricultural technologies

There is a wealth of information available on the factors that influence agricultural technology adoption. This information reveals a host of variables that influence the adoption of technologies. These variables range from socio-economic variables (e.g. age, education, marital status), wealth indicators – some of which can be a proxy for risk aversion – (e.g. land holding size, income, asset holdings/values) and agro-ecological variables (e.g. plot slope,

soil quality, rainfall, temperature, location controls), to variables capturing market imperfections (e.g. access to credit, insurance, and information; distance to markets) as well as the influence of social networks (e.g. group membership, number of social connections) (Pannell & Zilberman, 2020).

Farmers' decisions to accept new technology are influenced by the dynamic interaction between the technology's characteristics and a variety of situations and events, according to Loevinsohn et al. (2013). Diffusion is the consequence of a succession of individual decisions to start utilizing new technology, decisions that are frequently the result of a trade-off between the uncertain advantages of the new invention and the uncertain costs of adopting it (Hall & Khan, 2002). Understanding the factors that influence this decision is critical for both economists investigating growth determinants and technology creators and disseminators (Hall & Khan, 2002).

Typically, economic studies of technology adoption have attempted to explain adoption behaviour in terms of personal qualities and endowments, imperfect knowledge, risk, uncertainty, institutional restrictions, input availability, and infrastructure (Feder et al. 1985; Koppel 1994; Foster & Rosenzweig 1996; Kohli & Singh 1997; Rogers, 2003 & Uaiene, 2009) cited in (Mwangi & Kariuki, 2015). Recently, social networks and education have been added as variables influencing technology adoption (Uaiene, 2009). Some studies group these factors into distinct categories. Akudugu et al. (2012), for example, classified the factors that influence agricultural technology adoption into three categories: economic, social, and institutional factors. As referenced by Lavison (2013), Kebede et al. (1990) classified the factors that influence technology adoption into three categories: social,

economic, and physical. This classifies the factors that influence the adoption of agricultural technology into technological, economic, institutional, and household-specific factors to allow for a thorough examination of how each factor affects adoption.

Technology characteristics

A technology's characteristics are a requirement that is a key consideration for its adoption. Trialability, or the ability of a potential user to try something out on a small scale before fully adopting it, is a key factor in technology adoption (Doss, 2003). Mignouna, Manyong, Rusike, Mutabazi and Senkondo (2011) found that the characteristics of the technology played a crucial part in the adoption choice process when researching factors of adopting Imazapyr-Resistant maize (IRM) technology in Western Kenya. Farmers who believe the technology is compatible with their needs and compatible with their surroundings are more inclined to accept it because they see it as a good investment. Farmers' perceptions of the technologies' performance have a considerable impact on their decision to embrace them. Farmers' perceptions of current rice variety characteristics influenced their decision to adopt it, according to a study by Adesina and Zinnah (1993). Wandji et al. (2012) cited in Mwangi and Kariuki (2015) found a similar result while researching farmers' attitudes toward aquaculture technology adoption in Cameroon. According to their findings, farmers' attitudes toward fish farming aided adoption. This review reveals that technology characteristic is an important factor considered by farmers before adopting any agricultural technology. As a result, before any new technology is introduced to farmers,

they must be involved in it to enhance their adoption or otherwise, of such technologies.

Household-specific factors

The human capital of the farmer is assumed to have a significant influence on farmers' decisions to adopt new technologies. Most adoption studies have attempted to measure human capital through the farmer's education, age, gender, and household size (Fernandez-Cornejo, Beach & Huang, 1994, 2007; Keelan, Thorne, Flanagan, Newman & Mullins, 2009; Mignouna et al., 2011). Education of the farmer has been assumed to have a positive influence on farmers' decision to adopt new technology. The education level of a farmer increases his ability to obtain, process and use information relevant to the adoption of new technology (Mignouna et al., 2011). For instance, a study by Okunlola, Oludare and Akinwalere (2011) on the adoption of new technologies by fish farmers and Ajewole (2010) on the adoption of organic fertilizers found that the level of education had a positive and significant influence on the adoption of the technology. This is because higher education influences respondents' attitudes and thoughts making them more open, rational and able to analyse the benefits of the new technology (Waller, Hoy, Henderson, Stinner & Welty, 1998). This eases the introduction of an innovation which ultimately affects the adoption process (Adebiyi & Okunlola, 2013).

Other studies that have reported a positive relationship between education and adoption as cited by Uematsu and Mishra (2010) include; Goodwin and Schroeder (1994) on forwarding pricing methods, Huffman and Mercier (1991); Putler and Zilberman (1988) on the adoption of

microcomputers in agriculture, Mishra and Park (2005); Mishra et al. (2009) on use of the internet, Rahm and Huffman (1984) on reduced tillage, Roberts et al. (2004) on precision farming and Traore, et al. (1998) on on-farm adoption of conservation tillage. On the other hand, some authors have reported insignificant or negative effect of education on the rate of technology adoption (Khanna, 2001; Samiee, Rezvanfar & Faham, 2009). Studying the effect of education on technology adoption, Uematsu and Mishra (2010) reported a negative influence of formal education towards adopting genetically modified crops. The above empirical evidence has shown mixed results on the influence of education and adoption of new technology.

Age is also assumed to be a determinant of the adoption of new technology. Older farmers are assumed to have gained knowledge and experience over time and are better able to evaluate technical information than younger farmers (Mignouna et al, 2011; Kariyasa and Dewi 2011). On the contrary, age has been found to have a negative relationship with the adoption of technology. This relationship is explained by Mauceri et al. (2005) and Adesina that as farmers grow older, there is an increase in risk aversion and a decreased interest in long-term investment in the farm. On the other hand, younger farmers are typically less risk-averse and are more willing to try new technologies. For instance, Alexander and Van Mellor (2005) found that the adoption of genetically modified maize increased with age for younger farmers as they gain experience and increase their stock of human capital but declines with age for those farmers closer to retirement.

Gender issues in agricultural technology adoption have been investigated for a long time and most studies have reported mixed evidence regarding the different roles men and women play in technology adoption (BonabanaWabbi 2002). In analysing the impact of gender on technology adoption, Morris and Doss (1999) found no significant association between gender and the probability to adopt improved maize in Ghana. Morris and Doss concluded that technology adoption decisions depend primarily on access to resources, rather than on gender and if the adoption of improved maize depends on access to land, labour, or other resources, and if in a particular context, men tend to have better access to these resources than women, then in that context, the technologies will not benefit men and women equally. On the other hand, gender may have a significant influence on some technologies. Gender affects technology adoption since the head of the household is the primary decision-maker and men have more access to and control over vital production resources than women due to sociocultural values and norms (Mignouna et al., 2011). For instance, a study by Obisesan (2014) on the adoption of technology found that gender had a significant and positive influence on the adoption of improved cassava production in Nigeria. His result concurred with that of Lavison (2013) which revealed that male farmers were more likely to adopt organic fertilizer, unlike their female counterparts. Household size is simply used as a measure of labour availability. It determines the adoption process in that, a larger household can relax the labor constraints required during the introduction of new technology (Mignouna et al, 2011).

Experience is another farmer characteristic that plays a crucial role in farmers' retention or disadoption of agricultural technologies. When farmers are in the process of testing the technologies' effectiveness and benefits over time, their experience with the technology can influence their decision to retain the technologies or discontinue them. A study by Ainembabazi and Mugisha (2014) found an inverted-U relationship between the adoption of and experience with agricultural technologies in banana, coffee and maize. This suggests that farming experience is useful in the early stages of adoption of a given technology when farmers are still testing its potential benefits, which later determine its retention or disadoption over time.

Farm size is critical in agricultural economic systems. Real-world research reveals that in most countries, suitable farm size is the key to sustainable agriculture and that increasing farm size in the early phases of development is critical to swift economic growth, poverty reduction, and rural development (Timmer, 2015). This has been true for developed European and North American countries, (Timmer, 2015), as well as Japan and East Asian growing economies (Hayami & Ruttan, 1971) For example, Hu et al. (2022) found that farmers with larger farms are more willing to adopt new technologies, spend more time and money in the pursuit of agricultural knowledge, and pay more attention to productive technology rather than processing technology.

Effects of FBOs on the intensity of adoption of agricultural technologies and farmers' welfare

Several studies have been conducted to evaluate the impact of FBOs on crop productivity worldwide. These studies have resulted in two streams of

findings; one stream suggests a positive impact of FBOs on crop production whereas the other portrays a negative effect on crop productivity (Benin et al., 2011; K. Davis et al., 2012; Mwaura, 2014). Debela et al. (2018), for instance, observed that farmers' cooperatives enhanced the income and productivity of smallholder farmers in Eastern Oromia, Ethiopia. When farmer-based organizations receive adequate resources and incentives, they benefit the members. Such benefits can include access to services and input delivery which in turn result in improved farm performance and profitability.

Although farmer groups may provide all the aforementioned benefits among others, they may also deviate from their core mandate and result in less effectiveness if members put on free-riding behaviour. Also, when politics increases, FBOs may have reduced effectiveness due to political influences, favouritism, and cronyism (Ahmed, 2019).

Conceptual Framework based on empirical review

The Conceptual Framework used to analyse the impact of the SDRLRP project on the livelihoods of rice farmers in the Northern and Ashanti regions of Ghana is presented in Figure 6. The Conceptual Framework was constructed by the author after a theoretical review of the theory of change and diffusion of innovation, concepts and empirical research outputs of studies related to the objectives of the study.

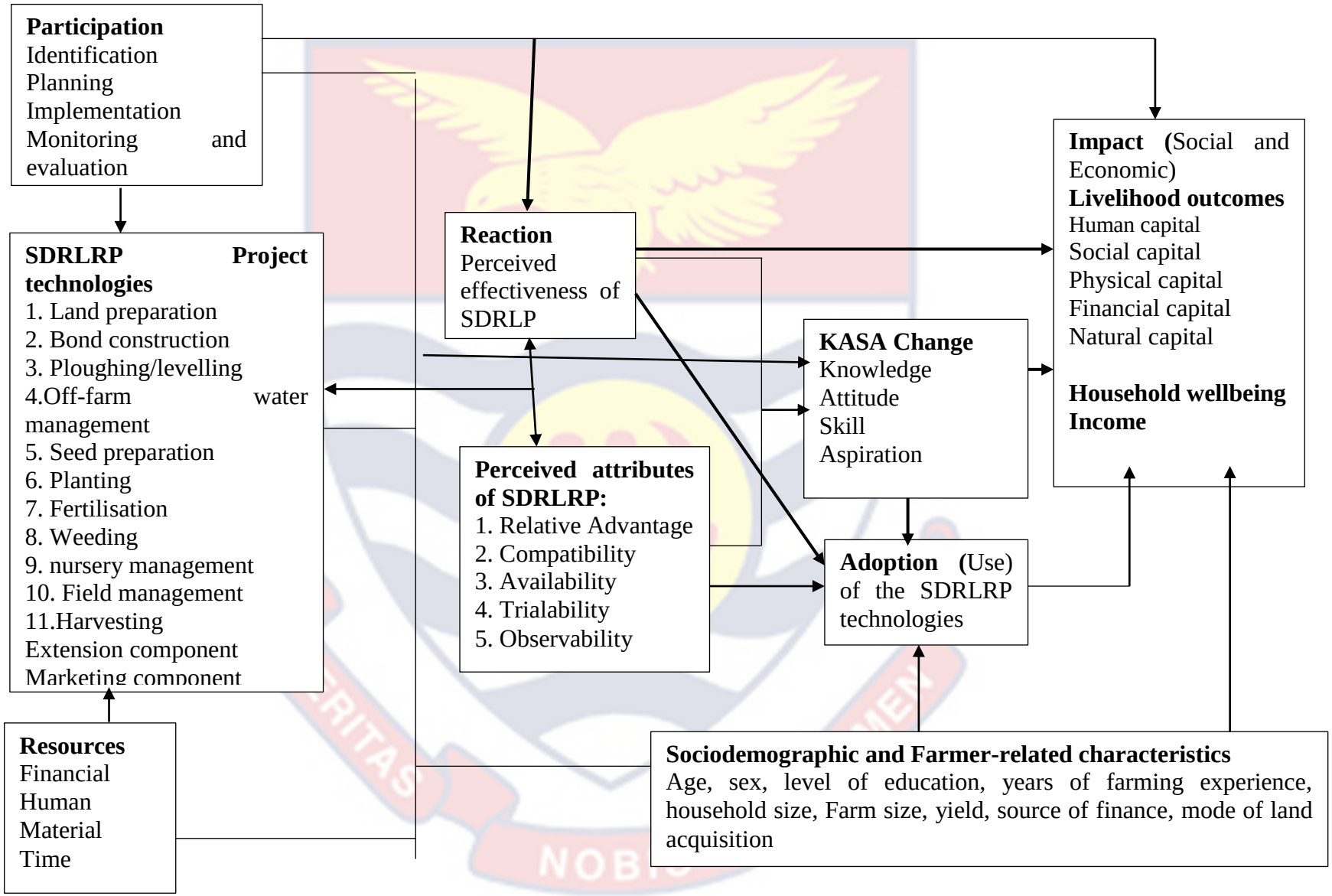

Figure 6: Conceptual Framework for Impact of SDRLRP Project on Rice Farmers' Livelihood Source: Author's construct (2021)

The resources, activities of the project and the participation of the beneficiaries in the problem identification, planning, implementation and monitoring and evaluation are key to forming the bases of the reaction, beneficiaries' KASA and adoption of the technologies. Resources such as experts, project beneficiaries, funds, machinery and equipment are used to implement the project activities. Beneficiaries participate in the project cycle which comprises problem identification, planning of the project, implementation of the project and monitoring and evaluation of the project, as depicted in Figure 6.

The beneficiaries' participation in the project informs their reaction towards the project. Inherent in the beneficiaries' reaction are the perceived effectiveness, that is, whether the activities of the project result in the intended goal. The perceived effectiveness is affected by the perception of the beneficiaries of the attributes of the activities or the technologies of the project. The technology attributes that influence beneficiaries perceived effectiveness of the project activities include the relative advantage of the technologies, compatibility of the technologies with the norms or existing technologies, complexity or ease of use of the technologies disseminated, trialability of the technologies and observability of the technologies (Figure 6).

Relative advantage is the quality of a technology to yield more expected results than the existing technologies known and practised by the beneficiaries. That is, it is the degree to which an innovation is perceived as being better than the existing ones. Compatibility is the degree to which an innovation or technology is perceived as consistent with the existing values, past experiences, and needs of potential adopters. If innovation is more

compatible, the uncertainty of its adoption is less because it aligns well with the individual's situation. Complexity or ease of use represents the degree to which an innovation is perceived by potential adopters as relatively difficult or simple to understand and use compared to the existing ones. Perceived ease of use means the degree to which a farmer believes that the use of, for example, SDRLRP technologies would be free from effort. Trialability is the degree to which an innovation may be experimented with or tried on a limited basis. Innovations that can be tried on a limited basis are likely to be adopted more rapidly than innovations that are not divisible. Observability is the degree to which the results of an innovation are visible to others. Some ideas are easily observed and communicated to other people, whereas other innovations are difficult to observe or describe to others. Viewing from Figure 6, these attributes combine with the perceived effectiveness of beneficiaries to form a reaction towards the SDRLRP technologies.

The reaction and the attributes of the technologies perceived by the farmers affect the KASA. A positive reaction, KASA and perception of beneficiaries of the technologies would lead to the adoption of the technology. However, the adoption of technologies does not depend on only reaction, KASA and perceived technology attributes, but also the participation of beneficiaries in the project and sociodemographic and farm-related characteristics of the farmers. For example, farmers with a high level of education are highly likely to comprehend the information about technologies which will in turn facilitate decision-making on the adoption of the technologies. Again, the farm size determines which technologies to adopt or not. For instance, farmers farming small portions of land may not be interested

in adopting the use of tractors to plough, irrespective of the relative advantage and ease of use of tractors. This is because such technology may not yield high returns on investment, considering the peasant nature of their farms. Conversely, farmers cultivating many hectares of land may easily adopt the tractor usage for the reason that investment may yield good returns. Also, access to extension services or officers is imperative to facilitate technology adoption. extension officers guide farmers to understand and appreciate new technologies and innovations. Through this service, extension officers help reduce the perceived complexity of technologies and provide farmers with the necessary information needed to make informed decisions about the technologies to influence adoption.

The adoption of the technologies is expected to impact the livelihoods of farmers. The impact can be felt in the social, environmental and economic aspects of the farmers' livelihoods and well-being (Figure 6). The livelihoods can be classified as physical, natural, financial, social and human capital as well as well-being. The physical livelihood comprises infrastructure such as roads, markets and so on. Financial capital is the income of farmers. Social capital is concerned with networking. In this case, linking farmers to input dealers and buyers of produce and forming farmer associations are all examples of the social capital impact project technologies are expected to make. Human capital comprises the education the beneficiary receives to become knowledgeable of technology and the ability to apply the technologies. Well-being comprises the farmers' ability to provide household necessities such as being able to afford hospital bills, pay for children's school fees, and maintain house buildings, among others. The adoption of the

SDRLRP technologies, therefore, impacts farmers' livelihood and well-being (Figure 6).

Chapter Summary

The chapter reviewed theories and frameworks to guide the study as well as concepts and empirical research on the objectives of the study. The theories reviewed are the theory of change and the diffusion of innovation theory. Bennett's hierarchy of evidence and sustainable livelihood framework were the frameworks reviewed. The concepts reviewed are adoption, sustainable livelihood, the effect of agricultural extension and farmer-based organisation on the adoption of an agricultural project, agricultural technology, livelihood capitals, measures of adoption, rice production interventions in Ghana, impact evaluation, measurement of adoption, correlation, content analysis and world rice production. The empirical review consisted of the impact of projects on livelihood, the impact of agricultural extension delivery on rice production and farmers' livelihood, the perceived effectiveness of agricultural interventions among beneficiaries, the relationship between perceived effectiveness and adoption of agricultural interventions and the effect of participation in programmes on the adoption of programme practices. The empirical review also included factors influencing the adoption of agricultural technologies, perceived technology attributes that influence technology adoption, level of adoption of agricultural technologies, the relationship between KASA and perceived project effectiveness, rice training intervention and effect on rice farmers' livelihood, the effect of FBOs and on adoption agricultural technologies and farmers' livelihood and the relationship between perceived project effectiveness and impact. The chapter

also contains the conceptual framework constructed by the author based on the theoretical framework, concepts and empirical reviews related to the objectives of the study.

CHAPTER THREE

RESEARCH METHODOLOGY

Introduction

Chapter three describes the procedures and methods used in conducting the study. The chapter includes the research philosophy, the study area, the study population, sampling procedures and techniques, sample size, the method of data collection, data analysis as well as ethical considerations.

Research Philosophy

A research philosophy is a set of beliefs about how data about a phenomenon should be collected, analyzed, and used (Rahi, 2017). According to Willis et al. (2007), a philosophy is defined as a comprehensive belief system, worldview, or framework that guides research and practice in a particular field. Any particular research study, as a systematic inquiry, is supported by specific philosophical assumptions such as the nature of reality (ontology), the type of knowledge that can be generated (epistemology), and a discipline-specific method of generating that knowledge (methodology) (Taylor & Medina, 2011). These philosophical assumptions serve as the foundation of a paradigm. Paradigm refers to "a system of ideas, or world view, used by a community of researchers to generate knowledge. It is a set of assumptions, research strategies and criteria for the rigour that are shared, even taken for granted by that community" (Fossey et al., 2002, p.22). Paradigms shape the nature of research and can be viewed as a distinct method of generating knowledge (Taylor & Medina, 2011). There are four main types of paradigms widely used in conducting research: Positivism, Interpretivism, Advocacy and Pragmatism (Rahi, 2017).

The positivist paradigm holds that true knowledge can be gained through observation and experimentation. Positivists typically use scientific methods to generate knowledge. Positivism is also referred to as the Scientific Method, Empirical Science, Post Positivism, and Quantitative Research (Rahi, 2017). According to Levine et al. (1987), reality remains stable in positivism and can be observed or described objectively.

The interpretive paradigm's proponents believe in a deep understanding of a concept and explore their understanding of the world in which they live. They form subjective interpretations of their experiences or specific objects or things. This paradigm is also known as Constructivism, Social Constructivism, and Qualitative Research. The interpretive belief is that true knowledge can only be obtained through an in-depth interpretation of the subject (Rahi, 2017). Interpretivist research "is guided by the researcher's set of beliefs and feelings about the world and how it should be understood and studied" (Denzin & Lincoln, 2005, p. 22). According to the interpretive paradigm, "knowledge is relative to particular circumstances—historical, temporal, cultural, subjective—and exists in multiple forms as representations of reality (interpretations by individuals)" (Benoliel, 1996, p. 407). Interpretivists recognize that "objective reality can never be captured" and accept multiple meanings and ways of knowing. "I only know it through representations" (Denzin & Lincoln, 2008, p. 5). The interpretive paradigm is primarily concerned with recognizing and narrating the meaning of human experiences and actions (Fossey et al., 2002).

The advocacy and participatory paradigm "holds that research inquiry needs to be intertwined with politics and a political agenda" (Creswell, 2009, p. 9). The term "critical paradigm" is another name for this framework. Advocacy and participatory paradigm emanated from the works of authors such as Fay (1987) and Kemmis and Wilkinson (2002), who argued that the positivist paradigm did not effectively handle social and political issues. To remedy this, the authors emphasized that research must link to social and political issues to address the issues of empowerment, inequality, oppression, dominance, repression, and alienation should be included in this research's agenda which can be contained in the advocacy and participatory paradigm.

Pragmatism addresses the weaknesses of positivism and interpretivism through the use of a mixed-method approach (R. B. Johnson & Onwuegbuzie, 2004). Proponents of pragmatism believe that a mix method approach can yield true knowledge. The approach focuses more on how to address the problem at hand than on the method (Rahi, 2017). According to Tashakkori et al. (1998), researchers who adopt pragmatism employ all approaches to understand the problem of interest and are free to use both quantitative and qualitative approaches. The important thing is to find the best research techniques and procedures to solve the problem statement (Rahi, 2017).

This study is positioned in the pragmatic paradigm. This was informed by the research objectives that required quantitative and qualitative approaches to achieve. The fundamental belief of pragmatism is that researchers must use all approaches appropriate to address the research problem, as opposed to positivism and interpretivism which confine researchers to respective quantitative and qualitative research methodologies.

Research Design

Abutabenjeh and Jaradat (2018) described a research design as an outline that directs the research procedure by indicating how a study progresses from the research purpose to the outcomes. De Vaus (2001) added that research design produces a broad strategy to combine components of a study logically and coherently. Furthermore, the research design determines how data are collected, measured, and analysed, and most importantly provides clear guidance for the research procedures (Creswell & Poth, 2016).

The study adopted a cross-sectional convergent design which allows for the collection of quantitative and qualitative data to answer research questions (Zheng, 2015). According to Ganju, Mahapatra and Saggurti (2013), the cross-sectional convergent design allows for the modification of quantitative data with qualitative data findings by collecting and analyzing quantitative data followed immediately by a limited qualitative data to expound on the quantitative findings during the same data collection period. Using this design, quantitative data were obtained from randomly selected farmers, while qualitative data were acquired from purposefully selected Agricultural Extension Agents (AEAs) and the staff of the regional department of agriculture Regional and national MoFA staff through in-depth interviews throughout the same period. Moreover, the quantitative data were supplemented by qualitative data collected from purposefully sampled farmers through focus group discussions (FGD) to elaborate on some quantitative results.

The purposeful selection of the farmers was based on their desire and availability to participate in the FGD to seek clarification on some of the quantitative responses. The use of the design for the study was deemed appropriate in that the study required quantitative and qualitative data to achieve all the objectives. Furthermore, the study approach involved the collection of quantitative data subsequently analysed to provide understanding a general understanding of the study. The subsequent qualitative data and analysis also enabled the researcher to delve deep into the perspectives of research participants (Creswell, 2009; Tashakkori et al., 1998).

The qualitative approach was used to investigate the key informants' perceptions and viewpoints on the usage of resources to achieve the SDRLRP goal. Phenomenology, in particular, was used to offer a coherent summary of the key informants' experiences by drawing insights into the meaning of their experiences from the stories they shared about how resources were used to achieve the programme goal (Creswell, 2009). According to Lester (1999), phenomenology involves the gathering of in-depth information and perceptions through interviews, discussions, experiences and observations about a phenomenon. Furthermore, Donalek (2004) notes that philosophy guides research to investigate experiences through the descriptions provided by the people involved. Respondents are frequently asked to explain their experiences as they perceive them in interviews.

Study Area

The study was conducted in the Ashanti and Northern regions of Ghana where the SDRLRP Project was implemented. The Ashanti Region is in the heart of Ghana, bordering the northern and southern parts of the

country. Its land is perfect for farming cocoa, plantain, citrus fruits, and other cereal crops like maize. The region lies in the semi-deciduous agroecological zone at latitude 6.800 N and longitude -1.510W. The region experiences two annual rainfall peaks in May/June and October with annual rainfall ranging from 1100 to 2900 millimetres. In the region, the average annual temperature ranges from 25.5°C in the southern districts to 32°C in the northern districts in the Ashanti region. Humidity is high in the southern districts, with an average of 85% in the southern districts and 65% in the northern districts.

The region covers an area of 24,389 square kilometres, with a total agricultural land size of 1,463,340 hectares. A total of 1,181,788 hectares of arable land (81%) are cultivated. The region has a population of 4,881,422 people, according to the Ghana Statistical Service's 2010 population census (GSS, 2010). Agriculture employs and provides income for over 65 per cent of the population. The region has a farmer population of 2,274,745 people, accounting for 46.6 per cent of the total population. The region has approximately 3,180 square kilometres of forest resources which represent 22.5 per cent of Ghana's forest reserves. Approximately 2,340 sq km (65%) of this forest reserve is currently exploited, while the remaining 1,240 sq km (32%) is protected. Wawa, Odum, and Sapele are among the economic trees found in the region. As a result, lumbering activities occur in nearly all districts throughout the region.

The Northern region is located within latitude 10. 390 and longitude -0.390. It is bordered to the north by the Upper East and Upper West Regions, to the south by the Bono East and Volta regions, and to the west by the Republic of Togo and La Cote d'Ivoire. Except for the northeastern border

with the Gambaga escarpment and along the western corridor, the land is mostly flat and covers an area of approximately 70,383 square kilometres. In terms of land area, it is Ghana's largest region. The Black and White Volta rivers, as well as their tributaries namely Nasia and Daka rivers drain the Region. The northern part of the region is much drier because of its proximity to the Sahel and the Sahara regions. The southern part of the region, on the other hand, has transitional agroecological climatic conditions. The vegetation in the region is primarily grassland (Savannah grassland) with clusters of drought-resistant trees such as baobabs or acacias, mangoes, and neem. The rainy season lasts from May to October, with an annual rainfall of 750 to 1200 mm. The dry season lasts from November to April each year.

Temperatures are highest at the end of the dry season and lowest in December and January. The hot harmattan winds from the Sahara, on the other hand, blow frequently between December and the beginning of February. Temperatures can range from 14° C at night to 40° C during the day. Agriculture employs more than 75% of the economically active population. The region has the most lowland valleys suitable for rice production, and farmers in the region have culture rice compared to others of the country, with the region accounting for the majority of the local production margins (NRDS, 2020). The pictorial locations of the study areas are depicted in Figure 7.

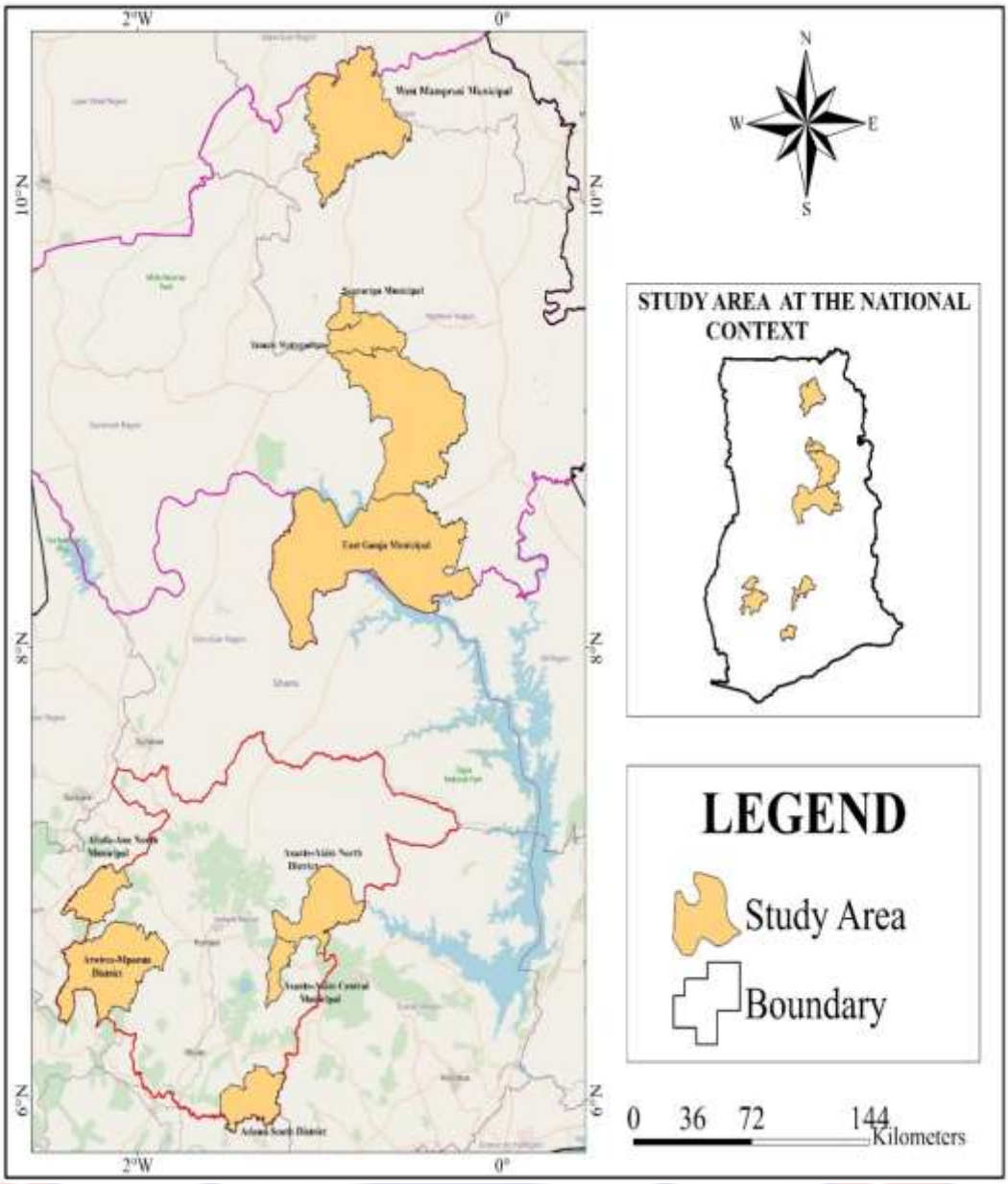

Figure 7: Map of the study areas

Source: Department of Geography and Regional Planning, University of Cape Coast (2021).

Population

The study populations are rice farmers and Agricultural Extension Agents (AEAs) who participated in the SDRLRP project in the Ashanti Region (Ahafo Ano North, Atwima Mponua, Adansi South, Asanti Akim North and Asante Akim Central) and the Northern Region (West Mamprusi,

Tamale Metropolis, Sagnerigu and East Gonja), national MoFA staff and staff of the regional department of agriculture of the selected regions who participated in the project.

Sampling Procedure and Sample Size

Suitable and representative sample size depends on the study population, data type, and analysis to be performed (Johnson, 2001). Therefore, different sample sizes were determined for each population set. The table for sample size determination (Krejcie & Morgan, 1970) was used to determine the representative size of the sample for the farmers.

The number of rice farmers who participated in the project was 2221, with 1396 from the Ashanti region and 825 from the Northern region, according to data from the Regional Departments of Agriculture in the two regions. Following Kretchie and Morgan's sample size determination table, 331 rice farmers were sampled for the study (Table 2). Twelve of the 50 AEAs that participated in the SDRLRP project were selected using the census. This is because only 12 of the 50 AEAs were in active service. One national MoFA staff and two staff from the regional department of agriculture from the national headquarters were purposefully chosen for key informant interviews.

Table 2: Population and sample sizes of rice farmers

Region	District	Population size	Sample size
Ashanti			
	Asante Akim North	220	33
	Ahafo Ano North	320	48
	Atwina Mponua	210	31
	Asante Akim Central	196	29
	Adansi South	450	67
Northern			
	West Mampusi	180	27
	Tamale Metro	256	38
	Sagnerigu	200	30
	East Gonja	189	28
Total		1396	331

Source: Field Data (2021).

Sampling Procedure

Selection of farmers

A multistage sampling procedure was used to select the 331 rice farmers whose data was used in the study. The procedure was put into action as follows: The first step was to determine which communities in each district were to be included. The project included five (5) Ashanti districts (Asante Akim North, Ahafo Ano North, Atwina Mponua, Asante Akim Central, and Adansi South) and four (4) Northern districts (Tamale Metro, Sanerigu, East Gonja, and West Mamprusi), according to data from the regional departments of agriculture in the two regions.

The second step was to compile a list of the important rice-growing communities in each of the nine districts. Non-proportionate stratified sampling was then used to select two communities at random from the Tamale Metropolis, two from the Sanerigu district, two from the East Gonja District,

two from the West Mamprusi District, two from the Asante Akim Central districts, two from the Asante Akim North districts, two from the Adansi South District, and two from the Atwina Mponua District.

The third step was to compile a list of rice farmers from each of the nineteen communities. Based on a predefined sample size of 331 rice growers in the Ashanti and Northern regions, the proportionate sample size was estimated for each community using the Kejcie and Morgan (1970) Table. Following the determination of the proportionate and representative sample size for each community, the simple random lottery technique was used to select 331 individual rice farmers at random. Purposive sampling was used to select 12 farmers for two focus group sessions, one in the Asanti Region and one in the Northern Region, to collect in-depth qualitative information. These 12 farmers were selected based on their years of farming experience and interactions with the project's AEAs.

Selection of AEAs, national, Department of Agriculture and MoFA staff

The study targeted 50 AEAs because that was the number of AEAs who had been trained and were involved in the SDRLRP project. Twelve AEAs obtained through census were interviewed, 7 from the Ashanti Region and 5 from the Northern Region.

Two regional staff of the department of agriculture and one MoFA staff from the national level involved in the SDRLRP project implementation were purposefully chosen as additional key informants for in-depth qualitative interviews. The representatives were chosen based on their direct involvement in the project's design, implementation, and monitoring.

Data Collection Instruments

Structured interview schedule, interview guide and focus group discussion guide were developed and used to collect primary data for the project. A structured interview schedule (Appendix A), interview guide (Appendix B) and focus group discussion guide (Appendix C) were used to collect data from farmers, AEAs and national staff of the Department of Agriculture and MoFA. The validity of the instruments was checked by the researcher to ensure the face validity of the instruments. The supervisors of the student researcher guaranteed the content and construct validity of the items on the instruments by examining the contents of the instruments to ensure that they are consistent and appropriate to the objectives of the study. The aptitude, talents and trustworthiness of a researcher are critical in ensuring the validity and dependability of data in qualitative research (Cypress, 2017).

The items on the structured interview guide were divided into ten sections numbered in the upper case alphabets, from A to J. Section A collected data on the demographic and socio-economic characteristics of the rice farmers; Section B on the organization or group affiliation of the farmers; Section C on the perceived effectiveness of the SDRLRP project; section D on the level of rice farmers' participation in the implementation cycle of the SDRLRP project; section E on the knowledge, attitude, skills and aspirations (KASA) of the farmers concerning the SDRLRP project; section F on the level of adoption of the SDRLRP project technologies by the farmers and impact on yield; Section G on access to inputs; section H on the access to financial services; Section I on the impact of the project on the livelihood outcomes of

the farmers; and Section J on the impact of the project on the rice farmers' household.

The Focus Group Discussion guide was used to gather data from the purposively selected farmers. It explored follow-up topics like factors that facilitated their adoption of the project technologies, how the project has impacted their livelihood outcomes and their household and the factors that accounted for disadoption or low adoption intensity of some of the technologies.

The interview guide contained open-ended questions. The questions sought to find out the opinions of key stakeholders on the extent to which the project resources (funds, staff, time, land, vehicles, etc.) were used to achieve the objectives, the relevance and the effectiveness of the implementation processes of the project. Perception about the extent of the achievement of the project objectives and factors that impeded or supported the project to deliver its expected outcomes were also measured. A document review was used to study reports and write-ups on the project.

Measurement of Variables and Analytical Tools

Objective one which sought to describe the use of resources for the achievement of goals of the sustainable development rainfed lowland rice production project, is a qualitative objective that identified the project inputs or resources (staff, time, funds, vehicles, plots and participants) and how they were utilised to achieve the SDRLRP project's goal. Secondary data such as documents from the implementing agencies were reviewed as well as primary data comprising interviews with key implementing staff and project counterparts were conducted to answer questions such as: How much money

was allocated for the project and what specific activities or was it meant to cater for? Was the money used for exactly what it was to be used for or otherwise? If otherwise, how did that affect the implementation of the project activities? How many participants were targeted and how many participated? If there was a difference, what accounted for that and how did the difference affect the achievement of the project aim? Were the desired sizes of demonstration plots of land acquired, and at the required locations? The data was analysed using content and thematic analyses and results were presented in a text.

Objective two which sought to examine the perceived effectiveness of the SDRLRP among the small-scale rice farmers in the Ashanti and the Northern regions was measured on the ordinal scale. Farmers were asked to rate their perceived effectiveness (defined as the extent to which they think the project activities have achieved the desired goals) of the various activities of the project including organizing and strengthening farmers groups, optimized rice cultivation technology, appropriate land preparation/development, access to agricultural Inputs (seeds fertilizers, small machinery), access to market information and dialogue among farmers and Stakeholders and access to extension services. These were measured on a five-point Likert-Type scale ranging from 1 to 5; 1 represents Least Effective, 2 representing Lowly Effective, 3 representing Moderately Effective, 4 representing Effective and 5 being Very highly Effective. For example, “organizing and strengthening farmers' groups” may be perceived to be Very highly Effective if the farmers think it has contributed immensely to strengthening their FBOs. In the same vein, access to market information may be perceived to be Most Effective if

farmers think that as a result of the project, they can receive information on input availability and cost more rapidly and on time, and output information. The methods of analysis employed were descriptive statistics such as mean and standard deviation, and inferential statistics like dependent sample t-test. The results were presented in tables.

Objective three assessed the level of participation of the small-scale rice farmers in the implementation of the sustainable development rainfed lowland rice production project in the Ashanti and Northern regions. Twelve items or variables were measured on a five-point Likert-Type scale to capture the level of participation of the rice farmers in all four (4) phases of the project implementation (Project identification, Project planning, Project implementation and project monitoring and evaluation) with 1=Very Low Involvement (VLI), 2=Low Involvement (LI), 3=Moderate Involvement (MI), 4=High Involvement (HI) and 5= Very High Involvement (VHI). Each phase has three items measuring it. Descriptive analysis was used to analyse this objective and results were presented in percentages, frequencies and bar chats. Mean, standard deviation and dependent sample t-tests were used to analyse the data, and the results are presented in tables.

The fourth objective aimed at assessing the change in Knowledge, Attitude, Skills and Aspiration of the farmers before and after the project. Variables measured under this objective are knowledge, attitude, skills and aspiration. Knowledge is conceptualized as “Having information about or being aware of SDRLRP technologies”, Attitude is conceptualized as “The perceived importance farmers attach to the project technologies”, Skills are conceptualized as “The rice farmers’ ability to practice the project

technologies" whereas Aspiration was conceptualized as "The rice farmers' willingness to practise the project technologies". All four variables were measured on a five-point Likert-Type scale ranging from 1 to 5. For the "Knowledge" construct, 1 represents "very low" and 5 represents "Very High". With regards to the "Attitude" construct, 1 represents "very lowly important" and 5 represents "Highly Important". For the "Skill" construct, 1 represents "Very low" and 5 represents "Very High"; and for the "Aspiration" construct, 1 represents "Very lowly willing" and 5 represents "Very Highly willing". Mean, standard deviation and dependent sample t-tests were used to analyse the objective. The results were presented in tables.

Objective five sought to measure the intensity of adoption of the technologies disseminated through sustainable development rainfed lowland rice production projects by the smallholder rice farmers in the two regions. While the adoption rate refers to the rate at which farmers accept an invention and includes the factor of "time" as one of its pillars, the intensity of adoption refers to the current degree of use of technology and focuses on how many people are utilizing which technology (Mwangi & Kariuki, 2015).

In this study, the researcher measured the intensity of the SDRLRP technology adoption by calculating the frequency and percentages of rice farmers who have embraced the SDRLRP technologies using binary or dichotomous options following recent studies such as Ochieng, Schreinemachers, Ogada, Dinssa, Barnos and Mndiga (2019) and Acheampong, Sayer, Macgregor and Sloan (2021). This method aided the researcher to compute the percentage of the SDRLRP technology adopters (sustained adoption) and how many of the technologies they have

adopted (Tegegne, 2017). It also allowed the researcher to understand why some technologies were adopted by a small number of farmers while others were adopted by a large number of farmers. This objective was measured using the natural dichotomy and interval scale. The dichotomous measurement was 0 and 1. 0 represents "No, not using" and 1 represents "Yes, already using".

The interval measurement categorised the number of the SDRLRP technologies adopted by each farmer. This was analysed using descriptive statistics including percentages and frequencies, and inferential statistics such as Pearson product-moment correlation to examine the association between the intensity of adoption (measured on the interval level) and over variables such as background characteristics, KASA, perceived effectiveness and perceived level of participation. A Chi-square tests was run to compare the intensity of adoption between the two regions.

The sixth objective, which sought to determine the impact of livelihood outcomes (natural, financial, physical, social and human capitals) of smallholder rice farmers in the two regions, measured natural, financial, physical, social and human capitals, in addition, to change in household status and income level to capture the project impact on the livelihood of the farmers. The five livelihood capitals were measured on a five-point Likert-Type scale "Before and After" the project with 1 representing "Very Low" and 5 representing "Very High". They were analysed using mean, standard deviation and dependent sample t-tests. The change in household status concerning the SDRLRP project was captured on a dummy as 1=Yes and 0= No. Income level, on the other hand, was captured on a six-point Likert-Type

scale with 0 representing Very Poor and 5 representing Well off. This objective was analysed using descriptives such as frequencies and percentages, means, standard deviation and dependent sample t-test.

Objective seven sought to predict the factors contributing to the livelihood outcomes of small-scale rice farmers in the Ashanti and Northern regions of Ghana. This was achieved using OLS regression.

Pre-Testing of the Research Instruments

Pre-testing of research instruments is a crucial part of the research process to ensure the reliability of data collection. Pretesting a research instrument determines the degree of dependability of the research instrument and also ensures that the findings are consistent with the results of the study. When the study is replicated, pretesting establishes the external and internal reliability of the instrument. According to Carmines and Zeller (1979) and Taherdoost (2016), the pretesting is done to fine-tune items on the research instrument and to achieve three key objectives. These are to ensure: a) the suitability of the research instrument, b) that the researcher obtains clarity of the items included in the instrument, and c) that the researcher follows all administrative protocols relevant to research (Adjei et al., 2012).

The interview schedule for farmers was pretested on thirty rice farmers from Twepeane in the Ashanti region and Sanga in the Northern region of Ghana who participated in the SDRLRP project. The pretest was done from 24th to 28th September 2020. The researcher and five research assistants conducted pre-testing. The researcher was able to rewrite some questions, delete some irrelevant questions, and rearrange some questions in the research instrument as a result of the pre-test results before the major data collection.

The Likert-type scales were coded and entered into Statistical Package for Social Sciences (SPSS) version 25 to determine Cronbach Alpha coefficients to measure the internal consistency of the items.

Mallery and George (2000) describe Alpha Coefficient values of 0.8-0.9 as excellent, 0.6-0.7 as good, 0.5-0.6 as acceptable and below 0.5 as unacceptable. The implication of the Mallery and George (2000) categorisation is that the higher the Coefficient, the better it is in terms of the reliability of the items. Results presented in Table 3 show that the Alpha Coefficients for various variables ranged from 0.70 for items on natural capital to 0.98 for items on Aspiration. This implies that the Likert-type scale constructs were either good or excellent.

Table 3: Alpha coefficient of variables of the study

Constructs of the study	Number of Items	Alpha Coefficient indicators of the study
Perceived effectiveness of SDRLRP	10	0.96
Framers' participation in SDRLRP	12	0.86
Knowledge before participating in the SDRLRP	10	0.70
Attitude before participating in the SDRLRP	10	0.93
Skills Before participating in the SDRLRP	10	0.97
Aspirations before participating in the SDRLRP	10	0.94
Knowledge after participating in the SDRLRP	10	0.93
Attitude after participating in the SDRLRP	10	0.91
Skills after participating in the SDRLRP	10	0.98

Table 3:Cont.

Aspirations after participating in the SDRLRP	10	0.88
SDRLRP Technologies	10	0.91
Human Capital before participating in the SDRLRP	10	0.90
Natural Capital before participating in the SDRLRP	4	0.78
Social Capital before participating in the SDRLRP	10	0.92
Financial Capital before participating in the SDRLRP	5	0.92
Physical Capital before participating in the SDRLRP	4	0.87
Human Capital after participating in the SDRLRP	10	0.88
Natural Capital after participating in the SDRLRP	4	0.70
Social Capital before participating in the SDRLRP	10	0.95
Financial Capital after participating in the SDRLRP	5	0.91
Physical Capital after participating in the SDRLRP	4	0.91

Source: Field Data (2021).

The pre-testing also offered the opportunity to review or delete certain questions For example, Question 11 and Question 18 were found to elicit the same information on the number of acres of land cultivated by farmers. The question 18 was removed to avoid recurrence. Question 5 which sought to collect information on the highest educational qualification was once again found to be problematic. The No formal education, Junior High School (JHS), Senior High School (SHS), and Middle School were included in the responses

as the majority of the 30 farmers mentioned the above as their highest formal education qualification.

Question 43 in section G focusing on access to inputs was also changed. Initially, the question asked respondents to list inorganic fertilizers and agrochemicals used. However, most farmers were unable to state the chemical fertilizers they used. The researcher, therefore, obtained names and pictures of suggested agrochemicals promoted by the SDRLRP project from a member of the team of implementation. NPK (15-15-15) and Urea or Sulphate of Ammonia were added as inorganic fertilizer used. In addition, names of weedicides such as "stump", sulphonate, condemn, warrior and attack were obtained from the pretest and were included in the final instrument.

Data Collection

The pretested and the corrected research instruments were presented to the Institutional Review Board of the University of Cape Coast for ethical clearance (see Appendix D for the ethical Clearance Certificate). An Introductory letter was obtained from the Department of Agricultural Economics and Extension (DAEE), School of Agriculture, to introduce the researcher and the research assistants to the respondents and other stakeholders of the SDRLRP project.

The data were collected between November 2020 and March 2021 for a period of 5 months. The interview dates were agreed upon with respondents in each of the study regions, districts and villages. The data from farmers were collected by the researcher and trained enumerators (AEAs) using the structured interview guide. The researcher conducted the focus group discussions and key informant interviews using the focus group discussion

guide and interview guide respectively. At each segment of data collection, the researcher/enumerators introduced themselves to the respondents and assured the respondents' of the confidentiality and anonymity of their responses.

Data processing and analysis

The quantitative data were coded and entered in Statistical Package for Social Sciences (SPSS), version 25 to generate descriptive statistics which were used to clean the data entry errors. The recordings were first listened to and transcribed from the local languages (Twi and Dagbani) to English and then organised into themes. Thematic analysis was used to analyse the qualitative data. This enabled the researcher to organize and gain insight into meaningful patterns (themes) across the dataset (Braun & Clarke, 2012). The themes were then coded into Microsoft Word software.

Multicollinearity diagnostic test of the effect of KASA on the effectiveness of SDRLRP project activities

A multicollinearity diagnostic test was conducted to examine the variance of inflation factors (VIF) and the tolerance of the independent variables used in the regression analysis. Pallant (2020) pointed out that there is collinearity when the independent variables in the regression analysis are excessively correlated. A tolerance value of zero indicates a sign of collinearity. A study by Bosompem, Annor-Frempong and Achiaa (2013) noted that a variance inflation factor nearing 10 calls for concern whilst a tolerance value of 1 indicates no need for multicollinearity. The results as presented in Table 4 indicates that there is no issue of collinearity among the independent variables used in the model. This means that the variables are fit to be used for the regression analysis.

Table 4:Multicollinearity Test of the effect of KASA on the effectiveness of SDRLRP project activities

Variables	Correlation	Multicollinearity	
	Effectiveness	Tolerance	VIF
Knowledge	0.419	0.756	1.322
Attitude	0.385	0.604	1.655
Skills	0.552	0.466	2.145
Aspiration	0.511	0.531	1.885

Source: Field Data (2021).

Analytical framework

The analytical framework presents the objectives of the study; the variables measured to achieve the objectives; how the variables are measured; and the method of analysis for each objective (Table 5).

Table 5:Analytical framework

objectives	Variables	Level of measurement	Analytical tool
1. Describe the resources (personnel, funds and equipment) invested in the SDRLRP project to achieve the project goal.	-		Content analysis and thematic analysis
2. Assess the level of participation of the small-scale rice farmers in the implementation of the sustainable development rainfed lowland rice production project	Participation	Ordinal/Likert scale	Mean and standard deviation
3. Examine the perceived effectiveness of the SDRLRP project from the stakeholders	Effectiveness	Ordinal/Likert scale	Mean, standard deviation, OLS regression

Table 5:Cont.

4. Determine the change in knowledge, attitude, skills and aspirations of smallholder rice farmers from participation in the SDRLRP project	Knowledge, attitude, skills, aspiration	Ordinal/Likert scale	Mean, standard deviation, dependent sample t-test.
5. Examine the intensity of adoption of the SDRLRP technologies by smallholder rice farmers.	Intensity of adoption	Nominal (1=yes, 0=no), interval (range of the number of technologies adopted by each farmer)	Percentages, frequencies, Pearson product-moment correlation, Chi-square
6. Assess the livelihood outcomes of the smallholder farmers engaged in the SDRLRP project.	natural, financial, physical, social and human capital	Ordinal/Likert scale	Mean, standard deviation, frequency, percentage, dependent sample t-test.
7. Identify the factors contributing to the livelihood outcomes of small-scale rice farmers involved in the SDRLRP project.	Age, sex, marital status, participation, effectiveness, knowledge, skills, aspiration, attitude, mode of land payment, land size	Nominal, ordinal, ratio	Mean, standard deviations, OLS regression

Source: Author's construct.

Variables for Regression Analyses and their Expected Relationships with the Intensity of Adoption of the SDRLRP Technologies based on Literature

Table 6 presents the independent variables for regression analyses hypothesised to relate with the intensity of adoption of the SDRLRP technologies either negatively or positively, based on literature.

Table 6: Variables for regression analyses and their expected relationships with the intensity of adoption of the SDRLRP technologies

Independent variables	Measurement	Expected relationship	Literature sources
Sex	Nominal (1=male, 0=female)	+	Morris and Doss (1999)
Age	Ratio (years)	+/-	Kariyasa and Dewi (2011), Mauceri et al. (2005)
Marital status	Nominal (1=married, 0=unmarried)	+	Pannell and Zilberman (2020)
Educational status	Ration (years spent in school)	+	Mignouna et al., 2011
Farming experience	Ration (years)	+	Ainembabazi and Mugisha (2014)
Farm size	Ratio (acre)	+	Timmer (2015)
Household size	Ratio(number of dependents)		Pannell and Zilberman (2020)
Knowledge	Ratio (mean value)	+	Mekonnen and Gerber (2015)
Attitude	Ratio (mean value)	+	Mekonnen and Gerber (2015)
Skills	Ratio (mean value)	+	Mekonnen and Gerber (2015)
Aspiration	Ratio (mean value)	+	Mekonnen and Gerber (2015)
Effectiveness	Ratio (mean value)	+	Aphunu and Otoikhian (2021)
Participation	Ratio (mean value)	+	Amadu, McNamara and Miller (2020)

Source: Author's construct.

Justification for performing regression analyses with variables measured with Likert scale (ordinal-level measured variables)

Carifio and Perla (2007) corrected Jamieson's (2004) misinterpretation and alleged abuse of Likert scales, stating that Likert-type scales are originally ordinal-level scales and should not be regarded interval level-scales, and that only non-parametric statistical tests should be performed with them. Carifio and Perla (2007) cited research such as the Gene Glass Monte Carlo ANOVA study (Glass et al., 1972), which demonstrated that Likert response formats might be rationally viewed as interval scales and even ratio scales given the proper anchoring terms and circumstances. Glass et al. (1972), as mentioned in Carifio and Perla (2007), recognized 3 major criteria: (i) the "scale or subscales should have 4 to 8 items but preferable closer to 8; (ii) the level of the data should be collected using 5 to 7 point likert- response format and (iii) analysis should generally be done not on item by item (micro) bases on the format but on the scale bases (macro)"

Glass et al. (1972, p. 237) opined that "the relevant question is not whether ANOVA (a parametric statistics) assumptions are met exactly, but rather whether the plausible violations of the assumptions have serious consequences on the validity of probability statements based on the standard assumptions". Hence, Glass et al. (1972, p.237) stated that "the flight to non-parametrics was unnecessary principally because researchers asked 'Are normal theory ANOVA assumptions met?' instead of 'How important are the inevitable violations of normal theory of ANOVA assumptions?'. In effect, researchers have been asking wrong questions in other to negate the use of likert-type scale as interval scales.

Additionally, Carifio and Perla (2007; p.111) pointed out that "one does not have to lose statistical power and sensitivity by using non-parametric statistical tests in its (parametric) place when analyzing likert scale data and even analyse such data selectively at the item level". Based on this, the researcher considered the Likert-type scales used in this study interval scales because the scales met the criteria outlined by Carifio and Perla (2007) and Glass et al. (1972). As a result, parametric statistics such as ANOVA and the t-test described in the data analysis section were preferable to their non-parametric counterparts: Other researchers recommend the Kruskal Wallis test and the Mann Whitney U test when employing Likert-type scales in all cases.

Chapter Summary

This chapter described the research methodology for the study. It discussed the philosophy that guided the study, the research design, the study area, the population and sample for the study, and the sampling method. The chapter also described the instruments used for data collecting and how the variables or constructs in the study were measured. In addition, the chapter discussed the pretesting procedure and presented the pre-test result to determine the validity and reliability of the study's constructs. Moreover, the chapter discussed the study data collecting, processing, and analysis processes.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

Chapter four presents and discusses the results of the use of resources to achieve the goal of the SDRLRP project. The types of resources are detailed, as well as how they were utilised. The resources are described in terms of project funds, time, equipment, and staff assigned to the project. The chapter also presents and discusses the findings on specific objective two which sought to determine the perceived effectiveness of the SDRLRP technologies from farmers' perspective.

Additionally, the perceived effectiveness of technologies reflects how participants see the contribution of technologies to the achievement of the objectives of the SDRLRP project in terms of economic, social and environmental (SEE) impact are discussed in this chapter. Furthermore, the results on the level of participation of small-scale rice farmers in the SDRLRP project were captured in the chapter as well as the results of the change in the KASA of farmers involved in the SDRLRP project. Moreover, the chapter examined the dynamics of the intensity of the adoption of the SDRLRP technologies among rice farmers in the two regions. The nature of livelihood outcomes and the impact of the SDRLRP project on the livelihood outcomes of the rice farmers are also presented in this chapter. Again, the chapter reported on the factors that contribute to the livelihood outcomes of the farmers involved in the SDRLRP project.

The use of resources to achieve the goals of the SDRLRP project

Results of the project document review revealed that human resources (people) from Japan (The Experts) and Ghana (Counterparts (C/Ps), funds, time, equipment, and machinery were used to implement the SDRLRP (Table 7). The Japanese experts were assigned to the project's technical aspects such as land development, extension management, and rice production technologies. They were complemented by twenty-nine (29) counterparts and ten (10) administrative personnel assigned from Ghana. The number of counterparts increased from 29 to 64 in the process of implementing the project, with training on the various components of the project taking place in various countries, mostly in Asia and Africa. However, towards the end of the project, only 13 counterparts and 8 administrative workers remained in post. USD 283,734.20 (GHC 405, 739.91) was committed to the purchase of machinery and equipment such as laptops, vehicles, and survey equipment, as well as the establishment of office space, while USD 1,223,418.48 (GHC 1,749,488.42) was given to the project's operational costs from 2009 to 2013. The Japanese spent 191.5 man-months on the project in total (Table 7).

Table 7: Inputs committed to the implementation of the SDRLRP project

Personnel assigned to the SDRLRP project	
Japanese Experts (long- and short terms):	*Long-term experts:* Team Leader/Rice Production, Rice Cultivation Technology, Extension/Project Managemen Land Development and Administrative Coordinator *Short-term experts*: Farming System Management, Participatory Rural Appraisal, Post-harvest Processing, Marketing, Farming Support, Farming Analysis
Ghanaian side (Counterparts)	*Assigned* Counterparts=Twenty-nine (29) Administrative personnel= ten (10) *At post* Counterparts =Thirteen (13) Administrative personnel= eight (8)
Trained Counterparts as 2014	Sixty-four (64) C/Ps trained in Japan, Burkina Faso and Uganda
Time	
Japanese Experts (long- and short terms):	Total experts' assignment=191.5 man-months Long-term experts = 175 man-months Short-term Experts=16.5 man-months
Machinery and equipment	
	1. Vehicle 2. Motorbike 3. Equipment for post-harvest 4 Survey Set 5. Miller 6. Destoner 7. Stone 8. Picker 9. Huller 10. Rice Cleaning Machine 11. Air Conditioner 12. Copier 13. Projector 14. Desktop/Laptop PC 15. GP 16. Digital Camera, 17. Printer and others
Funds	
Machinery and equipment	USD 283,734.20
Operational cost (from JICA)	USD 1,223,418.48 (from 2009 to 2013)
Office Accommodation	
	1. Project office for Japanese experts and Counterparts Kumasi and Tamale, 2. conference room 3. one small storage for equipment

NB: GHC 1=USD 1.43 in 2009

Source: Compiled by the author from project documents.

Table 6 shows that the various types of resources were employed in the project and were assigned to specific tasks aimed at achieving the project goal. The analyses of the interviews on the use of project resources to achieve the project's goal revealed four major themes: (1) Well-trained and efficient utilization of human resources, (2) Adequate provision for effective use of

machinery and equipment, (3) Adequate funds allocation, and (4) Ample time allocation for project implementation.

Theme I: ***Well-trained and effective utilisation of human resources***

Human resources or capital is one of the three key resources utilized by the project to achieve its goals. Kucharčíková, Mičiak and Hitka (2018) defined human resource as the sum of natural and acquired knowledge, skills, abilities, and experience of an individual put to use to achieve a goal of a project/programme. The Japanese experts provided training at the regional and district levels, regional and district directors, AEAs and other staff of the MoFA. Some of the staff of MoFA were trained in Burkina Faso, Uganda, and Japan on aspects of the project. The human resource base of the project was, therefore, said to be well-equipped to carry out the project to achieve its goals. For example, in terms of training on the efficient transfer of the project technologies to the farmers to enhance adoption, an AEA indicated that

> *"We were having some refresher courses during the period of the project. The refresher courses were helping and also giving us the upper hand on the [rice cultivation] process [involved] in the project as well as [far as] rice cultivation is concerned…so in that aspect, it was also good as it was a success of the project"* (AEA1).

Another AEA confirmed that

> *"We the extension officers were also well educated by the project to help, our capacity was good"* (AEA2).

Other statements from an AEA indicated that training was relevant.

Training made the AEAs very knowledgeable and skilful in the rice cultivation technologies that enabled them to easily practice with the farmers" (AEA4).

Some of the trained AEAs also trained other AEAs which enabled more farmers to be reached. It can be said from the aforementioned statements that the skilled and well-equipped human resources contributed significantly to the goal of enhancing rice production of farmers as proper technologies were transferred to farmers. Farmers were also assisted to easily adopt the technologies.

The human resource recruited for the project was said to be fit and capable of project implementation which is one of the goals of the project. A regional official stated that

"The staff who were recruited on the project were very experienced people; in fact, some of them were on board right from the inception and the project design phases and for that matter, their experience was very rich. Others too had their training outside and local training and they had worked on many other projects like inland valley rice project before this…these and some of them have been directors before so the worth of experience was very high among the staff who were running the project so at the end of the day, I think they were very effective" (RC1).

An AEA indicated that

"…if it [is on] a scale of 1 to 5, with 5 being the highest, I would give it [the effectiveness of the project] 5 owing to the human resource". (AEA 3).

Therefore, the human resource component was believed to have contributed to the effectiveness (reaching the goal) of the project. The result reflects the assertion that human resource is an important resource in project implementation to ensure the achievement of project goals (Turner, 2009).

Theme II: ***Adequate provision for, and effective use of, machinery and equipment***

The thematic analysis of the material resources invested in the SDRLRP project showed that vehicles, motorcycles, post-harvest equipment, survey set, miller, destoner, pickers, huller, rice cleaning machines, air conditioner, photocopier, projector, computer, GPS machine, digital camera and printers were provided for the effective running of the project. These resources, according to respondents, were put to good use and they contributed significantly to the attainment of the goal of the project. A regional director indicated that

> "*When it comes to resources like vehicles and office equipment, they assisted us to achieve the output or the objective of the project. All those resources were made available to us when we want to use them or go to the field to conduct training. The vehicles were always fueled which enabled us to reach farmers on time. Remember all the activities were time-bound and it is important to move to the field to train farmers when they needed your help. I believe these contributed to the result we were able to achieve at the end of the project*." (RC2).

The vehicles were used to visit project sites to check that all activities were carried out as planned. This is evidenced in an emphasis by a regional director that

"*The vehicles made it easier to monitor the project activities to ensure that all the project activities are being done*" (RC1).

Thus, the material resources helped the project recruits to work effectively and smoothly without any hindrance to obstruct performance.

Theme III: ***Time allocation for the implementation of the project***

Time is a key resource in determining the success of a project. The time allotted to the activities determines whether or not all project activities are performed to accomplish the goals of the project (Turner, 2009). The period allotted to the Japanese specialists and their Ghanaian counterparts was deemed sufficient to complete all project operations. According to the study, the time was spent entirely on project operations with very little distraction.

The interviewees agreed that the project resources were used efficiently and effectively towards achieving the project goal of boosting rice productivity and improving farmers' income. This indicates that the organization of resources: human, financial, and material, is required for achieving a project goal, which is consistent with Turner (2009), who states that human, financial, and material resources that are organized in a novel way to undertake a unique scope of work, of given specification, within cost and time constraints, helps to achieve beneficial change.

Theme IV: ***Adequate funds allocation***

Funds are a valuable resource for project financing. It is required to obtain the remaining two project resources (human and material). For example, funds are required to purchase machinery and equipment, as well as to train and motivate personnel to carry out project operations to fulfil the project's goal. As a result, its deficiency is a significant threat to project

management success and project success. According to the findings of the study, the funds granted by JICA were sufficient to fund the project. However, a review of the project documents showed that no funds were formally allotted to the project in the year to the project's completion. According to the project document, the Ghanaian government was supposed to fund the last year of the project as part of the agreement between the Ghanaian government and JICA, but the government did not release funds. This, of course, became a challenge in the project's last year, as several training and extension activities were difficult to implement. Despite this obstacle, the project was completed by the planned year (2014), because

> "*When the Ghanaian government was not providing funds, the Japanese found a way of funding the remaining activities*." (RC3).

This implies that the lack of Ghanaian government funds during the last period of the project had no negative impact on project management and project success. As a result, it can be inferred that the funds were sufficient to fund project activities, which resulted in the attainment of the project goal of boosting rice productivity and improving livelihoods among rice farmers in the project regions.

Smallholder farmers' perceived effectiveness of the sdrlrp project activities

Generally, farmers perceived the technologies to be highly effective (M=3.92) in contributing to the overall achievement of the goals of the SDRLRP project. Specifically, the seed preparation (M=4.05, SD=0.88), planting (M=4.18, SD=0.87), fertilization (M=4.24, SD=0.87), weeding (M=4.08, SD=0.77), and harvesting (M=4.49, SD=0.58) were all perceived to

be highly effective by rice farmers in contributing to the overall achievement of the goal of SDRLRP project goal. Furthermore, rice farmers rated land preparation (M=3.71, SD=0.80), bund building (M=3.76, SD=.945), ploughing/levelling (M= 3.65, SD=0.97), off-farm water management (M=3.59, SD=1.07), nursery preparation (M= 3.49, SD=1.27), and field management (3.87, SD=0.76) to be highly effective in contributing to the achievement of the goal of SDRLRP project (Table 8).

Table 8:Perceived effectiveness of sustainable development rainfed lowland rice production project from the stakeholders

SDRLRP Technologies	Perceived level of effectiveness	
	Mean	SD
Harvesting	4.49	0.58
Fertilization	4.24	0.87
Planting	4.18	0.87
Weeding	4.08	0.77
Seed preparation	4.05	0.88
Field management	3.87	0.76
Bund construction	3.76	0.95
Land preparation	3.71	0.80
Ploughing/levelling	3.65	0.97
Off-farm water management	3.59	1.07
Nursery preparation	3.49	1.27
Overall	3.92	

Scale: Means were calculated from a scale of 1= Least Effective, 2 = Lowly Effective, 3 = Moderately Effective, 4 = Highly Effective, and 5 = Very Highly Effective.
Source: Field Data (2021).

Among all the SDRLRP project technologies, the most effective is harvesting (M=4.49, SD=0.58). The result of the study implies that the farmers perceived that all the technologies transferred to them have contributed to the yield of rice and the income of farmers (Table 8). The result compares better with Azumah et al. (2018) who concluded from a study of rice farmers in

northern Ghana that they perceived agricultural extension technologies transferred as effective. The SDRLRP project technologies were generally helpful to farmers as they increased the rice yield and income of farmers. The objective also examined the null H_0 which stated that

There is no statistically significant effect of KASA on the level of effectiveness of SDRLRP activities.

This was achieved using OLS multiple linear regression analysis.

The effect of KASA on the level of effectiveness of SDRLRP activities

The results in Table 9 show the statistics used to determine the effect of KASA on the level of effectiveness of SDRLRP technologies perceived by the smallholder rice farmers involved in the project. The F statistic value of 47.768 was statistically significant at 1%, indicating that KASA together explained the perceived effectiveness of the SDRLRP project. However, the P-Values indicate that knowledge, skills and aspiration significantly predicted the perceived effectiveness of the SDRLRP project. The related variables recorded an R-Square value of 0.370 (Table 9) which indicates the knowledge, skills and aspiration of the farmers involved in the project explained 37% of the perceived effectiveness of the SDRLRP project.

Table 9: Effect of KASA on the level of perceived effectiveness of SDRLRP technologies

Variable	B	SE	Beta	t-Value	Sig
(Constant)	0.767	0.256		2.998	0.003
Knowledge	0.126	0.035	0.184	3.640	0.001***
Attitude	0.008	0.069	0.006	0.113	0.910
Skills	0.389	0.080	0.315	4.893	0.001***
Aspirations	0.246	0.065	0.227	3.761	0.001***
F-Statistic	47.768**				
R-Square		0.370			
Adjusted R-square		0.362			

***$p < .001$; (N = 331) ***$p < .001$; *$p < .05$

Note: T = Tolerance and VIF = Variance Inflation Factor

Field Data (2021)

The multiple linear regression equation used for the analysis is explained as follows:

$$E = \alpha + \beta_1 K + \beta_2 AT + \beta_3 S + \beta_4 AS + \varepsilon \quad (1)$$

Where

E = Level of Effectiveness (Dependent variable)

α = Constant

K = Knowledge (Independent variable)

AT = Attitude (Independent variable)

S = Skills (Independent variable)

AS = Aspirations (Independent variable)

β_1 = Coefficient of Knowledge

β_2 = Coefficient of Attitude

β_3 = Coefficient of Skills and

β_4= Coefficient of Aspirations

$$E = 0.767 + 0.18(4K) + 0.315(S) + 0.227(AS) + \varepsilon \quad (2)$$

Farmers' knowledge about the SDRLRP activities had a positive association with the perceived effectiveness of the project and was statistically significant at 1%. From the result, a unit increase in knowledge about the project practices increases the level of effectiveness by 18.4%. The rice farmers' knowledge about the project technologies is operationalised as their exposure to, and awareness of the SDRLRP practices. Farmers' knowledge of agricultural technologies is positively associated with their perception of project effectiveness (Pan et al., 2018). The result agrees with Somanje et al. (2021) who found that the knowledge of farmers directly influences how they perceived the effectiveness of agricultural interventions. The result, therefore, implies that farmers' knowledge (exposure to, and awareness of) projects is an important underpinning factor that influences how effective they will perceive the project.

Skill was found to be positively associated with the perceived effectiveness of the SDRLRP project at a statistical significance level of 1%. The result indicates that a unit increase in the skills of farmers increases the perceived effectiveness of the SDRLRP project by 31.5%. Farmers' skills denote the extent to which they can practice an agricultural practice. Farmers' ability to practice the technology received will translate into seeing how effective the technology can be to improve productivity and income. The result implies that the more able rice farmers are to practice the SDRLRP technologies, the more effective they perceive the SDRLRP project.

Aspiration significantly predicted the effectiveness of the SDRLRP project technologies. It positively correlated with the perceived effectiveness of the project at a statistically significant level of 1%. This implies that a unit increase in the aspiration of farmers about the project technologies causes a 22.7% increase in the perceived effectiveness of the SDRLRP project. Aspiration is defined as the motivation to practice certain technologies. Farmers may aspire to practice project technologies after they have been exposed to and had preliminary experience with the technologies (OECD, 2001). Framers may also have seen the outcome that the technologies can result. These factors may form the basis of the farmers' motivation to practice the technologies in the future to gain more of the benefits the technologies promise. The result of the study implies that farmers' aspirations about the SDRLRP technologies have a positive association with their perceived effectiveness of the technologies.

Level of participation of the small-scale rice farmers in the sustainable development of rainfed lowland rice production project

The level of participation (involvement) of farmers in programme identification (M=2.18, SD=1.03), implementation (M=2.31, SD= 0.87) and monitoring and evaluation (M= 2.33, SD=1.14) was low, except for planning (M= 2.33, SD=1.14) that can be said to be moderate (Table 10).

Table 10: Level of small-scale rice farmers' participation in the SDRLRP project cycle

SDRLRP project cycle	Level of participation	
	Mean	SD
Project identification		
Assessing rice farmers' needs	2.40	1.16
Prioritization of rice production projects	2.39	1.2
Development of project proposal	1.74	1.23
Weighted mean	2.18	
Project planning		
Deciding project location	3.06	1.15
Raising community contribution	2.61	1.11
Deciding project management team	1.76	1.26
Weighted mean	2.48	
Project implementation		
Implementation of project activities	3.09	1.13
Managing work and budget for the project	2.20	1.03
Procurement of goods and services	1.63	1.09
Weighted mean	2.31	
Project monitoring and evaluation		
Reviewing project progress performance	2.47	1.13
Determining whether the project addresses rice farmers' need	2.31	1.41
Assessing achievement of project deliverables/objectives	2.22	1.38
Weighted mean	2.33	
Overall Mean	2.33	

Scale: 1=Very Low Involvement (VLI), 2=Low Involvement (LI), 3=Moderate Involvement (MI), 4=High Involvement (HI) 5= Very High Involvement (VHI).

Source: Field Data (2021).

Specifically, with regard to project identification, the farmers were lowly involved in the assessment of rice farmers' needs (M=2.40, SD=1.16), prioritization of rice production projects (M=2.39, SD=1.2) and development of the project the proposal (M=1.74, SD=1.23). The findings contrast Oyugi and Kibua (2006) who found that the majority of participation occurred during the project's identification but agree with Blackman (2003) who asserted that despite the recent rise in the "bottom-up" approach to development, project beneficiaries are still not fully involved in the identification of projects aimed at improving their situation. The project implementer explained that

> *"Few farmers were consulted at the project identification stage and since the project proposal development is technical in nature and requires competencies and experience, many farmers were not involved"* (RC1).

Maraga et al. (2010) found that even when participation is incorporated into projects, it is sometimes defined in terms of local labour investment rather than actual decision-making, which seemed to be the case with SDRLRP.

The farmers were moderately involved in raising community contribution (M= 2.61, SD= 1.11) and deciding on project location (M= 3.06, SD=1.15). A project implementer explained that

> *"The rice farmers were adequately consulted in deciding where the project sites should be located because project location plays a crucial role in farmers' participation in the SDRLRP project. This resulted in locating demonstration sites proximal to the farmers which ensured their active participation in the implementation of the SDRLRP"* (RC2).

However, when it came to deciding project management team, farmers perceived their involvement to be low (M= 1.76, SD= 1.26). The results mirror Osore et al. (2018) who concluded a low involvement of farmers in the formation of the project team. The results also agree with Mubyazi and Hutton (2012) who found that farmers are not highly involved in all cycles of the project because many cycles of projects require elites to participate which seemed to be the case for the SDRLRP.

In terms of project implementation, of participation of rice farmers in the SDRLRP project was low with a mean score of M=2.31 and SD= 0.87. Specifically, whilst farmers' participation in the procurement of goods and services (M=1.63, SD=1.09) and managing work and budget for the project (M= 2.20, SD= 1.03) were low, their involvement in the actual implementation of project activities was moderate (M=3.09, SD= 1.13). Although the extent of participation was low for all the indicators of farmers' participation in the SDRLRP implementation, the farmers somewhat played a role in it. Etwire et al. (2013) reported that farmer's participation in agricultural projects can either be nominal, consultative, action-oriented or collegial, however, contrasting Uduji and Okolo-Obasi (2018) who discovered that young rural women (YRW) rarely participated in the e-wallet programme due to the cultural and traditional context, anchored in beliefs, norms and practices that breed discrimination, and women's vulnerability to poverty.

Project monitoring and evaluation

The results presented in Table 10 revealed that generally, farmer participation in the monitoring and evaluation of the SDRLRP project was low (M= 2.33, SD=1.14). Specifically, except for reviewing the project progress

and performance where farmers moderately participated (M= 2.47, SD= 1.138), all the other indices of involvement in monitoring and evaluation indicated low involvement of farmers. For example, farmers participated lowly in assessing the achievement of the project deliverables and objectives (M= 2.22, SD= 1.38) and in determining whether the project addresses the needs of rice farmers (M= 2.31, SD=1.14).

Overall, the result shows that the rice farmers participated in the SDRLRP project but at different levels, concerning the different cycles of the project and their corresponding different indices. The result agrees with Nxumalo and Oladele (2013) who pointed out that without participation, there would be no programme and no development, and with Etwire et al. (2013) that farmers' participation in agricultural projects can either be nominal, consultative, action-oriented or collegial, indicating that farmers' cannot have the same level of participation in all the cycles of a project. The generally low participation of the rice farmers in almost all the project cycles could be due to the reason put forward by Osore et al. (2018) that high levels of illiteracy in coastal communities caused the community members to be unable to effectively participate in project identification, project planning and proposal development phases since these phases require technical skills. The objective also tested the null hypothesis which stated that: H_0 there is no statistically significant difference in the level of rice farmers' participation in the implementation cycle of the SDRLRP Project based on their sex.

Change in knowledge, attitude, skill and aspirations (kasa) of smallholder rice farmers

The main aim of implementing agricultural programmes is to improve knowledge, skills, attitude and aspirations of farming practices to enhance productivity and development of farmers which is expected to be positive. Change opens up the mind of farmers about modern technologies and the external world relevant to farming practices and life in general (Fu & Akter, 2016).

Knowledge of farmers on SDRLRP technologies before and after the project

The study determined the knowledge of rice farmers on SDRLRP Technologies before and after the project. From the study, the mean score of farmers' overall knowledge of the SDRLRP project technologies was 1.66. The farmers' knowledge of the SDRLRP project technologies after the project recorded a mean score of 4.19 (Table 11). Specifically, before participating in the SDRLRP project, the farmers perceived that they had very low knowledge of how to construct bunds for rice production (M= 1.04, SD= .88), how to plough or level land for rice production(M=1.27, SD= .97), how to manage off-farm water for rice production (M=1.21, SD=1.03), how to prepare seed for growing rice (M= 1.35, SD=0.96) and how to prepare a nursery for raising rice seedling (M=1.37, SD=1.05), as presented in Table 11.

After participating in the project, however, the findings demonstrated a substantial increase in the knowledge level of the farmers in the various technologies disseminated to them. For instance, the farmers gained high knowledge of how to construct bunds for rice production (M=3.87, SD=0.72),

how to plough or level land for rice production (M=3.91, SD=0.7), how to manage Off-farm water management for rice production (M=3.88, SD= 0.83), how to prepare seed for growing rice (M=4.34, SD=2.88) and how to prepare a nursery for raising rice seedling (M= 3.87, SD=2.54).

Table 11: Knowledge of farmers about SDRLRP technologies

SDRLRP technologies	Knowledge			
	Before		After	
	Mean	SD	Mean	SD
Harvesting	2.37	1.00	4.61	2.84
Weed control	2.06	0.95	4.39	2.27
Land preparation	2.00	0.90	4.10	0.61
Planting of rice seedlings	1.95	2.33	4.41	2.28
Field Management	1.77	1.04	4.31	3.28
Fertilizer application	1.71	1.01	4.41	0.57
Preparation of nursery	1.37	1.05	3.87	2.54
Seed preparation	1.35	0.96	4.34	2.88
Ploughing/levelling of land	1.27	0.97	3.91	0.72
Management of off-farm water	1.21	1.03	3.88	0.83
Construction of bunds	1.04	0.88	3.87	0.72
Weighted mean	1.66		4.19	

Scale: Means were calculated from a scale of 1 = Very Low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very High

Source: Field Data (2021).

The findings of the study corroborate Fu and Akter's (2016) conclusion that such a change in the knowledge of farmers is true, particularly by demonstrating an increase in the knowledge level of rice farmers about rice production methods before and after the project (M=1.66, SD=.72; M=4.19, SD=0.82). An AEA indicated that

"Before the start of the project, farmers had a very limited understanding of the SDRLRP project technologies. However, after participating in the project, they acquired comprehensive knowledge about these technologies" (AEA4).

The results indicate that rice farmers in the study area lacked an understanding of the majority of rice-producing technology. The objective also tested the null hypothesis that states that there is no statistically significant difference in the knowledge of farmers before and after participating in the SDRLRP project.

Difference between knowledge level before and after participating in the SDRLRP Project

Results presented in Table 12 revealed a statistically significant difference between the knowledge levels of the rice farmers about the SDRLRP technologies before and after introduction (p= 0.00 is less than 0.05). The knowledge of farmers was low (M=1.66, SD=0.72) before participating in the project but increased highly (M=4.19, SD=1.66) after participating in the project.

Table 12: Knowledge of rice farmers before and after the SDRLRP project

Variable	N	Mean	SD	t-Value	df.	P-Value
Knowledge Before	331	1.66	0.72	-45.64	330	0.001**
Knowledge After	331	4.19	0.82			
Paired Difference		-2.54	1.01			

**$p < 0.01$; *p<0.05

Source: Field Data (2021).

The study, therefore, rejected the H_0: that there is no statistically significant difference in knowledge of rice farmers before and after participating in the SDRLRP project. The rice farmers in the study area can, therefore, be said to have gained knowledge in technologies needed to boost rice production. The result concurs with Meena and Singh (2019) who discovered a statistically significant difference in the change in farmers' knowledge, in a study that determined the impact of training for efficient water management in agriculture. The significant intervention has caused an improvement in the knowledge of farmers.

Attitude of rice farmers toward SDLRP technologies

The results presented in Table 13 revealed that the relevance farmers attached to the SDRLRP project technologies improved after participating in the project. For example, the relevance the farmers attached to land preparation for rice production before the project recorded a low mean score (M=2.26, SD=.98), but the mean score improved to high (M= 4.26, SD=0.57) after participating in the project, and the attitude of the farmers on the off-farm water management for rice production before the project was extremely low (M= 1.50, SD= 1.01) but appreciated substantially (M=4.04, SD=0.73) after participating in the SDRLRP project, as presented in Table 13.

Table 13: Attitude of rice farmers on SDLRP technologies before and after the project

	Attitude			
	Before		After	
SDLRP Technologies	Mean	SD	Mean	SD
Harvesting	2.39	0.94	4.50	0.59
Weed control	2.32	0.97	4.37	0.59
Land preparation	2.26	0.98	4.26	0.57
Field management	2.15	2.04	4.19	0.62
Fertilizer application	2.01	1.04	4.49	0.56
Planting of seedlings	1.99	1.04	4.33	0.63
Preparation of seeds	1.83	1.05	4.37	0.57
Preparation of nursery	1.65	1.12	3.87	1.18
Ploughing / levelling the land	1.56	1.07	4.24	2.29
Bund construction	1.53	1.09	4.14	0.68
Off-farm water management	1.50	1.01	4.04	0.73
Weighted mean	1.93		4.26	

Scale: Means were calculated from a scale of 1 = Very Lowly Important, 2 = Lowly Important, 3 = Moderately Important, 4 = Highly Important, 5.00 = Very Highly Important

Source: Field Data (2021).

The result implies that the attitude of rice farmers concerning the perceived importance of the SDRLRP technologies to their rice production improved greatly after participating in the project. This is in agreement with Fu and Akter (2016) that farmers' exposure to programme interventions impacts their attitude by changing how relevant they feel the programme activities are to them. It can be inferred from the study that the rice farmers in

the study area perceived the SDRLRP project activities as highly important to them after they participated in the project. The objective also tested the null hypothesis (H_0) which states that: There is no statistically significant difference in the attitude of farmers before and after participating in the SDLRP project.

Difference between Attitude of farmers before and after participating in the SDRLRP project

Results presented in Table 14 revealed that generally, the relevance farmers attached to the SDRLRP project technologies highly improved (M= 4.26, SD=.46). The P-Value of 0.001 was less than 0.05 which indicates that the improvement in the attitude of farmers towards the project technologies was statistically significant.

Table 14: Attitude of farmers before and after participating in the SDRLRP project

Variable	N	Mean	SD	Mean diff.	t-value	df.	P-Value
Attitude of Rice farmers Before	330	1.93	0.79	-2.33	-55.07	329	0.001**
Attitude of Rice farmers After	330	4.26	0.46				

**p < 0.01; *p<0.05

Source: Field Data (2021).

The results of the study imply that there was a statistically significant difference in the attitude of rice farmers towards the SDRLRP project technologies before and after participating in the project. An AEA indicated that

"After the farmers were trained in the SDRLRP project technologies, the farmers were happy and expressed that the technologies are better

in terms of increasing rice productivity than the ones the farmers were practising before" (AEA2).

The study, therefore, rejected the H_0: that: There is no statistically significant difference in the attitude of rice farmers before and after participating in the SDRLRP project. This is consonant with Meena and Singh (2019) that a statistically significant difference exists in farmers' attitudes after they are exposed to programme interventions.

Level of Skills of Rice Farmers on SDRLRP Technologies before and after the project

The study results revealed the skills of the rice farmers before and after participating in the SDRLRP project. The weighted mean score (M= 1.53) indicated that the farmers perceived skills to be low before the project while their level increased to high (M=4.08) after participating in the project (Table 15). For example, the farmers' skills in harvesting rice reported a low mean score (M= 2.44, SD=2.79) before participating in the SDRLRP project, shot to and a high mean score (M=4.39, SD= 0.63) after participating in the SDRLRP project activities. Furthermore, the farmers' skill in the construction of bunds for rice production recorded a very low mean score (M=0.97, SD=0.52) before they participated in the project, however, after participating in the project, the mean score for the same increased (M= 3.91, SD=0.70), as presented in Table 15.

Table 15: Perceived level of skills of rice farmers on SDRLRP technologies before and after the project

	Skills			
	Before		After	
SDLRP Technologies	Mean	SD	Mean	SD
Land preparation	1.91	0.25	4.14	0.59
Construction of bunds	0.97	0.52	3.91	0.72
Ploughing or levelling of land	1.04	0.99	3.95	0.70
Management of off-farm water	1.02	0.99	4.14	0.75
Planting of seeds	1.25	1.03	3.73	1.16
Preparation of seeds	1.25	1.03	4.21	0.66
Preparation of nursery	1.19	1.02	3.73	1.16
Planting of seedlings	1.64	1.06	4.21	0.66
Application of fertilizer	2.01	198	4.27	0.66
Management of rice field	1.78	1.51	4.09	0.65
Harvesting	2.44	1.79	4.39	0.63
Weighted Mean	1.53		4.08	

Scale: Means were calculated from a scale of 1 = Very Low, 2 = Low, 3 = Moderate, 4 = High, 5 = Very High

Source: Field Data (2021).

The findings highlight the fact that farmers' overall skill set improves after participating in agricultural interventions. The ability to practice something is referred to as skill in this study. The study found that rice farmers had a high ability to apply rice production technologies of the SDRLRP project (M=4.08, SD=0.45). The results are similar to Fu and Akter's (2016). This provides insight into the project's impact on the farmers as highlighted by an AEA

"The training has improved the skills of rice farmers in applying rice production technologies. All others being equal, this skill can translate

into an increase in rice productivity to improve the income and economic status of farmers" (AEA 3).

The study also tested the H_o which states that: There is no statistically significant difference in the skills of rice farmers before and after participating in the SDRLRP project.

Difference between Skills before and after the SDRLRP Project

The result presented in Table 16 revealed that the skills of farmers in the SDRLRP project technologies highly improved (M= 4.08, SD=0.45). The P-Value of 0.000 which is less than 0.05 indicates that the improvement in skills was statistically significant.

Table 16: Skills before and after the SDRLRP Project

Variable	N	Mean	SD	t-value	Mean diff.	df.	P-Value
Skills of Rice Farmers Before	331	1.53	0.85	-53.31	-2.56	330	0.000**
Skills of Rice Farmers After	331	4.08	0.45				

**p<0.01; *p<0.05

Source: Field Data (2021).

The study, therefore, rejected the null H_o which states that: there is no statistically significant difference in the skills of rice farmers before and after participating in the SDRLRP project. The national coordinator for the SDRLRP project indicated that

"Rice farmers have had an improved skill in rice production and management due to their participation in the SDRLRP activities" (NC).

The results of the study agree with Meena and Singh (2019) who found that farmers usually develop high skills in applying agricultural technologies after they have been trained in agricultural technologies.

Aspirations (willingness) of farmers on SDRLRP technologies before and after the project

The rice farmers' aspirations about the SDRLRP project technologies represent their motivation/willingness to practice the SDRLRP technologies. This was measured before and after the project. According to the study, the mean score (M) of farmers' aspiration to use such technologies before participating in the SDRLRP project was 1.68, with a standard deviation of (SD) of 0.79. Also, the study found that the farmers' aspirations after the project recorded a mean score of 4.08, with an SD of 0.52 (Table 17).

Table 17: Aspirations (willingness) of farmers to use SDRLRP project technologies

SDRLRP technologies	Attitude			
	Before		After	
	Mean	SD	Mean	SD
Preparation of land	2.25	1.95	4.21	0.66
Construction of bunds	1.15	1.14	3.83	0.95
Ploughing or levelling of land	1.13	1.09	3.77	1.04
Management of off-farm water	1.20	1.09	3.73	1.01
Planting of seeds	1.20	1.10	4.16	0.78
Preparation of seeds	1.42	1.09	3.65	1.26
Preparation of nursery	1.37	1.18	3.65	1.26
Planting of rice seedlings	1.76	1.16	4.23	0.75
Application of fertilizer	1.72	1.16	4.32	0.75
Management of rice field	2.14	0.95	4.19	0.60
Harvesting	2.49	0.97	4.52	0.59
Weighted mean	1.68		4.08	

Scale: Means were calculated from a scale of 1 = Very Lowly willing, 2 = Lowly willing, 3 = Moderately willing, 4 = Highly willing, 5.00 = Very Highly willing.
Source: Field Data (2021).

The results of the study demonstrate that the aspirations of rice farmers to practice the SDRLRP project technologies were very low (M=1.68, SD=0.78) before they participated in the project, but increased tremendously to a high level (M=4.08, SD=0.57) after they participated in the SDRLRP project. In hindsight, it can be said that the SDRLRP project has impacted farmers' motivation to apply or practice some rice cultivation techniques. Aspirations have been found to impact economic behaviour, as well as political and societal engagement, of farmers and community members alike, (Nandi & Nedumaran, 2021). Aspirations have also been found to have a big impact on agricultural output, livelihoods, and rural welfare by influencing short and medium-term decisions and having a significant impact on technology adoption (Mausch et al., 2018). The result of the study implies that the SDRLRP project has impacted the rice farmers' aspirations which agrees with Fu and Akter (2016) and can be speculated that this change could influence the farmers' adoption of the project technologies.

Difference between Aspirations for Rice Farmers Before and After the SDRLRP Project

To confirm the attribution of the difference in the rice farmers' aspirations before and after the project to the SDRLRP project, a dependent sample t-test was run. From the study, the difference in the mean score of the farmers' aspirations before the project (M= 1.68, SD =0.79) and after the project (M= 4.08, SD=0.52) was significant (t (df= 330) =56.789, *p*= 0.001, n= 331 at2 tailed), as revealed in Table 18.

Table 18: Aspirations for rice farmers before and after the SDRLRP project

Variable	N	Mean	SD	t-Value	Mean diff.	df.	P-Value
Aspirations of Rice Farmers Before	331	1.68	0.789	-56.79	-2.39	330	0.001
Aspirations of Rice Farmers After	331	4.08	0.517				

**$p < 0.01$; *$p<0.05$

Source: Field Data (2021).

Deducing from the study, there has been a statistically significant improvement in the mean score of aspiration for rice farmers after participating in the SDRLRP project. Based on the study, it can be said that there was an improvement in aspiration. This result confirms Meena and Singh's (2019) discovery that agricultural programme interventions have a significant impact on the aspirations of farmers (participants). In implication, the project has been effective with regards to affecting farmers' aspirations which all other things being equal, can enhance the adoption of the SDRLRP project technologies, with an overall impact of increasing the rice production and income of the rice farmers.

Determinants of the intensity of adoption of the SDRLRP project technologies by smallholder rice farmers

The determinats of the adoption intensity was determined by examining the dynamics of the intensity of the adoption of the SDRLRP technologies among rice farmers in the two regions and identifying the

determinants of the choice of adoption of the technologies as well as determining the sociodemographic characteristics that influence the intensity of adoption of the SDRLRP technologies.

The intensity of adoption of project technologies and their impact on yield

Results presented in Table 19 show that all farmers in the Northern Region and 97.6% in the Ashanti region adopted land preparation technology, although the difference in intensity of adoption was statistically insignificant (X^2=3.00; P-Value=0.08). Similarly, 99.2% of farmers in the Northern Region and all of farmers in the Ashanti Region used harvesting technology, however, the level of adoption was statistically insignificant (X^2=1.69; P-Value=0.19). Ploughing/leveling was used by 96.7% of farmers in the Northern Region and 61.1% of farmers in the Ashanti Region. This was statistically significant (X^2 =51.59; P-Value=0.00) at the 1% significance level, implying that Northern Region farmers adopted ploughing technology more than Ashanti Region farmers.

Field management was practiced by all farmers in the Ashanti Region and 95.1% of farmers in the Northern Region. The difference in field management adoption intensity between the regions was statistically significant (X^2=8.66; P-Value=0.00) at 1%, indicating that more farmers in the Ashanti Region practiced field management than in the Northern Region. Similarly, in the Northern Region, the majority of farmers (88%) applied nursery preparation technology, while fewer than half (45.1%) used nursery technology. The X^2 value of 75.06 and P value of 0.00 show the difference in the intensity of nursery technology adoption across the regions was

statistically significant at 1%. Consequently, more farmers in the Ashanti Region adopted nursery technology than in the Northern Region.

The majority (78.9%) of farmers in the Northern Region and slightly more than half (60.6%) of farmers in the Ashanti Region practiced off-farm water management. This was statistically significant (X^2=14.35; P-Value=0.00) at the 1% significance level, implying that more farmers in the Northern Region employed off-farm water management technology than in the Ashanti Region (Table 19).

Table 19: Intensity of adoption of the SDRLRP project technologies by farmers in the Ashanti and Northern regions

SDRLRP technologies	Intensity of adoption					
	Northern Region		Ashanti Region			
	Yes		Yes			
	Freq.	%	Freq.	%	X^2 - Value	P-Value
Land preparation	123	100	205	97.6	3.00	0.08
Harvesting	122	99.2	208	100	1.69	0.19
Weeding	121	98.4	206	99.0	0.29	0.59
Fertilizer	120	97.6	198	95.2	1.15	0.28
Ploughing/ levelling	119	96.7	127	61.1	51.59	0.00**
Field management	117	95.1	208	100	8.66	0.00**
Seed preparation	116	94.3	196	94.2	0.00	0.97
Planting	116	94.3	194	93.3	1.69	0.19
Off-farm water management	97	78.9	126	60.6	14.35	0.00**
Bund construction	91	74.0	155	74.5	0.02	0.89
Nursery preparation	56	45.6	183	88.0	75.06	0.00**

*p<0.05; **p<0.01

Source: Field Data (2021).

The study reveals a heterogeneous intensity of adoption, although all the technologies were adopted. It is clear from the results (Table 19) that, more farmers in the Northern Region adopted the project technologies than they did in the Ashanti Region. Generally, the majority of the project participants adopted the technologies in all the regions. The result contrasts Vecchio et al. (2020) who reported that only 28.7% of participants adopted the PF technologies in Kenya but mimics Kimaru-Muchai et al. (2020) who reported that all of the participants adopted the Zai pits for improved farm productivity. Based on the individual technologies, the study result contrasts both Kimaru-Muchai et al. (2020) and Vecchio et al. (2020) who reported that more farmers adopted the individual technologies of the SDRLRP project than they did in the two studies by both Kimaru-Muchai et al. (2020) and Vecchio et al. (2020) in Kenya.

From the results (Table 19) that two of the technologies that were adopted by a small number of farmers in the Ashanti Region were off-farm water management (60.6%) and ploughing or levelling (61.1%). The reason attributed to the low adoption intensity, as summarised from the FDG in the Ashanti Region, was that the ploughing is more labour-intensive and tiresome. Because of the use of a big wooden leveller to level the land, one farmer could not do that. Hiring labour to support comes with an extra cost, which could not be borne by the farmers. Hence, the abandonment of the technology by many farmers. With regard to off-farm water management, the reason ascribed was that the practice is very involving, in terms of time and energy. So many farmers also decided to stop practising it after the project ended. In the

Northern Region, the technology adopted by less than half of the farmers was nursery preparation.

Intensity of adoption of the SDRLRP technologies by individual farmers

This session reported on the number of SDRLRP project technologies adopted by individual farmers. The result revealed that, out of the 11 project technologies presented to the farmers, the majority (n=204, 61.6%) adopted between 10 and 11 of the technologies, and less than half of the farmers (106, 32%) adopted 7 to 9 out of the 11 project technologies. Meanwhile, a few (n=14. 4.2%) and (n=7, 2.1%) have adopted between 4 to 6 and 1 to 3 respectively, as presented in Table 20.

Table 20: Intensity of adoption of the SDRLRP technologies by farmers

	Intensity of adoption	
Number of technologies	Freq.	%
1-3	7	2.1
4-6	14	4.2
7-9	106	32.0
10-11	204	61.6

M=9.7 SD=1.56

Source: Field Data (2021).

The study revealed that almost all (93.6%) of the farmers adopted between 7 to 11 of the project technologies. This is not surprising because farmers recounted during the FGD that the technologies were perceived to be beneficial and would increase rice production. Notwithstanding a few difficulties associated with practising some of the technologies which threaten their sustained use for a long period. However, the findings contrast with previous research, such as Ochieng et al. (2019), who discovered that fewer than half of Kenyan and Tanzanian farmers adopted less than four of the 10 agricultural technologies disseminated to them. In conclusion, the results show

that the majority of rice farmers have adopted the majority of the SDRLRP technologies, demonstrating a higher intensity of adoption as compared to the findings of other studies.

Perceived attributes of technologies determining the adoption of the SDRLRP technologies

Results presented in Table 21 revealed that more than half of the project participants (n=183, 55.3%) adopted Land preparation due to its relative advantage. Again, (n=143, 43.2%) adopted bund construction due to its relative advantage over the old technologies being used. Furthermore, weeding and filed management (n= 166, 50.2%) and (n= 179, 54.1%) were respectively adopted as a result of their relative advantage.

Table 21: Distribution of perceived attributes of the SDRLRP technologies

SDRLRP technologies	Perceived technology attributes									
	Relative advantage		Trialability		Compatibility		Complexity (Ease of use)		Observability	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Land preparation	183	55.3	99	29.9	15	4.5	26	7.9	3	0.9
Bund construction	143	43.2	68	20.5	29	8.8	21	6.3	10	3.0
Ploughing/ levelling	146	44.1	77	23.3	18	5.4	22	6.6	9	2.7
Off-farm water management	154	46.5	67	20.2	10	3	29	8.8	7	2.1
Seed preparation	161	48.6	93	28.1	19	5.7	44	13.3	4	1.2
Nursery	147	44.4	82	24.8	22	6.6	23	6.9	9	2.7
Planting	153	46.2	118	35.6	14	4.2	31	9.4	6	1.8
Fertilization	155	46.8	82	24.8	32	9.7	44	13.3	13	3.9
Weeding	166	50.2	92	27.8	9	2.7	45	13.6	14	4.2
Field management	179	54.1	79	23.9	17	5.1	35	10.6	16	4.8
Harvesting	158	47.7	89	26.9	19	5.7	41	12.4	18	5.4

Source: Field Data (2021).

In general, the study found that all individual SDRLRP technologies were adopted based on their perceived characteristics by farmers, albeit there was heterogeneity in the number of farmers who considered specific technology characteristics before adopting the SDRLRP technologies. The findings support Rogers' (2004) argument that farmers' technology adoption decisions are frequently influenced by their perceptions of the qualities of the technology. Such perceived qualities of technology are particularly influential in farmers' decisions to embrace the technology (Doss, 2006; Mignouna et al., 2011).

According to the study, the perceived technology attribute that influenced the majority of farmers to accept the SDRLRP project technologies was the relative advantage of the technology. This was followed by technology availability. However, observability least influenced the farmers to adopt the SDRLRP technologies. This was expected because Rogers (2004) establishes that although all the perceived technology attributes influence farmers' adoption of the technology, the relative advantage is the most important characteristic that influences farmers' adoption decision the most, compared with compatibility and trialability.

The relative advantage of technology shows the degree to which an innovation is considered as being better than the current ones (in terms of economic benefit, social prestige and the like). The findings imply that the SDRLRP technologies were regarded to be better than the existing rice production methods used by farmers before the project, with this being the feature of the SDRLRP technologies that affected the majority of the farmers to adopt the technologies. According to the FGD, farmers agreed that

SDRLRP technologies help boost rice yield when compared to conventional ways.

Trialability was the second characteristic that influenced farmers' adoption of the SDRLRP technologies, next to relative advantage. Trialability is the degree to which an innovation can be experimented with or tried on a limited basis. Rogers (2004) notes that innovations that can be tried on a limited basis are likely to be adopted more rapidly than innovations that are not divisible. Rogers (2004) further noted that trying innovation helps potential adopters to see how it works under the context and conditions of the individual adopter. This connotes that rice farmers found the SDRLRP technologies to fit their rice production techniques and environment, hence, trialability is the second characteristic considered by several farmers for adopting the SDRLRP technologies.

Although observability and ease of use were expected to positively influence more farmers to adopt the SDRLRP technologies, the results turned out to be otherwise. The study indicated that observability and ease of use of the technologies were considered by only a few of the farmers to adopt the SDRLRP technologies. In other words, these characteristics influenced the farmers the least to adopt the project technologies. The result implies that although farmers may observe the technology as is being demonstrated and by their participation in the demonstration, may perceive the technology to be easily used or practised (Rogers, 2004), these may not be enough for them to adopt the technology if it is not relatively advantageous over the existing technology, easily tried and compatible with their social values and environment. Also, difficulty in practising a technology can deter farmers

from adopting it. The result is best explained by the revelation from the FGD that some of the SDRLRP technologies, especially bunding, were difficult to practice. According to the farmers, the bunding causes them waist pain and is also labour intensive, as a single farmer cannot practice it alone on his or her farm.

The results of the study, therefore, imply that the SDRLRP technologies were adopted mainly based on their relative advantage, trialability and compatibility.

Relationship between the intensity of adoption and demographic, farm-related characteristics of farmers, KASA, level of perceived effectiveness and participation in the SDRLRP project

The results presented in Table 22 revealed that the sex of farmers, marital status, farming experience, mode of land payment, knowledge, skills, attitude, aspiration, effectiveness and participation significantly influenced rice farmers' adoption of the SDRLRP technologies. Specifically, a weak negative association (r =-0.12) existed between the sex of rice farmers and the intensity of adoption of the SDRLRP technology at a 5% significant level (P-Value=0.03). Similarly, there was a weak negative correlation (r = -0.12) between rice farming experience and the level of adoption of the SDRLRP technologies at a 5% significance level (P-Value=0.03).

The marital status of farmers correlated positively but weakly (r = 0.12) with the level of adoption of the SDRLRP technologies at a statistical significance of 5% (P-Value=0.03) whereas the mode of land payment also had a positive but weak association (r=0.28) with the level of adoption of the SDRLRP technologies significant at 1% (P-Value=0.00). Furthermore, a

respective moderate positive correlation (r=0.24) and (r=0.43) were found between skills and aspiration of farmers and the intensity of adoption of the SDRLRP technologies at a 1% statical significance level.

Moreover, attitude (r=0.17), effectiveness (r=0.22) and knowledge (r=0.23) of farmers about the SDRLRP technologies respectively had a moderate positive correlation with the intensity of adoption of the SDRLRP project technologies significant at 1%. In addition, a weak negative correlation was observed between participation (r=-0.14) and the intensity of adoption of the SDRLRP project technologies.

Table 22: Relationship between the intensity of adoption and demographic characteristics, work-related characteristics, KASA, level of perceived effectiveness and participation

variables	Intensity of adoption	
	(r)	p-value
Sex	-0.12*	0.03
Number of dependents	-0.04	0.54
Age of Farmers	-0.03	0.56
Marital Status	0.12*	0.03
Level of Education	0.02	0.68
Experience	-0.12*	0.03
Mode of land payment	0.28**	0.00
Farm Size cultivated	-0.08	0.16
Skills	0.24**	0.00
Aspiration	0.43**	0.00
Attitude	0.17**	0.00
Effectiveness	0.22**	0.00
Participation	-0.14*	0.02
Knowledge	0.23**	0.00

n=331, **p<0.01; *p< 0.05

Source: Field Data (2021).

The result of the study implies that female rice farmers had a higher level of adoption of the SDRLRP technologies than men. Gender affects technology adoption since the head of the household is the primary decision-maker and men have more access to and control over vital production resources than women due to sociocultural values and norms (Mignouna et al., 2011). For instance, a study by Obisesan (2014) on the adoption of technology found that gender had a significant and positive influence on the adoption of improved cassava production in Nigeria. More specifically, Lavison (2013) revealed that male farmers were more likely to adopt organic fertilizer, unlike their female counterparts. While the result of the study confirms that sex affects the intensity of adoption of agricultural technologies, it contradicts Lavison (2013). The study's findings could be attributed to the arduous nature of SDRLRP technologies, which required not only more muscle endurance but also a significant time commitment to application in the fields. This assertion is supported by a study that found that female farmers are more resilient on the farm than male farmers who perform the most difficult tasks but spend relatively little time on the field (Gomes et al., 2022).

The results of the study further indicate that married farmers would highly adopt the SDRLRP technologies more than unmarried farmers. Moreover, farmers who had been cultivating rice for a longer period would have a low rate of adopting the SDRLRP technologies whereas farmers who paid for land with cash would have a higher intensity of adoption of the SDRLRP technologies than those who paid through sharecropping.

The perceived effectiveness of a technology is viewed as a primary motivator for farmers to adopt the technology. The results of the study mirror Aphunu and Otoikhian (2021) who found a significant positive association between the effectiveness of extension agents and the adoption of technologies by farmers. The results also agree with Azumah et al. (2018) who observed that more than 50% of farmers adopted improved production techniques as a result of their perception of the effectiveness of the technologies. In implication, the rice farmers' perception of the level of effectiveness of the SDRLRP project technologies positively influenced the intensity of adoption of the technologies.

Participation, according to Nwankwo, Peters and Bokelmann (2009), is a key factor that determines the adoption of agricultural project technologies. Wollni, Lee and Thies (2009) found that farmers' participation in organic markets and farmer-based organizations had a positive effect on the number of soil conservation methods (adoption intensity) employed on the farm among small-scale farmers in Honduras. Amadu, McNamara and Miller (2020) investigated the adoption of climate-smart agriculture in southern Malawi and found that programme participation had a positive and statistically significant effect on the adoption of climate-smart agricultural practices. Similarly, Thompson and Sinha (2008) found that higher levels of brand community participation improved the likelihood of the adoption of a new product. In addition, Posthumus, Gardebroek and Ruben (2010) examined how participation influenced farmers' decisions to adopt soil conservation methods and found that participation strongly and positively affected soil conservation technologies adoption.

Furthermore, Kumar, et al. (2020) maintain that participation in agricultural training and farm visits significantly increases the adoption of improved technologies and practices. Abdallah et al., (2021) also revealed that farmers' participation in the Planting for Food and Jobs enhanced the adoption of practices that improve productivity. Amadu, Miller and McNamara (2020) found a positive and statistically significant yield effect of CSA programme participation and the intensity of agroforestry fertilizer trees adoption. However, the result of the study contradicts the assertions and the findings cited above. The possible reason is that participation in a project cycle does not necessarily results in the adoption of the project technologies. Farmers, for example, need inputs that would enable them apply project technologies on the field. in the case of the SDRLRP project, rice farmers need to tractor to be able to practice ploughing effectively. If rice farmers are unable to hire or purchase a tractor, they cannot adopt the ploughing technology, even though they participated in the implementation of the SDRLRP project technologies. The study, therefore, concludes that participation in agricultural projects does not necessarily translate into adoption of the project technologies.

The study's results concur with Gerbi and Megerssa (2020) who in their study to examine the relationship between knowledge, skills and attitude on the adoption of highland maize in Western Ethiopia, found a positive and significant relationship between knowledge ($\chi 2=41.49$; $p=0.000$) to adoption, and concluded that an increase in farmers' knowledge favours adoption. The finding of the study also agrees with Chuang et al. (2020) who found that Sustainable Agriculture (SA) knowledge and perceived importance (attitude) positively related to SA adoption. Chuang et al. (2020) noted that a 1%

increase in SA knowledge level was determined to increase the SA adoption score by 0.932% among respondents. Similarly, a 1% increase in SA importance level was determined to increase the SA adoption level by 0.811%. The authors concluded that participants in the SA training programme with higher levels of SA knowledge and perceived importance would adopt more innovative technologies in their farming practices. This implies that an increase in the knowledge, attitude, aspiration and skills of farmers positively relates to an increase in the adoption intensity of the SDRLRP project technologies. This calls for the intensive demonstration of agricultural technologies by MoFA and other stakeholders to increase the KASA of farmers about the technologies to enhance adoption.

Factors that influence the intensity of adoption of the SDRLRP Technologies

The results presented in Table 23 showed the highest VIF value of 2.4 which depicts that there was no issue of multicollinearity among the independent variables. The results further indicated that farm size, mode of land payment, number of adult dependents, aspiration and participation significantly predict the intensity of adoption of the SDRLRP technologies. The R-square of 0.517 indicates that the independent variables explained about 52% (51.7%) variance in the intensity of adoption of the SDRLRP technologies.

Table 23: Factors influencing the intensity of adoption of SDRLRP project technologies

Independent variables	B	S. E	Beta	t	Sig.	VIF
(Constant)	3.517	2.136		1.647	0.103	
Sex	-0.092	0.436	-0.017	-0.211	0.834	1.278
Age	0.012	0.020	0.058	0.607	0.545	1.893
Marital status	0.511	1.026	0.038	0.497	0.620	1.166
Educational status	0.017	0.140	0.010	0.120	0.905	1.348
Number of adults (18 years and above)	0.141	0.052	0.233**	2.698	0.008	1.531
Farm size	-0.196	0.098	-0.195*	-2.004	0.048	1.953
Farming experience	-0.040	0.022	-0.172	-1.816	0.072	1.837
Effectiveness	0.382	0.306	0.122	1.250	0.214	1.951
Knowledge	0.132	0.149	0.072	0.886	0.378	1.341
Attitude	-0.205	0.344	-0.048	-0.596	0.552	1.324
Skills	-0.703	0.512	-0.146	-1.374	0.172	2.314
Aspiration	1.598	0.421	0.413**	3.797	0.000	2.429
Participation	-0.383	0.126	-0.255**	-3.032	0.003	1.448
Mode of payment for land	1.304	0.518	0.254**	2.516	0.013	2.097
R	0.719					
R-Square	0.517					
Adjusted R-Square	0.449					
F-Statistic	7.579 **					

**p<0.01; *p< 0.05

Source: Field Data (2021).

The linear equation for the OLS regression used for the analysis is described below.

Y= Dependent variable (Intensity of adoption of SDRLRP project technologies)

X_1 = Number of adult dependents

X_2= Farm size

X_3= Aspiration

X_4= Participation

X_5= Mode of land payment (1= Cash, 0= Sharecropping)

C= Constant

$Y= C+ \beta_1 X_1 + \beta_2 X_{2+} \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon$

$Y= 3.517+ (0.233) X_1 + (-0.195) X_2 + (0.413) X_3 + (-0.255) X_4 + (0.254) X_5 + \varepsilon$

The number of adult dependents positively correlated with the intensity of adoption of the SDRLRP technologies with an effect size of 23.3% at a 1% significance level. The result implies that an additional adult dependent on the rice farmers results in a 23.3% increase in the intensity of adoption of the SDRLRP technologies. Household size is often used to measure the availability of labour. It is thought to facilitate the adoption process in that, a larger household may have the capacity to reduce labour constraints required during the introduction of new technology and its adoption (Mwangi & Kariuki, 2015). The results of the study, thus, support the theoretical position that increased household size increases the adoption intensity of agricultural technologies with particular emphasis on the SDRLRP technologies in the Ashanti and Northern regions of Ghana.

Farm size was found to negatively correlate with the adoption intensity of the SDRLRP technologies. According to the results of the study, an acre increase in farm size will result in a 19.5% decrease in the adoption intensity of the SDRLRP technologies. Although farm size was expected to have a

positive association with adoption intensity (Hu et al., 2022), the results of the study turned otherwise. This can be explained by the fact that most of the SDRLRP technologies, for example, ploughing, levelling, and field management require farmers to acquire additional labour to be able to practice. In situations where farmers cannot afford additional labour cost, would not want to use under 18 dependents as labour and does not belong to a functional FBO, a farmer may cultivate a small farm size on which they can employ personal strength to practice as much of the SDRLRP technologies as is possible. This is true when a farmer indicated that

> *"Currently, all of the FBOs established here [in the community] by project implementers to facilitate 'ndoboa' (group labour) have failed due to misunderstanding and financial difficulties. As a result, we [farmers] no longer gain from group labour; we [farmers] have all been farming individually and utilizing those technologies that our individual strength allows"* (F11).

In implication, the adoption intensity of agricultural technologies may decrease even with large farm sizes, if farmers are unable to afford more labour and mechanisation.

Aspiration, conceptualised as the willingness to use technology, is positively associated with the adoption intensity of the SDRLRP technologies at a 1% significance level. According to the study's result, a unit increase in the willingness of farmers to use the SDRLRP technologies results in a 41.3% increase in the adoption intensity of the technologies. This is consistent with studies such as Mekonnen and Gerber (2015) who found a strong positive

relationship between aspiration and the adoption of agricultural technologies in rural Ethiopia.

Participation was negatively associated with the intensity of adoption of the SDRLRP technologies with an effect size of -0.26 at a 1% significance level. This implies that an increase in participation in the implementation of agricultural technologies does not translate into the adoption intensity of the technologies. Although participation is found to be a key determining factor in the intensity of adoption of agricultural project technologies (Nwankwo, Peters & Bokelmann, 2009) the result of the study contradicts the theoretical position and disagrees with other studies such as Wollni, Lee and Thies (2009), Posthumus, Gardebroek and Ruben (2010), Thompson and Sinha (2008), Kumar, et al. (2020), Amadu, McNamara and Miller (2020) and Abdallah et al., (2021) that reported a positive association between participation and adoption of agricultural technologies in various parts of the world. The possible reason is that participation in a project cycle does not necessarily results in the adoption of the project technologies.

Farmers, for example, need inputs that would enable them to apply project technologies in the field. in the case of the SDRLRP project, rice farmers need to tractor to be able to practice ploughing effectively. If rice farmers are unable to hire or purchase a tractor, they cannot adopt the ploughing technology, even though they participated in the implementation of the SDRLRP project technologies. The study, therefore, concludes that participation in agricultural projects does not necessarily translate into the adoption of the project technologies. The result calls on stakeholders and agricultural project implementers to increase efforts to intensify the

demonstration of agricultural technologies to farmers to enhance aspiration to result in the high adoption of agricultural technologies.

The mode of payment was negatively associated with the number of technologies that were adopted. Rice farmers pay for land through sharecropping or cash. This means that farmers with sharecropping are more willing to adopt the technologies. This also implies that the farmers will get more benefits in share-cropping than payment of land in cash. Farmers, particularly those in rural areas, are generally unwilling to invest large sums of money in their farming business. Farmers are disincentivised when they are required to make additional financial commitments. Because land for agricultural activities in rural areas is typically obtained from family or through sharecropping with little financial implication, farmers who pay for land in addition to making other financial commitments in some SDRLRP technologies such as ploughing are more likely to abandon those technologies that require a financial commitment. As a result, fewer SDRLRP technologies may be adopted. The findings suggest that the more farmers spend for land for rice cultivation in cash, the less likely they are to adopt more SDRLRP technologies.

Surprisingly, there was no significant relationship between sex and the intensity of adoption of project technologies. This implies that the level of adoption of the project technologies was unrelated to the sex of the farmers. Farmers, both male and female, may use the technologies equally.

Impact of the implementation of the sustainable development rainfed lowland rice production project on smallholder rice farmers in terms of livelihood outcomes

This section presents and discusses results on the nature of livelihood outcomes and relates the result of the impact of the SDRLRP project on the livelihood outcomes of the rice farmers in the Northern and Ashanti regions of Ghana. Furthermore, the study establishes the statistical significance of the differences in livelihood outcomes.

Impact of the SDRLRP Project on the Livelihood of Beneficiaries

The livelihood outcomes of the beneficiaries were assessed in terms of human, natural, social, financial and physical capital. In general, the study, in hindsight, has demonstrated an improvement in all five livelihood capitals.

Human Capital

The results as presented in Table 24 show that the overall human capital of beneficiaries before participating in the project was low (M=1.74, SD= 0.50). However, the average mean of beneficiaries based on human capital after participating in the project was moderate (M=3.61, SD=0.45). Specifically, the impact of beneficiaries on the following human capital dimensions; water management (M=1.53, SD=0.63), technical know-how (M=1.78, SD= 0.69), managing land for rice production (M= 1.79, SD=0.73), packaging skill (M= 1.50, SD=0.72), innovative and creative thinking (M= 1.63, SD=0.71) ranged from very low to low. The results on the impact on human capital after participating in the project ranged from moderate to high. Explicitly, the impact of beneficiaries on water management (M=3.63, SD=0.72), technical know-how (M=3.76,

SD=0.69), managing land for rice production (M=3.75, SD=0.68), packaging skill (M=3.27, SD=0.89), innovative and creative thinking (M=3.30, SD=0.79) ranged from moderate to high.

Natural Capital

The impact of natural capital on the livelihood of beneficiary farmers after participating in the SDRLRP project was enhanced. The impact on access to land (M= 2.27, SD=.98), effective use of land for rice production (M=1.82, SD=.69), effective use of water for rice production (M=1.63, SD=.68) and ability to pay for land if rented (M=1.91, SD=.80) before participating in the SDRLRP project were between very low and low. The results on the impact of livelihood on natural capital have increased after participation in the SDRLRP project. The weighted mean on the impact of livelihoods on human capital has increased from M=1.83 to M=3.71 (Table 24).

Table 24: Impact of the SDRLRP Project on the livelihood outcomes of the rice farmers

Livelihood outcomes	Impact of the SDRLRP technologies			
	Before Project		After Project	
Human Capital	Mean	SD	Mean	SD
Access to extension services	2.36	0.88	3.91	0.71
Rice production skills	1.88	0.73	3.87	0.63
Technical knowhow	1.78	0.69	3.76	0.69
Managing land for rice production	1.79	0.73	3.75	0.68
Water management	1.53	0.63	3.63	0.72
Soil management	1.60	0.63	3.54	0.72
Marketing skills	1.73	0.89	3.45	0.74
Packaging skill	1.50	0.72	3.27	0.89
Innovative and creative thinking	1.63	0.71	3.30	0.79
Knowledge on sustainable rice farm management	1.57	0.84	3.61	0.66
	1.74		3.61	

Table 24:Cont.

Weighted mean				
Natural Capital				
Access to land	2.27	0.98	3.93	0.41
Effective use of land for rice production	1.82	0.69	3.73	0.66
Effective use of water for rice production	1.63	0.68	3.70	1.76
Ability to pay for land if rented	1.91	0.80	3.43	.89
Weighted mean	1.83		3.71	
Social Capital				
Networking with financial institutions	1.50	0.61	2.83	1.20
Networking with other farmers	1.80	0.72	3.68	2.37
Networking with government-relevant ministry	1.72	0.73	3.51	.34
Networking with transporters	1.69	0.71	3.24	2.51
Networking stores or silos	1.61	0.74	2.79	1.17
Networking with processors	1.76	0.79	3.25	1.98
Networking with millers	1.91	0.83	3.46	.97
Networking farmers ' cooperative	1.63	0.74	3.24	.98
Networking with other production groups (NGOs and civic groups)	1.50	0.71	2.88	1.17
Networking with trade unions	1.40	0.61	2.70	1.16
Weighted mean	1.67		3.17	
Financial Capital				
Access to banks	1.46	0.79	2.87	1.19
Access to credit unions	1.47	0.67	2.77	1.27
Personal savings	1.95	0.85	3.71	.83
Access to Government subsidies	1.74	0.80	3.56	.89
Access to government grants	1.39	0.59	2.49	1.18
Weighted mean	1.62		3.10	
Physical Capital				
Ease of Transporting product	1.74	0.87	3.28	.95
Access to established market	1.83	0.75	3.16	1.11
Accessible roads	1.85	0.76	3.18	.99
Access to farm implements	1.74	0.75	2.98	1.12
Weighted mean	1.79		3.14	

Scale: Means were calculated from a scale of 1 – 1.44 = Very Low, 1.45 – 2.44 = Low, 2.45 – 3.44 = Moderate, 3.45 – 4.44 = High, 4.45 – 5.00 = Very High

Source: Field Data (2021).

Social Capital

The weighted mean of the impact of the SDRLRP project on the livelihood of beneficiaries before participating in the project (M=1.62, SD= 0.53) and after participating in the project (M= 3.10, SD=0.96) shows that there was a significant improvement in the social capital of the participants of the project (Table 24). Although the social capital of beneficiaries on networking with other farmers, networking with government relevant ministry, networking with transporters, networking with processors, networking millers and networking with farmers ' cooperatives was moderately enhanced after participating in the project,

Financial Capital

The average mean score for financial capital on the various constructs before participating in the project (M=1.62, SD=0.52) and after participating (M=3.10, SD=0.84) indicates an increment from low to moderate (Table 24). This implies that regarding the financial capital of rice farmers, the result indicates that much has changed.

Physical Capital

The result indicates that there was a moderate improvement in the mean score of rice farmers before (M=1.79 SD= 0.59) and after (M=3.14 SD= 0.82) participating in the SDRLRP (Table 25). The findings imply that the SDRLRP project has increased the physical capital of beneficiary rice farmers in the study regions. The study sought to test the null hypothesis that: H_0 There is no significant change in the livelihood of the farmers before and after the project.

Impact of SDRLRP project technologies on the livelihood outcomes of beneficiaries before and after the project

The results presented in Table 25 showed that generally, there were statistically significant differences in the mean scores of all the livelihood categories before and after the project. The means score of the farmers' human capital (M=1.74, SD=0.50) is statistically lower than after the project (M=3.61, SD=0.45) at t (df=362)=61.454, p<0.05, n=327 at 2 tailed. The mean score of natural capital after the project (M=3.71, SD=1.29) was significantly higher than before the project (M=1.82, SD=0.55) at t(df=319)= -25.02, p<0.05, n=320 at 2 tailed. Social capital before (M=0.67, SD=0.53) and after (M=3.17, SD= 0.97) also recorded showed a statistically significant difference at t(df=326)= -29.39, p<0.05, n=327 at 2 tailed, likewise financial capital before (M=1.62, SD=0.52) and after (M=3.09, SD=0.84) at t(df=318)= -30.73, p<0.05, n=319 at 2 tailed, and physical capital before (M=1.79, SD=0.64) and after (M=3.14, SD=0.82) at t(df=320)= -29.84, p<0.05, n=321 at 2 tailed (Table 25).

Table 25: Impact of SDRLRP project technologies on the livelihood outcomes of beneficiaries before and after the project

Livelihood outcomes	Impact of the SDRLRP technologies						
	N	Mean	SD	t-Value	Mean diff.	df.	P-Value
Human Capital Before	327	1.74	0.50	-61.55	-1.87	326	0.000**
Human Capital After	327	3.61	0.45				
Natural Capital Before	320	1.82	0.55	-25.02	-1.89	319	0.000**
Natural Capital After	320	3.71	1.29				
Social Capital Before	327	.67	0.53	-29.39	-1.51	326	0.000**
Social Capital After	327	3.17	0.96				
Financial Capital Before	319	1.62	0.52	-30.73	-1.48	318	0.000**
Financial Capital After	319	3.09	0.84				
Physical Capital Before	321	1.79	0.60	-29.84	-1.36	320	0.000**
Physical Capital After	321	3.15	0.82				

**p<0.01; *p<0.05

Source: Field Data (2021).

The result reveals that the improvement in the livelihood capitals before and after the SDRLRP project is statistically significant at a p-value of 0.05. As a result, the researcher is confident that the improvement in the rice farmers' livelihood is due to the introduction and practice of the SDRLRP technologies. The result agrees with Mariyono (2018) who found that farmers who participated in the farmers' field school for vegetable production reported very positive impacts of the Farmers' Field School on all of the five categories of livelihood assets. The result of the study points out that agricultural programmes improve farmers' livelihoods provided they are adopted.

Impact of SDRLRP Programme on Households' Wellbeing

The findings on the impact of the SDRLRP programme on household well-being presented in Table 27 showed that 97.5% of the households have been positively impacted by the SDRLRP Programme concerning the payment of rent. Regarding purchasing household items, (97%) of beneficiaries noted a positive impact on their households. Others, Crop yield (95.8%), Income (91.5%), Children's health (90%) and access to a regular healthy meal (88.8%) have been significantly impacted by the SDRLRP programme, as presented in Table 26.

Table 26: Impact of the SDRLRP Programme on households' wellbeing

	Impact of the SDRLRP technologies			
	Yes		No	
Household wellbeing	Freq.	%	Freq.	%
Payment of rent	233	97.6	90	27.2
Purchase of household items	321	97	8	2.4
Crop yield	317	95.8	12	3.6
Income	303	91.5	9	2.7
Children's health	298	90	33	10
Access to a regular healthy meal	294	88.8	34	10.3

Table 26:Cont.

Payment of medical bills	281	84.9	49	14.8
Payment of children's school Expenses	279	84.3	50	15.1
House maintenance	261	78.9	16	4.8
Saving money for future	256	77.3	75	22.7

Source: Field Data (2021).

The study showed that on the household level (private goods and services), an interesting observation is that the project has impacted positively on the farmers' livelihood. For example, about 96% of the farmers indicated that the project has enabled them to increase their rice yield and 97% of the farmers revealed that they can purchase household items. About 77% of the farmers also agreed that they are now able to save money for the future as a result of the project, while about 92% (91.5%) of the farmers pointed out that their income status has been impacted positively by the project. The result is in line with Guijt and Woodhill (2002) who in their 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. Thus, the result implies that the SDRLRP project has provided some relief in terms of payment of children's medical bills, payment of rent, and household maintenance. In addition to the result in Table 26, the FDG revealed that some of the farmers attest to the fact that their household food security is improved due to the application of the SDRLRP technologies.

Farmers' income status before and after participating in the SDRLRL Project

Further investigation was carried out on the farmers' income status because improvement in the income levels of the rice farmers was one of the

two major focuses of the SDRLRP project. The study revealed that almost half of the rice producers (n= 164, 49.5%) were moderately poor, about (n= 100, 30.2%) and (n=23, 6.9%) were poor and very poor respectively before participating in the project, as shown in Figure 8. However, the majority of the farmers had their income status improved, becoming well off (n=149, 45%) and moderately better off (n=111, 33.50%) after participating in the SDRLRP project (Figure 9).

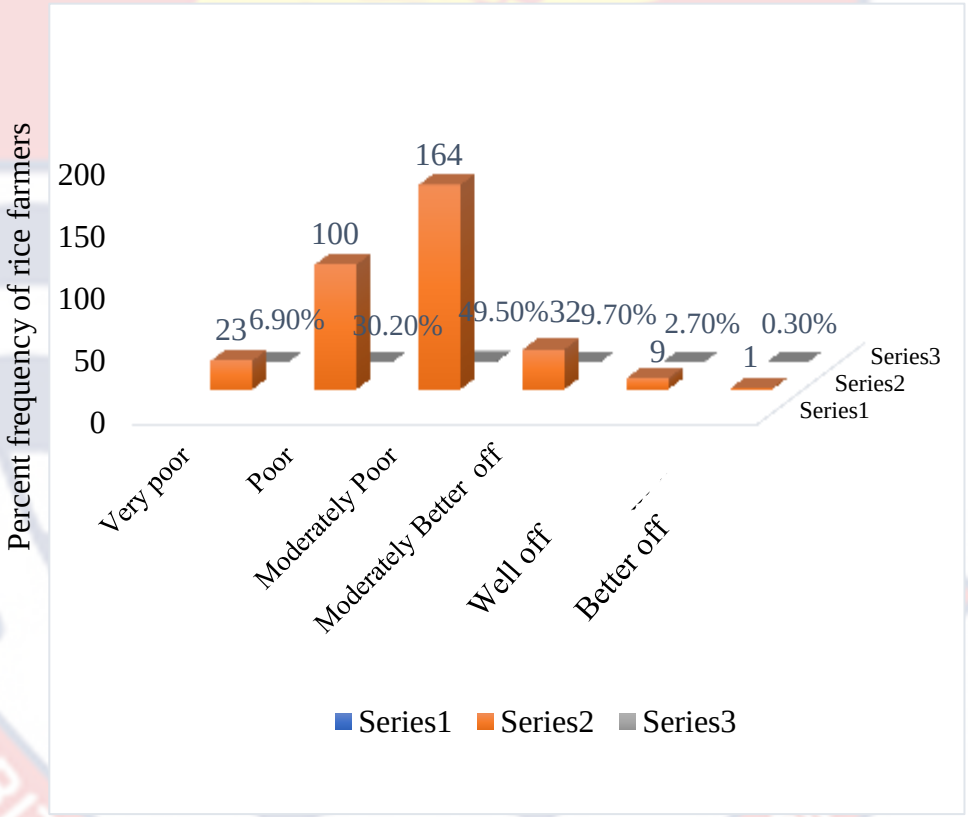

Figure 8: Rice farmers' income status before the SDRLRP project
Source: Field Data (2021).

Income status after the project

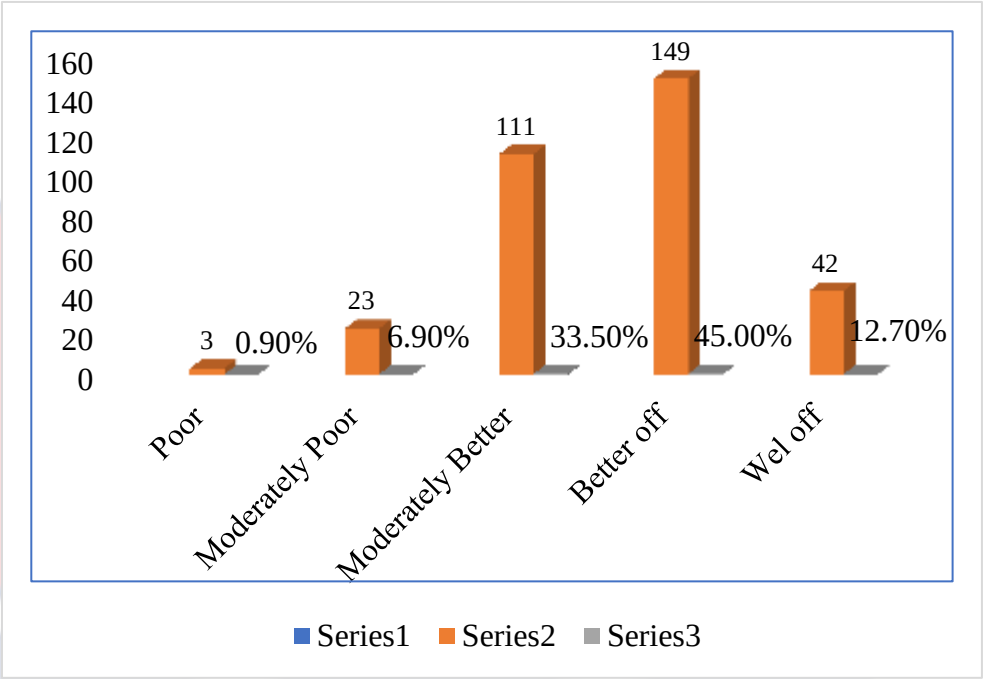

Figure 9: Income status after the SDRLRP project

Source: Field Data (2021).

The result again points to the fact that agricultural projects impact beneficiaries' livelihoods, especially their income, which confirms Guijt and Woodhill's (2002) assertion that majority of agricultural programmes improve the livelihoods, especially income, of beneficiaries.

The current financial position of the rice farmers after SDRLRP

The study demonstrated that out of the ... ...mers ...ewed, 232 of them representing 70.10%, noted that ... ...rren... ...on is a result of participating in the SDRLP project, and 18.7% of them indicated their current position is partially due to participating in the SDRLRP project whiles a few (n= 20, 6%) dissociates their current position from the SDRLRP project (Figure 10).

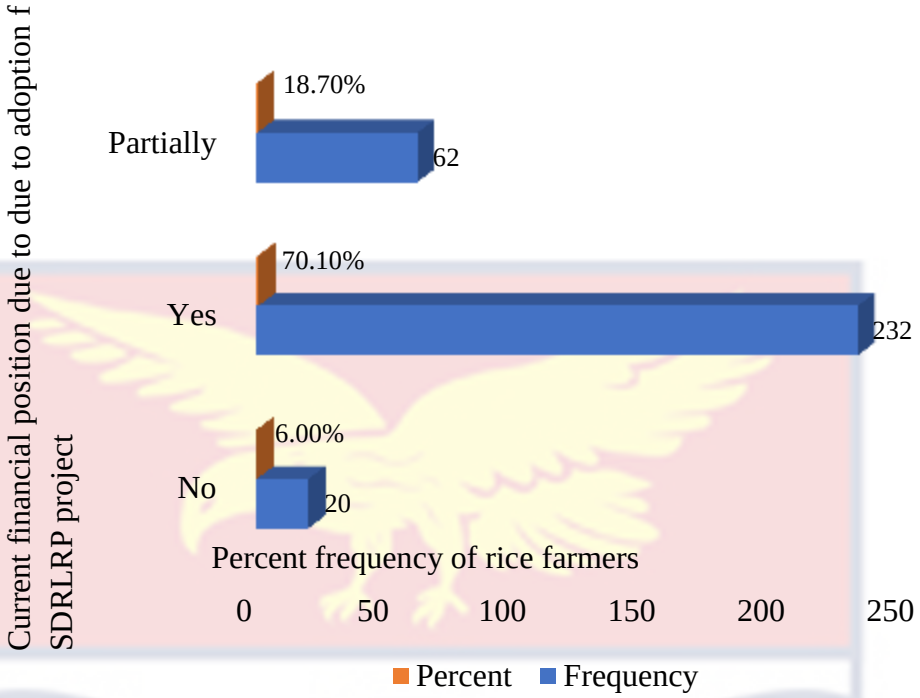

Figure 10: Current financial Position of farmers
Source: Field Data (2021).

Although the majority of the farmers attributed their income status to the project, a number of them had differing perceptions. This may be due to the disadoption of some of the project technologies by some of the farmers who have not yet realised the benefits of the technologies. Overall, the result implies that the project has contributed to the improvement in the finances of the farmers, in addition to other livelihood gains. This is buttressed by the result from the FGD that as a result of the farmers' participation in, and adoption of the SDRLRP technologies, some of the farmers are now (after the project) able to spend more money on their children's education. Some farmers also indicated that they have been able to purchase motorbikes, and built and/or renovated houses with corrugated roofing sheets.

Factors contributing to the livelihood outcomes of small-scale rice farmers

This section sought to identify the factors contributing to the livelihood outcomes of the farmers involved in the SDRLRP project. The livelihood outcomes had been measured in terms of human, social, financial physical and natural capital. The study sought to determine how socio-demographic characteristics Knowledge level, and effectiveness of the project influence each of the livelihood outcomes.

Factors contributing to the human capital livelihood outcome of the small-scale rice farmers

The multiple linear regression equation used for the analysis is explained as follows:

$$HC = C + \beta_1 ES + \beta_2 K + \beta_3 AT + \beta_4 SK + \beta_5 AS + \beta_6 SE + \beta_7 A + \beta_8 MS + \beta_9 E + \beta_{10} LS + \beta_{11} FE + \beta_{12} P + \varepsilon \quad (1)$$

Where,

HC= Livelihood outcome on human capital (Dependent variable)

C= Constant

ES= Effectiveness

K = Knowledge

AT = Attitude

SK= Skills

AS= Aspirations

SE= Sex of respondents

A= Age of the respondents

MS= Marital Status

E = Education

LS=Land size

FE= Farming experience

P=Participation

β_1 = Coefficient of Effectiveness

β_2 = Coefficient of Knowledge

β_3 = Coefficient of Attitude

β_4 = Coefficient of Skills

β_5= Coefficient of Aspirations

β_6 = Coefficient

β_7 = Coefficient

β_8 = Coefficient of Marital Status

β_9 = Coefficient of Education

β_{10}= Coefficient of Land Size

β_{11} = Coefficient of Farming Experience

β_{12} = Coefficient of Participation

ε = error term

$$HC = 1.8 + 0.14(ES) + 0.25(A) + 0.21(A) + 0.13\,(LS) + \varepsilon \quad (2)$$

The results presented in Table 27 indicate that the coefficient of determination (R^2) was 0.31, which signifies that 31% of the total variance in the human capital livelihood outcome was explained by the explanatory variables. The explanatory variables including the level of effectiveness, attitude, aspiration, and land size significantly predicted the human capital

livelihood outcome. The F-Statistic of 9.79 is statistically significant at 1% indicating that the model is fit.

Table 27:Factors contributing to the human capital livelihood outcomes of small-scale rice farmers

Independent variables	B	SE	Beta	t-Value	Sig	VIF
(Constant)	1.18	0.30		3.94	0.00	
Effectiveness	0.11	0.05	0.14*	2.10	0.04	1.72
Knowledge	-0.04	0.03	-0.07	-1.17	0.24	1.36
Attitude	0.24	0.06	0.25**	3.86	0.00	1.59
Skills	0.08	0.08	0.08	1.03	0.30	2.32
Aspiration	0.18	0.06	0.21*	2.90	0.00	1.93
Sex	-0.04	0.07	-0.03	-0.58	0.56	1.10
Age	-0.00	0.00	-0.03	-0.47	0.64	1.52
Marital status	-0.09	0.12	-0.04	-0.71	0.48	1.11
Education	0.00	0.02	0.01	0.13	0.89	1.23
Land size	0.02	0.01	0.13*	2.46	0.01	1.12
Farming experience	0.00	0.00	0.12	1.90	0.06	1.61
Participation	0.02	0.02	0.05	0.94	0.35	1.11
F statistics	9.79**					
R	0.55					
R-Square	0.31					
Adjusted R-Square	0.28					

**$p < 0.01$; *$p < 0.05$

Source: Field Data (2021).

According to Ali et al. (2020), the adoption of agricultural technologies has a positive impact on livelihoods. Human capital is formal or informal training and education that enhance business productivity and output by promoting economic growth (Anang & Awuni, 2018). The human capital of the SDRLRP constitutes constructs such as technical know-how in sustainable rice production, knowledge in sustainable rice farm management, and rice production skills among others. According to the study, the factors that accounted for the gain in the human capital outcome of the farmers are the attitude and the aspiration of the farmers towards the SDRLRP technologies,

farmers' experience with rice production, the level of the project's effectiveness and the farmers' participation in the SDRLRP project.

Participation is strongly associated with agricultural technology adoption and is believed to improve the adoption of the programme's practices (Uduji & Okolo-Obasi, 2018). Participation, according to Nwankwo et al. (2009), is a key factor that determines the effective adoption of project activities. For instance, Wollni et al. (2009) found that participating in organic markets and farmer-based organizations has a beneficial effect on the number of soil conservation methods employed on the farm among small-scale farmers in Honduras. Amadu et al. (2020) investigated the adoption of climate-smart agriculture in southern Malawi and discovered that program participation had a positive and statistically significant effect on the adoption of climate-smart agricultural practices. The study's result implies that rice farmers' participation in the SDRLRP project enhanced their adoption of the training, knowledge and education (i.e human capital) they received concerning the sustainable management of rice farms, pointing out that participation in agricultural project has a positive relationship with the farmers' human capital livelihood. From the study, a unit increase in the rice farmers' participation in the SDRLRP project increases their human capital livelihood by 12.3% at 5% statistical significance level. This demonstrates the key importance of project participation to the livelihood of farmers.

Experience positively correlated with the human capital livelihood of farmers at a 5% significance level. According to the study, a unit increase in the farmers' experience in rice production corresponds to about a 13% (12.8%) increment in their human capital livelihood (Table 27). Farmers'

experience with technology either elsewhere or during project implementation can influence their decision to adopt or disadopt the technology (Ainembabazi & Mugisha, 2014). Therefore, if farmers' experience influences them to adopt the project technology, they are likely to improve their livelihood. The study's result has demonstrated empirically that the rice farmers' experience with rice production facilitated their adoption of the SDRLRP project technologies which in turn affected their human capital livelihood positively. This implies that the more farmers are exposed to and have a hands-on feel of project technologies and adopt them, the more increase their knowledge and managerial skills (i.e. human capital).

Farmers' attitudes and aspirations are also positively associated with their livelihood outcomes based on human capital at statistical significance levels of 1% and 5% respectively. Attitudes and aspirations of farmers, as part of KASA, have been found to impact positively adoption. The rice farmers' attitudes and aspirations were impacted positively, according to the study. This implies that a positive attitude and motivation to adopt the SDRLRP technologies positively affect their livelihoods based on human capital.

Factors contributing to the natural capital livelihood outcome of the small-scale rice farmers

The multiple linear regression equation used for the analysis is explained as follows

$$SC = C + \beta_1 SE + \beta_2 A + \beta_3 MS + \beta_4 ES + \beta_5 FE + \beta_6 E + \beta_7 K + \beta_8 AT + \beta_9 SK + \beta_{10} AS + \beta_{11} P + \varepsilon \quad (1)$$

Where,

NC= Livelihood outcome on Natural capital (Dependent variable)

C= Constant

S= Sex of respondents

A= Age of the respondents

MS= Marital Status

ES = Educational Status

YE= Years of experience in rice production

E= Level of Effectiveness

K = Knowledge

A = Attitude

S= Skills

A= Aspirations

P=Participation

β_1 = Coefficient of Sex

β_2 = Coefficient of Age

β_3 = Coefficient of Marital Status

β_4 = Coefficient of Educational Status

β_5= Coefficient of Years of Experience

β_6 = Coefficient of Effectiveness

β_7 = Coefficient of Knowledge

β_8 = Coefficient of Attitude

β_9 = Coefficient of Skills

β_{10}= Coefficient of Aspirations

$\beta_{11}P$ = Coefficient of Participation

ε= error term

$$NC = 1.392-0.186(MS) + 0.149(E) + \varepsilon \quad (2)$$

Results presented in Table 28 show that the explanatory variables explained a 7.8% variance in the natural capital livelihood outcome. The F statistic of 1.497 at a 1% significance level indicates that the model is fit. Also, the highest VIF value of 2.3 shows that there was no multicollinearity in the model and that all the independent variables rightly predict the dependent variable. Of the eleven independent variables, only two (marital status and effectiveness) significantly predicted the natural capital livelihood outcome.

Table 28: Factors contributing to the natural livelihood outcomes of small- scale rice farmers

Independent variables	B	SE	Beta	t	Sig	VIF
(Constant)	1.392	0.386		3.611	0.001	
Sex	0.055	0.081	0.038	.671	0.503	1.078
Age	0.001	0.004	0.009	.138	0.890	1.502
Marital status	-0.533	0.165	-0.186	-3.238	0.001*	1.100
Education	0.037	0.027	0.081	1.351	0.178	1.188
Experience	-4.578	0.004	-0.001	-.011	0.992	1.581
Effectiveness	0.144	0.068	0.149	2.115	0.035*	1.650
Knowledge	0.034	0.042	0.053	.818	0.414	1.377
Attitude	0.003	0.083	0.002	.033	0.974	1.649
Skills	0.024	0.100	0.020	.238	0.812	2.324
Aspirations	-0.004	0.082	-0.003	-.045	0.964	2.015
Participation	0.73	0.086	0.049	.850	0.396	1.064
F-Statistic	1.497**					
R	0.279					
R-Square	0.078					
Adjusted R-Square	0.048					

**p <0.01; *p <0.05

Source: Field Data (2021).

Marital status negatively correlated with the natural capital livelihood outcome, with an effective size of -18.6% at a 1% significance level. This implies unmarried farmers had more natural capital livelihood while married farmers had less.

Perceived project effectiveness positively correlated with the natural capital, with an effect size of 14.9% at a 5% statistical significance level. The effectiveness of a project depicts how well the project can achieve its objectives. The farmers' perceived effectiveness has a bearing on their livelihood because their perception determines their aspirations. Increased aspiration of farmers facilitates the adoption of the technologies, which in turn improves their livelihood. Because the scope of the SDRLRP project covers facilitating ease of access to land by reducing land tenure issues, the rice farmers, for example, can more easily access and pay for land after the project than before, dependent on the effectiveness of the land tenure component of the SDRLRP project. Therefore, the result of the study demonstrates a positive association between the effectiveness of the SDRLRP project and the natural capital of the rice farmers as a result of developing networking skills.

Factors contributing to the social capital livelihood outcome of the small-scale rice farmers

The multiple linear regression equation used for the analysis is explained as follows

$$SC = C + \beta_1 SE + \beta_2 A + \beta_3 MS + \beta_4 ES + \beta_5 FE + \beta_6 E + \beta_7 K + \beta_8 AT + \beta_9 SK + \beta_{10} AS + \beta_{11} P + \varepsilon \quad (1)$$

Where

SC= Livelihood outcome on Social Capital (Dependent variable)

C = Constant

SE= Sex of respondents

A= Age of the respondents

MS= Marital Status

ES = Educational Status

FE= Farming experience

E= Effectiveness

K = Knowledge

AT = Attitude

SK= Skills

AS= Aspirations

P=Participation

β_1 = Coefficient of Sex

β_2 = Coefficient of Age

β_3 = Coefficient of Marital Status

β_4 = Coefficient of Educational Status

β_5= Coefficient of Years of Experience

β_6 = Coefficient of Effectiveness

β_7 = Coefficient of Knowledge

β_8 = Coefficient of Attitude

β_9 = Coefficient of Skills

β_{10}= Coefficient of Aspirations

$\beta_{11}P$ = Coefficient of Participation

ε= error term

$$SC = -0.04 + 0.115(ES) + 0.148\ (YE)\ -0.180\ (E) + 0.167(SK) + 0.213(AS) + 0.264(P) + \varepsilon \quad (2)$$

Out of the 11 explanatory variables inputted into the regression model, the overall predictive power R^2 value was 0.189. This indicates that all the explanatory variables predicted livelihood outcomes based on social capital by 18.9%. The F statistic of 6.526 significant at a 1% level indicates that the model was fit. Moreover, the highest VIF of 2.373 indicates that there is no multicollinearity issue associated with the model and that the independent variables rightfully predict the dependent variable. While effectiveness negatively and significantly influences livelihood outcome, educational level, experience, skills, aspirations and participation significantly and positively predicted livelihood outcome of rice farmers based on their social capital (Table 29).

Table 29: Factors contributing to the social capital livelihood outcomes of small-scale rice farmers

	B	SE	Beta	t	Sig	VIF
(Constant)	-0.040	0.641		-.062	0.950	
Sex	-0.095	0.137	-0.037	-.695	0.488	1.083
Age	-0.002	0.006	-0.016	-.256	0.798	1.504
Marital status	0.277	0.274	0.054	1.010	0.314	1.103
Education	0.093	0.045	0.115*	2.059	0.040	1.192
Experience	0.017	0.007	0.148*	2.293	0.023	1.583
Effectiveness	-0.310	0.115	-0.180**	-2.695	0.007	1.701
Knowledge	-0.072	0.070	-0.062	-1.018	0.310	1.388
Attitude	0.089	0.138	0.043	.644	0.520	1.667
Skills	0.354	0.168	0.167*	2.116	0.035	2.373
Aspirations	0.398	0.137	0.213**	2.904	0.004	2.041
Participation	0.293	0.059	0.264*	4.976	0.05	1.065
F -Statistic	6.526**					
R	0.435					
R-Square	0.189					
Adjusted R-Square	0.160					

***$p < 0.01$; *$p < 0.05$
Source: Field Data (2021).

The education level of farmers is positively and significantly associated with social capital livelihood, with an effect size of 11.5% at a 5% level. This means that a year's increase in farmers' education will increase their social capital livelihood by about 12%. Educational level is positively linked with the adoption of agricultural innovation. The education level of a farmer increases his ability to obtain, process, and use information relevant to the adoption of new technology (Mignouna et al., 2011). For instance, a study by Okunlola, Oludare and Akinwalere (2011) on the adoption of new technologies by fish farmers and Ajewole (2010) on the adoption of organic fertilizers found that the level of education had a positive and significant influence on the adoption of the technology. This is because higher education influences respondents' attitudes and thoughts making them more open, rational and able to analyse the benefits of the new technology (Waller, Hoy, Henderson, Stinner & Welty, 1998). This implies that the more educated the rice farmers are, the more likely they are to assess and make an informed decision about the SDRLRP project technologies. The outcome of such a decision, if positive, can lead to adoption which eventually will lead to a gain in farmers' livelihoods such as social capital. The result of the study, therefore, stipulates that education positively and significantly influences the SDRLRP project participants' livelihood in terms of social capital.

Farmers' experience also positively and significantly correlated with the social capital outcome at a 5% level. This indicates that the farmers' experience with and trial of the social capital components for example, networking with input providers has contributed to the variation in the social capital livelihood.

The farmers' participation in the SDRLRP project also correlated with the social capital positively at a statistical significance level of 5% and an effect size of 26.4%. This means that a unit increase in farmers' participation in the SDRLRP project increased their social capital by 26.4%. The result gives an interesting observation by revealing that participation in the project can strengthen livelihood. This can be because participation in the project exposed the farmers to the various networks which they made use of. The farmers attested to this fact by stating that after the project, they do not have to travel far to get inputs such as fertilizers, because agrochemical dealers were identified and they were linked to them. These dealers were closer to them than those they used to buy fertilizer from before the project. Also, the researcher's field observation showed that many of the farmers' groups formed and or strengthened by the project still exist and are vibrantly operating. The farmers agreed that before the project, their group rarely attended meetings because the majority of them had not understood the relevance of the groups. But after the project was implemented, the groups became vibrant again because of the education they received during the project. Hence, the project strengthened networking with colleague farmers.

Skills and aspiration are other KASA variables that are positively and significantly associated with social capital livelihood at respective 1% and 5% levels with effect sizes of 16.7% and 21.3%. The result implies that a unit increase in the skill level of farmers and their aspirations concerning the SDRLRP project will cause a respective change of about 17% and 21% in their social capital. Skill and aspiration are positively linked with adoption (Gerbi & Megerssa, 2020a; Karki & Karki, 2019). This connotes that farmers'

livelihoods can improve when they have developed good skills and positive aspirations toward an intervention. Thus, the rice farmers' skills and positive aspiration toward the social capital component of the SDRLRP project have influenced the farmers' livelihood (social capital) positively.

The perceived effectiveness of the project, surprisingly, had a negative association with social capital, significant at 1% with an effect size of -18%. The result implies that perceived effectiveness is not necessarily always a catalyst for livelihood improvement. This may be because perception about how effective a project is does not translate into adoption, which also does not guarantee an impact on livelihood.

Factors contributing to the financial capital livelihood outcome of the small-scale rice farmers

The multiple linear regression equation used for the analysis is explained as follows

$$FC = C + \beta_1 ES + \beta_2 K + \beta_3 AT + \beta_4 SK + \beta_5 AS + \beta_6 SE + \beta_7 A + \beta_8 MS + \beta_9 E + \beta_{10} LS + \beta_{11} FE + \beta_{12} P + \varepsilon \quad (1)$$

Where,

FC= Financial Capital livelihood outcome (Dependent variable)

C = Constant

ES= Effectiveness

K = Knowledge

AT = Attitude

SK= Skills

AS= Aspirations

SE= Sex of respondents

A= Age of the respondents

MS= Marital Status

E = Education

LS=Land size

FE= Farming experience

P=Participation

β_1 = Coefficient of Effectiveness

β_2 = Coefficient of Knowledge

β_3 = Coefficient of Attitude

β_4 = Coefficient of Skills

β_5= Coefficient of Aspirations

β_6 = Coefficient

β_7 = Coefficient

β_8 = Coefficient of Marital Status

β_9 = Coefficient of Education

β_{10}= Coefficient of Land Size

β_{11} = Coefficient of Farming Experience

β_{12} = Coefficient of Participation

ε = error term

$$FC = 0.58 + 0.22(SK) + 0.18(FE) + 0.34(P) + \varepsilon \quad (2)$$

The results presented in Table 30 indicate that out of the 12 explanatory variables, skills, farming experience and participation significantly predicted the financial capital livelihood outcome. The R^2 of 0.27 implies that 27% of the variance in the financial capital livelihood outcome

was explained by the independent variables. Also, the F statistic of 8.24 was significant at 1% indicating that the model was fit. Moreover, the highest VIF of 2.32 shows that there is no multicollinearity among the independent variables and that the independent variables rightly explain the dependent variable.

Table 30: Factors contributing to the financial livelihood outcomes of small-scale rice farmers

Independent variables	B	SE	Beta	T	Sig	VIF
(Constant)	0.58	0.57		1.02	0.31	
Effectiveness	-0.01	0.10	-0.01	-0.11	0.91	1.72
Knowledge	-0.11	0.06	-0.12	-1.92	0.06	1.36
Attitude	0.01	0.12	0.00	0.04	0.97	1.59
Skills	0.41	0.15	0.22**	2.78	0.01	2.32
Aspiration	0.15	0.12	0.09	1.28	0.20	1.94
Sex	0.06	0.13	0.03	0.45	0.66	1.10
Age	-0.00	0.01	-0.03	-0.42	0.68	1.53
Marital status	-0.13	0.23	-0.03	-0.54	0.59	1.11
Education	0.04	0.04	0.06	1.08	0.28	1.23
Land size	0.03	0.01	0.10	1.82	0.07	1.12
Farming experience	0.02	0.01	0.18**	2.63	0.01	1.61
Participation	0.20	0.03	0.34**	6.80	0.00	1.11
F statistics	8.24**					
R	0.55					
R-Square	0.27					
Adjusted R-Square	0.24					

**$p < .001$; *$p < .05$

Source: Field Data (2021).

Skill was positively and significantly associated with financial capital livelihood at a 1% level with an effect size of 0.22. The result implies that a unit increase in the skill level of farmers will result in a 22% increase in financial capital. Skill is positively linked with adoption (Gerbi & Megerssa, 2020a; Karki & Karki, 2019). This connotes that farmers' livelihoods can

improve when they have developed good skills through education about the technologies. The result implies that the rice farmers' skill has influenced the financial capital livelihood positively.

Farmers' experience positively and significantly correlated with financial capital livelihood outcome at a 1% level with an effect size of 0.18. It implies that a unit increase in farmers' experience increases financial capital livelihood by 18%. Farmers' participation in the SDRLRP project enabled them to access banks easily, make personal savings and access credit unions which enhanced financial capital outcomes.

Farmers' participation in the SDRLRP project was likewise positively associated with their financial capital at a statistical significance level of 1% and an effect size of 0.34%. As a result, increasing farmers' participation in the SDRLRP initiative by one unit raises their financial capital by 34%. The findings reveal an intriguing observation: participation in the SDRLRP project improved rice farmers' financial livelihood. This can be linked to the farmers' exposure to diverse ways of increasing their financial capital as a result of their involvement in the initiative. The outcome requires stakeholders to implement strategies to encourage farmer engagement in agricultural projects to improve their financial well-being.

Factors contributing to the physical capital livelihood outcome of the small-scale rice farmers

The multiple linear regression equation used for the analysis is explained as follows

$$PC = C + \beta_1 ES + \beta_2 K + \beta_3 AT + \beta_4 SK + \beta_5 AS + \beta_6 SE + \beta_7 A + \beta_8 MS + \beta_9 E + \beta_{10} LS + \beta_{11} FE + \beta_{12} P + \varepsilon \quad (1)$$

Where,

PC= Physical capital livelihood outcome (Dependent variable)

C = Constant

ES= Effectiveness

K = Knowledge

AT = Attitude

SK= Skills

AS= Aspirations

SE= Sex of respondents

A= Age of the respondents

MS= Marital Status

E = Education

LS=Land size

FE= Farming experience

P=Participation

β_1 = Coefficient of Effectiveness

β_2 = Coefficient of Knowledge

β_3 = Coefficient of Attitude

β_4 = Coefficient of Skills

β_5= Coefficient of Aspirations

β_6 = Coefficient

β_7 = Coefficient

β_8 = Coefficient of Marital Status

β_9 = Coefficient of Education

β_{10}= Coefficient of Land Size

β_{11} = Coefficient of Farming Experience

β_{12} = Coefficient of Participation

ε = error term

$$PC = 0.50 + 0.178\,(E) + 0.15(LS) + 0.144(FE) + 0.26(P) + \varepsilon \quad (2)$$

The result presented in Table 31 indicates that the coefficient of determination (R^2) was 0.26, which indicates that 26% of the total variation observed in the physical capital livelihood was explained by the independent variables. Out of the 12 explanatory variables used in the model, 4 showed a statistically significant association with the dependent variable. These are effectiveness, land size, farming experience and participation. The F-value of 7.85 is statistically significant at 1% indicating that the model is fit.

Table 31: Factors contributing to the physical capital livelihood outcomes of small-scale rice farmers.

Independent variables	B	SE	Beta	T	Sig	VIF
(Constant)	0.502	0.572		0.877	0.381	
Effectiveness	0.262	0.102	0.178*	2.565	0.011	1.719
Knowledge	-0.065	0.058	-0.069	-1.125	0.262	1.362
Attitude	0.147	0.119	0.082	1.232	0.219	1.584
Skills	0.280	0.148	0.152	1.894	0.059	2.302
Aspiration	-0.029	0.119	-0.018	-0.242	0.809	1.925
Sex	-0.035	0.128	-0.015	-0.273	0.785	1.103
Age	-0.009	0.006	-0.107	-1.653	0.100	1.510
Marital status	0.047	0.233	0.011	0.202	0.840	1.115
Education	-0.003	0.041	-0.004	-0.070	0.945	1.227
Land size	0.039	0.014	0.150**	2.688	0.008	1.114
Farming experience	0.014	0.007	0.144*	2.152	0.032	1.601

Table 31:Cont.

Participation	0.155	0.033	0.259**	4.630	0.000	1.120
F statistics	7.85**					
R	0.51					
R-Square	0.26					
Adjusted R-Square	0.23					

***$p < .001$; *$p < .05$

Source: Field Data (2021).

The effectiveness of a project is how well the project can achieve its objectives. The farmers' perceived effectiveness has a bearing on their livelihood because their perception determines their aspirations. Increased aspiration of farmers facilitates the adoption of the technologies, which in turn improves their livelihood. Because the scope of the SDRLRP project covers facilitating ease of access to the market, for example, the rice farmers can more easily access the market after the project than before. Therefore, the result of the study demonstrates a positive association between the effectiveness of the SDRLRP project and the physical capital of the rice farmers as a result of easily accessing the market.

Farmers' experience also positively and significantly correlated with physical capital outcomes at a 5% level with an effect size of 16% (Table 31). This indicates that the farmers' experience with and trial of the physical capital components has contributed 16% of the variation in their physical capital livelihood.

The farmers' participation in the SDRLRP project also correlated with the physical capital positively at a statistical significance level of 1% and an effect size of 0.259. This means that a unit increase in farmers' participation in the SDRLRP project increased their physical capital livelihood outcome by

25.9%. The result gives an interesting observation by revealing that participation in the project can strengthen livelihood. This is because participation in the project exposed the farmers to various infrastructures such as a ready market for rice. Hence, the project strengthened the physical capital of farmers.

Although knowledge was expected to significantly and positively influence the level of all the livelihood outcomes, except the level of financial capital, it is insignificant in predicting the levels of the rest of the livelihoods, although it is positively associated with them. This implies that generally, knowledge alone does not translate into livelihood gains, although it might play a role.

Chapter Summary

This chapter presented and discussed the results of the study based on the objectives of the study in a chronological order. With respect to the resources used to implement the SDRLRP project, the results were obtained using thematic analysis and project document review. The results revealed four themes: Well-trained and effective utilisation of human resources, Adequate provision for and effective use of machinery and equipment, Time allocation for the implementation of the project and Adequate funds allocation. That is, human capital, time, machines and equipment and funds were the key resources committed to the project. From the study, these resources were adequate, timely provided and were effectively and efficiently used to achieve the goal of the SDRLRP project. The key finding was that the resources contributed to the effective and efficient implementation of the SDRLRP project which resulted in the achievement of the goals of the project.

Results on objective two revealed that, in general, farmers highly perceived the SDRLRP project technologies to be effective. Harvesting, fertilization, planting, weeding, and seed preparation were perceived to be the most effective SDRLRP project technologies. Furthermore, the study revealed that farmers' knowledge, skills and aspirations about the project technologies significantly contributed to their overall perception of the SDRLRP project's effectiveness. Farmers' knowledge, skills and aspirations, in particular, influenced the perceived effectiveness of project technologies by 36%.

Objective three looked into farmers' levels of involvement in the SDRLRP's implementation. The study found that farmers' involvement in the SDRLRP project cycle was generally low. Farmers were, nevertheless, moderately involved in the project location decision and project activities implementation.

Results from objective four showed that the rice farmers' KASA improved significantly after participating in the SDRLRP project. Before participating in the SDRLRP project, farmers had low levels of knowledge, skills, attitudes, and aspirations concerning the technologies for producing rice sustainably in rainfed lowland environments. However, after taking part in the project, the farmers' knowledge, attitude, skills and aspirations of the SDRLRP technologies improved significantly. The improvement was statistically significant, indicating that the farmers' participation in the SDRLRP project contributed to the improvement in KASA levels.

The study also found that in each region, approximately 8 out of 10 farmers adopted the technologies. However, the intensity of project technologies adoption was slightly higher in the Northern Region. On an

individual farmer basis, nearly all (10-11) of the technologies were adopted by more than half (61%) of the rice farmers. In terms of SDRLRP technology attributes that influenced adoption intensity, it was found that the relative advantage the technologies have over existing ones, as well as the availability of the SDRLRP technologies to farmers, influenced the farmers' adoption intensity of the technologies.

Furthermore, the study revealed that, in addition to the relative advantage of the technologies and technology availability, the level of perceived effectiveness of the project, perceived level of knowledge, skills, attitude, and aspiration, mode of land payment, and marital status of farmers had a moderately positive association with the intensity of SDRLRP project technology adoption. This suggests that increasing rice farmers' knowledge of SDRLRP technologies and payment for land through sharecropping, for example, improves the intensity of SDRLRP technology adoption.

Farmers' participation in the project, farming experience, farm size, and sex of farmers, on the other hand, were negatively associated with the intensity of adoption of SDRLRP project technologies. This means that farmers' participation in the project implementation, for example, did not necessarily affect the intensity of adoption of project technologies. One likely explanation is that, despite their participation in the project, farmers required resources such as tractors and levellers to assist them in using some of the project technologies such as ploughing and field management. The lack of these resources means that the farmers are unable to use the aforementioned technologies. As a result, farmers' participation in project execution may not result in the adoption of the project technologies.

Moreover, the study's results showed that the rice farmers' livelihoods improved after participating in the SDRLRP programme. Specifically, all of the farmers' livelihood outcomes in terms of social, natural, financial, physical, and human capital were low before the project but significantly improved after participation in the project. The improvement in all of the farmers' livelihood outcomes was statistically significant, indicating that the improvement was due to the SDRLRP programme. The SDRLRP project was also found to have benefitted rice farmers' household well-being, with the majority of farmers indicating that the project enhanced their rice yield and savings as a result of higher income. It was also found that the majority of farmers had improved their income status from moderately poor to better off, as a result of the SDRLRP project.

Lastly, the study revealed that socioeconomic and socio-demographic characteristics of farmers, as well as KASA, level of participation and perceived level of effectiveness of the project, influenced the livelihood outcomes of the farmers. specifically, the study showed that the perceived level of effectiveness of the project, perceived level of attitude, land/farm size and perceived level of aspiration positively influenced the human capital livelihood outcome of the rice farmers. Natural livelihood outcome was influenced positively by perceived effectiveness and negatively by marital status. Social capital livelihood outcome was significantly and positively influenced by education status, farming experience, skills, aspiration and participation. The effectiveness of the project, however, negatively influenced the social capital livelihood outcome of the farmers. With regards to financial capital, factors such as the skills of farmers, perceived effectiveness of the

SDRLRP project and participation influenced it statistically and positively. Lastly, physical capital livelihood outcome was influenced positively and statistically by the perceived effectiveness of the project, land size, perceived level of participation in the project and farming experience.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

The chapter concludes the study by providing a summary of the study, conclusions, and recommendations based on the study's objectives. It also shows area for further studies and the contribution to knowledge.

Summary

Impact evaluation of agricultural projects is critical for policy action. Policymakers need impact evaluation to decide whether programmes are generating the expected effects; to promote accountability in the allocation of resources across public programmes and fill gaps in understanding what works and what does not, and whether measured changes in well-being are attributable to a particular programme of policy intervention. Impact evaluation of the SDRLRP project, is, therefore, crucial to determine its effect on the livelihoods of the beneficiary farmers and to inform policy and guide future planning and implementation of similar interventions. Not only outcomes of the SDRLRP project was evaluated, but the inputs were also examined to describe how the resources of the project contributed to achieving the goals of the project. The input aspect of the evaluation complemented the outcome evaluation by linking the use of the project resources to the achievement of the overall goals of the project. The study assessed the impact of the sustainable development of the rainfed lowland rice production project on the livelihoods of small-scale rice farmers in the Ashanti and Northern regions of Ghana.

The study employed a cross-sectional convergent mixed method design that helped to collect quantitative and qualitative data. The target populations for the study were the rice farmers, AEAs and regional and national MoFA staff who engaged in the implementation of the SDRLRP project in the Northern and Ashanti regions of Ghana. The multi-stage sampling procedures were used to select appropriate samples from the population.

Simple random sampling was used to select 331 rice farmers for the quantitative data while census and purposive sampling were used to select 12 farmers, 12 AEAs, 2 regional staff from the Department of Agriculture and 1 national MoFA staff for the qualitative data. Data collection was carried out using content-validated and pre-tested interview schedules for farmers, while interview and focus group discussion guides were used to steer focus group discussions and key informant interviews with the target farmers, AEAs and regional counterparts. Frequencies, percentages, means, standard deviations, Pearson correlation, dependent sample t-tests, and OLS multiple regression were the statistical tools used to analyse the quantitative data. Content and thematic analysis were also carried out for qualitative data, where transcribed documents were read several times, essential parts of the documents identified and meaningful names (codes) provided; after which similar codes were placed together to form themes named to express their contents. Major findings based on the objectives of the study are presented in the ensuing paragraphs.

Results from the study revealed that the major resources used for the implementation of the SDRLRP project were human resources, financial resources and material resources. The human resources comprised of well-

trained project counterparts like exerts from Japan and AEAs, District and Regional directors of agriculture in Northern and Ashanti regions. The financial resource was made up of a substantial fund released by the Japanese government to finance the operational cost as well as the procurement of machinery and equipment and the establishment of office spaces in the two project regions. The material resources, on the other hand, were made up of laptops, survey sets, vehicles, and so on. These resources were adequately provided and effectively utilised in the project to achieve the project's objectives which contributed to the effectiveness or the achievement of the project goals.

Generally, the farmers' perception of the effectiveness of the SDRLRP project was high, with a mean value of 3.92. The result also revealed that changes in knowledge, skills, and aspiration of the farmers about the project had a positive relationship with the perceived effectiveness of the project. Thus, KASA had a statistically significant positive effect on the perceived effectiveness of the project.

The overall participation of the farmers in all four stages of the project cycle was low (M=2.33). Specifically, farmers' involvement in the project planning, identification, implementation and monitoring and evaluation was all low. Farmers' level of participation in the project was not dependent on their sex.

The knowledge of farmers about the SDRLRP technologies was low before they participated in the project. Similarly, their attitude towards the technologies, their skill in the technologies and their aspirations were all low before their involvement in the project. However, the farmers' knowledge,

attitude, skills and aspiration toward the project technologies become high after they participated in the project. The change in knowledge, attitude, skill and aspiration of the farmers before and after their involvement in the project was statistically significant.

From the result, the majority (61.6%) of the farmers adopted almost all the technologies (10-11). The reason ascribed to this huge adoption was that the technologies were deemed very beneficial and consistent with existing practices. Apart from the farmers' perceived importance of the technologies that resulted in their high intensity of adoption, the two most important attributes of the technologies that played a major role in the high adoption intensity were the relative advantage and the trialability of the technologies. The farmers' experience with the technologies and their mode of land payment significantly predicted their intensity of adoption of the technologies, however, these variables had a negative association with the intensity of adopting the technologies.

The impact of the SDRLRP project on the livelihood outcomes of the participating farmers in terms of human, natural, physical, financial and social capital was low before the project but improved to a high level after the farmers participated in the project. The change in the livelihood outcomes was statistically significant, according to the results of the study. The result of the study also indicated that the SDRLRP project highly impacted the farmers' households in terms of crop yield, payment of children's school and hospital bills, rent, and saving for the future, for instance, as at least 78% of the farmers associated this improvement to their participation in the SDRLRP project. Concerning the farmers' income, which was one of the major targets

of the SDRLRP project apart from productivity, the study revealed that the majority of the farmers were moderately poor before they participated in the project. Their income status, however, improved to make the majority of them better off, after the project. Almost all the farmers attributed their current income status to the project.

From the study, farmers' experience, participation in the project, attitude and aspiration towards the project technologies positively and significantly predicted the level of the rice farmers' livelihood outcome in terms of human capital, whereas marital status and the project's effectiveness significantly and positively predicted the level of natural capital. Also, the farmers' level of experience, educational level and the perceived effectiveness of the project positively and significantly predicted their social capital while skill, participation, experience and knowledge significantly and positively predicted the farmers' financial capital level. Lastly, the level of physical capital of the farmers was significantly and positively influenced by participation, experience, skill and perceived effectiveness of the project.

Conclusions

Based on the key findings of the study, the following conclusions were drawn:

The resources invested in the SDRLRP project were human, material, and financial, and they were used effectively and efficiently to meet the project's aims. In particular, competent and well-trained AEAs and resource personnel were employed in the project execution to demonstrate and practice the SDRLRP technologies with the farmers to facilitate adoption. Furthermore, the funding and equipment were sufficient to ensure the project's

implementation, which enhanced its effectiveness and contributed to the project's success.

The SDRLRP project technologies were perceived as highly effective by the farmers. The higher perception of the project's effectiveness was accounted for by the knowledge, skills and aspiration of the farmers about the project technologies. Farmers' knowledge, skills and aspirations, in particular, influenced the perceived effectiveness of project technologies by 36%.

Farmers' involvement in the SDRLRP project cycle was generally low. Farmers were, nevertheless, moderately involved in the project location decision and project activities implementation.

The rice farmers' KASA improved significantly after participating in the SDRLRP project. The improvement was statistically significant, indicating that the farmers' participation in the SDRLRP project contributed to the improvement in KASA levels.

Almost all the SDRLRP project technologies were adopted by the majority of farmers in all two regions. The relative advantage the technologies have over existing ones, as well as the availability of the SDRLRP technologies to farmers, influenced the farmers' adoption intensity of the technologies. In addition to the relative advantage of the technologies and technology availability, the level of perceived effectiveness of the project, perceived level of knowledge, skills, attitude, and aspiration, mode of land payment, and marital status of farmers had a moderately positive association with the intensity of SDRLRP project technology adoption. Farmers' participation in the project, farming experience, farm size, and sex of farmers, on the other hand, were negatively associated with the intensity of adoption of

SDRLRP project technologies. This means that farmers' participation in the project implementation, for example, did not necessarily affect the intensity of adoption of project technologies.

The rice farmers' livelihoods have improved after participating in the SDRLRP programme. Specifically, all of the farmers' livelihood outcomes in terms of social, natural, financial, physical, and human capital were low before the project but improved highly after participating in the project. The improvement in all of the farmers' livelihood outcomes was statistically significant, indicating that the improvement is due to the SDRLRP programme. The SDRLRP project also benefitted rice farmers' household well-being, especially by increasing rice yield and savings. Furthermore, the project improved the income status of the farmers from moderately poor to better off.

Socio-economic and sociodemographic characteristics of farmers, as well as KASA, level of participation and perceived level of perceived effectiveness of the project, influenced the livelihood outcomes of the farmers. Specifically, the perceived level of effectiveness of the project, perceived level of attitude, land/farm size and perceived level of aspiration positively influenced the human capital livelihood outcome of the rice farmers. Natural livelihood outcome was influenced positively by perceived effectiveness and negatively by marital status. Social capital livelihood outcome was significantly and positively influenced by education status, farming experience, skills, aspiration and participation. The effectiveness of the project, however, negatively influenced the social capital livelihood outcome of the farmers. With regard to financial capital, factors such as the skills of

farmers, perceived effectiveness of the SDRLRP project and participation influenced it statistically and positively. Lastly, physical capital livelihood outcome was influenced positively and statistically by the perceived effectiveness of the project, land size, perceived level of participation in the project and farming experience.

Recommendations

1. Government of Ghana should invest in the efficient and effective use of resources in the implementation of agricultural programmes to enhance agricultural programmes' effectiveness.
2. The Directorate of Agricultural Extension of MoFA should fall on the district counterparts involved in the SDRLRP project to disseminate the SDRLRP technologies to non-participants to also benefit from the project.
3. Project implementors like MoFA should increase farmers' involvement in all stages of programmes to enhance their sense of ownership of the programme.
4. MoFA should organise more training on agricultural technologies programmes to improve farmers' KASA to improve their productivity and livelihood.
5. MoFA should use the existing farmer groups as training channels to impact and benefit other rice farmers throughout the country. This suggests that increasing rice farmers' knowledge of SDRLRP technologies and payment for land through sharecropping, for example, improves the intensity of SDRLRP technology adoption.
6. MoFA should embark on more training programmes to effectively and sustainably enhance rice cultivation to improve rice farmers' livelihoods.

7. MoFA should consider implementing more agricultural programmes to improve the livelihood of farmers in general and rice farmers in particular.

Area for Further Study

Counterfactual analysis of the impact of the SDRLRP project on the productivity and income of the rice farmers in the Northern and Ashanti regions of Ghana who participated in the SDRLRP project.

Contribution to knowledge

The study is one of its kind to holistically evaluate an agricultural programme like the SDRLRP project using Bennett's framework for evaluation in the Ashanti and Northern regions of Ghana. The framework is rarely used in evaluating agricultural programmes in Ghana, and even when it is used, researchers usually evaluate the "outcome" aspect of the framework and leave out the "input" aspect. This study, however, evaluated the SDRLRP programme from "input" to "output", which provided a holistic and in-depth insight into the SDRLRP programme and its impact on the beneficiary farmers. The study also employed a cross-sectional convergent mixed-method approach, which offered a multi-level strategy for delving deeper into the experiences of the rice farmers, AEAs (district counterparts) and regional directors (regional counterparts) on the project and their impression of the effectiveness of the project.

Furthermore, this study employs the theory of change to link the project's inputs and activities to outputs, outcomes and the overall goal of the project. Most impact evaluation studies on agricultural programmes, especially the SDRLRP, have not examined how inputs of the programmes translate into

outcomes to achieve the overall project goal. This study, thus, has filled a knowledge gap by providing empirical evidence to that effect.

Finally, the study is one of a kind to empirically explore the best predictors of livelihood outcomes in terms of human, social, financial, physical and natural capitals in the Northern and Ashanti regions. Participation, effectiveness, aspiration, knowledge, skills, marital status, educational level and experience were the best predictors. Thus, the study adds up to knowledge.

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APPENDICES

APPENDIX A: STRUCTURED INTERVIEW GUIDE FOR RICE FARMERS

DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION

COLLEGE OF AGRICULTURE AND NATURAL SCIENCES

UNIVERSITY OF CAPE COAST, CAPE COAST

This questionnaire is to solicit information on **the Impact of Sustainable Development Rainfed Lowland Rice Production Project (SDRLPP) on Small-Scale Rice Farmers in The Ashanti and Northern Regions of Ghana** from the participants of Sustainable Development Rainfed Lowland Rice Production Project (SDRLRPP). This questionnaire is an input for the Doctor of Philosophy (PhD) thesis research purely in pursuit of academic purposes. All information provided will be treated confidential and will be used solely for the study.

RESPONDENT'S INFORMED CONSENT

I am here to research the **Impact of Sustainable Development Rainfed Lowland Rice Production Project (SDRLPP) on Small-Scale Rice Farmers in The Ashanti and Northern Regions of Ghana**. Your honest responses will only be used for academic purposes and will be treated with the utmost confidentiality. Your participation is very important. You are free to ask me anything about this survey. Do you accept that I go ahead with the interview?

Respondent accepts the interview……. 1 (Conduct the interview)

Respondent does not wish to be interviewed…….. ….2 (Terminate interview)

Thank you for accepting to take part in this study.

Identification Information

Questionnaire number: _____

Name of interviewer: _____

Name of Respondent: _____

Telephone no. of Respondent _____

Date of interview: _____

Region of Respondent _____

District of Respondent_____

Village _____

SECTION A: HOUSEHOLD DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS

A1 Demographic Characteristics

1. Sex:
    1. Male [ ]
    0. Female [ ]

Please indicate your age at last birthday _____ (in years)

2. Please indicate your marital status
    1. Married [ ]
    0. Not Married [ ]

3. Please indicate the number of years you have spent in school: _____

4. Indicate your highest educational qualification. Please tick [√]

    1. No formal education [ ]
    2. Middle School [ ]
    3. Junior High School (JHS) [ ]
    4. Senior High School (SHS) [ ]
    5. Certificate in General Agriculture [ ]
    6. Diploma [ ]
    7. Degree (Bachelor) [ ]
    8. Postgraduate Diploma [ ]
    9. Masters [ ]
    10. Other [ ] (specify)

5. Please indicate the number of adults (18 years and above) in your household_____

6. Please indicate the number of dependents (household size) _____

7. How long (**in years**) have you been producing rice? _____

8. How did you acquire the land you use for rice farming?

    1. Own land [ ]
    2. Family land [ ]
    3. Bought [ ]
    4. Inherited [ ]
    5. Rented [ ]
    6. Other [ ] (specify)

10. If rented, how did you pay for it?

    1. Cash [ ]

    0. Sharecropping [ ]

11. What is the size (in acres) of your rice farm? _____

12. Where do you obtain financial capital for your farming? **(multiple answers possible)**

    1. Personal savings [ ]

    2. Relatives [ ]

    3. Cooperatives [ ]

    4. Bank [ ]

    5. Farmers association [ ]

    6. Others [ ] (specify) _____

13. What is the total quantity (**bag)** of paddy rice you harvested last year (2020)?

14. What is the total quantity (**bag)** of milled rice you harvested last year (2020)?

15. What is the current market price per bag of milled rice? _____ (GH¢)

16. Which source(s) do you obtain your inputs from (**multiple answers possible)**?

    1. Government [ ]

    2. Friends [ ]

    3. Farmer's Cooperative Society [ ]

    4. Open market [ ]

    5. Input dealers [ ]

6. NGO [ ]

17. Do you engage in any non-farm activity?

1. Yes [ ]

0. No [ ]

18. If yes, what were the sources of your non-farm income? Please indicate below:

No.	**Tic k**	**Non-farm income Activity**	**Amount (**GH¢)
1.		Non-farm wage income e.g. security etc. [ ]	
2.		Self-employed income: e.g. trading, artisan, carpentry, etc.[ ]	
3.		Award (s) [ ]	
4.		Others e.g. pension, capital earnings, etc. [ ]	
Total Amount GH¢			

19. What motivates you to cultivate rice in your region? (**multiple answers possible**)

1. Project coverage [ ]
2. Market accessibility [ ]
3. Available valley land [ ]
4. Easy to produce [ ]
5. Available fertile land [ ]
6. Experience with rice production [ ]
7. A good source of income [ ]

8. Other [ ] (specify)

20. Do you have a ready market for rice in this area?

1. Yes [ ]

0. No [ ]

21. Did you cultivate rice last year 2019/20?

1. Yes [ ]

0. No [ ]

22. If yes, indicate below:

Crop	*Area grown (acres)*	*Sources of seed (see Code below)*	*The year started growing crop*
Rice			

Codes Sources: 1= Own farm; 2= Other farmers; 3= Local market; 4= Rural agro-dealer; 5= Urban agro-dealer; 6= Seed company; 7= Extension worker (government), 8= NGO; 9=Farmers group; 10= Cooperative; Other (specify)

SECTION B: ORGANIZATION OR GROUP AFFILIATION

23. Have you participated in Farmer Organization/Association (FBO)?

1. Yes [ ]

0. No [ ]

24. If yes, name of the organization.

_____

25. If Yes (about Q23), what type of association (s) is it?

1. Savings and Credit Institution [ ]
2. Farmer's Cooperative [ ]

3. NGO [ ]
4. Other [ ] (specify)_____

26. In which year did you join this organization? (Year)_____

Are you still active in the organization? _____

1. Yes [ ]
0. No [ ]

27. If you are no longer active with the organization, why did you stop?

_____

28. (**If SDRLRPP supported**) What sort of training have farmers received to run farmers' organization?

1. _____

_____

2. _____
3. _____

29. What benefits have you had as a result of being a member of the SDRLRRP-supported farmer organization over the past year (2020) compared to 5 years ago (2015)?

1. _____
2. _____
3. _____

SECTION C: PERCEIVED EFFECTIVENESS OF THE SDRLRP

30. Kindly choose from the scale below to indicate the extent to which the following activities have been effective (the extent to which the project activities have been successful in achieving the intended results) to you. 1= Least Effective, 2 = Lowly Effective, 3= Moderately Effective, 4= Highly Effective, 5 = Very Highly Effective

ITEM NO.	**SDRLRP technologies: To what extent have you been able to achieve the following objectives?**	**Level of effectiveness**				
		1	**2**	**3**	**4**	**5**
1	Land preparation					
2	Bund construction					
3	Ploughing/levelling					
4	Off-farm water management					
5	Seed preparation					
6	Nursery preparation					
7	Planting					
8	Fertilisation					
9	Weeding					
10	Field management					
11	Harvesting					

SECTION D: LEVEL OF RICE FARMERS' PARTICIPATION IN THE IMPLEMENTATION CYCLE OF THE SDRLRP PROJECT.

31. Kindly choose from the scale below to indicate your level of participation (defined as the extent of involvement) in each cycle of the SDRLRP project implementation. 1=Very Low Involvement (VLI), 2=Low Involvement (LI), 3=Moderate Involvement (MI), 4=High Involvement (HI) and 5= Very High Involvement (VHI).

NO. OF ITEMS	PROJECT CYCLE/ACTIVITIES	LEVEL OF PARTICIPATION				
		1=VLI	**2=LI**	**3=MI**	**4=HI**	**5=VHI**
A	**Project identification**					
1	Assessing rice farmers' needs					
2	Prioritization of rice production projects					
3	Development of project proposal					
B	**Project planning**					
4	Raising community contribution					
5	Deciding project location					
6	Deciding project management team					
C	**Project implementation**					
7	Procurement of goods					

	and services					
8	Actual implementation of project activities					
9	Managing work and budget for the project					
D	**Project monitoring and evaluation**					
10	Reviewing project progress and performance					
11	Assessing achievement of project deliverables and objectives					
12	Determining whether project addresses rice farmers' need					

SECTION E: MEASURING KNOWLEDGE, ATTITUDE, SKILLS AND ASPIRATIONS (KASA) ON SDRLRP TECHNIQUES

Choose from the appropriate scale to indicate the level of your knowledge, attitude, skill and aspiration of the following SDRLRP activities using the scale below:

32. **Measuring knowledge**: Knowledge is knowing or having information about something. Here, knowledge is measured as the extent of information one has about the rice production technologies before and after the SDRLRP project. 1=Very low (VL), 2=Low (L), 3= Moderate(M), 4=High (H) and 5=Very High (VH).

		1=VLK, 2=LK, 3=MK, 4=HK, 5=VHK	
	SDRLRP technologies	**Before**	**After**
1	Prepare land for rice production.		
2	Construction of bund for rice production.		
3	Ploughing or levelling land for rice production.		
4	Management of off-farm water for rice production		
5	Preparation of seed for growing rice.		
6	Preparation of nursery for raising rice seedlings.		
7	Planting of rice seedlings.		
8	Application of fertilizer.		
9	Weeding within the rice farm.		
10	Management of rice field.		
11	Harvesting of rice.		

33. **Measuring Attitude**. Attitude is the perceived importance of the SDRLRP technologies using; 1= Not very important, 2=Not Important, 3= Moderately important, = Highly important and 5=Very highly Important.

NO. OF ITEMS		**1=NVI, 2=NI, 3=MI, 4=I, 5=HI**	
	SDRLRP technologies	**Before**	**After**
1	Prepare land for rice production.		
2	Construction of bund for rice production.		
3	Ploughing or levelling land for rice production.		
4	Management of off-farm water for rice production		
5	Preparation of seed for growing rice.		
6	Preparation of nursery for raising rice seedlings.		
7	Planting of rice seedlings.		
8	Application of fertilizer.		
9	Weeding within the rice farm.		
10	Management of rice field.		
11	Harvesting of rice.		

34. **Measuring skills**: Skills: The ability to practice the rice production technologies before and after the project., 1=Very low (VL), 2=Low (L), 3= Moderate(M), 4=High (H) and 5=Very High (VH)..

NO. OF ITEMS		**1=SW, 2=, 3=MS, 4=HS, 5=VHS**	
	SDRLRP technologies	**Before**	**After**
1	Prepare land for rice production.		
2	Construction of bund for rice production.		
3	Ploughing or levelling land for rice production.		
4	Management of off-farm water for rice production		
5	Preparation of seed for growing rice.		
6	Preparation of nursery for raising rice seedlings.		
7	Planting of rice seedlings.		
8	Application of fertilizer.		
9	Weeding within the rice farm.		
10	Management of rice field.		
11	Harvesting of rice.		

35. **Measuring Aspiration**. Aspiration is the willingness to achieve a goal. Here, it is the willingness to practice the rice production technologies before and after the SDRLRP project. 1=Very lowly

willing (VLW), 2=Lowly willing (LW), 3=Moderately willing (MW), 4=Highly willing (HW), 5=Very highly willing (VHW).

NO. OF ITEMS		**1=VLW, 2=LW, 3=MW, 4=HW, 5=VHW**	
	SDRLRP technologies	**Before**	**After**
1	Prepare land for rice production.		
2	Construction of bund for rice production.		
3	Ploughing or levelling land for rice production.		
4	Management of off-farm water for rice production		
5	Preparation of seed for growing rice.		
6	Preparation of nursery for raising rice seedlings.		
7	Planting of rice seedlings.		
8	Application of fertilizer.		
9	Weeding within the rice farm.		
10	Management of rice field.		
11	Harvesting of rice.		

36. Have you seen a demonstration or trial plot of SDRLRP technique in the last 5 years?

1. Yes [ ]

0. No [ ]

37. Do you know the name of the organization that conducted the demonstration or trial?

    1. Yes [ ]

    0. No [ ]

38. If yes, specify. _____

39. If you have experienced different methods of learning about SDRLRP techniques, which do you prefer? (**Multiple responses possible**)

    1. Field days [ ]

    2. Demonstration plots [ ]

    3. Media (TV/Radio) [ ]

    4. Other (specify) [ ]

40. What are your reasons for your answer in **Q40**?

SECTION F: LEVEL OF ADOPTION OF PROJECT TECHNOLOGIES AND THEIR IMPACT ON YIELD

41. If you have information (knowledge) about SDRLRP techniques, have you used or would you consider using the SDRLRP technologies in your farm?

SN	Sustainable Development Rainfed Lowland Rice Production techniques	1=Yes, already using	0=No, not Using	If not using, reasons	If using, when did you start
1	Preparation of land for rice				

	production.				
2	Construction of bund or rice production.				
3	Ploughing or levelling land for rice production.				
4	Management of off-farm water for rice production				
5	Preparation of seed for growing rice.				
6	Preparation of nursery for raising rice seedlings.				
7	Planting of rice seedlings.				
8	Application of fertilizer.				
9	Weeding within the rice farm.				
10	Management of rice field.				
11	Harvesting of rice.				

42. What determines your choice of adopting the SDRLRP technology? (TICK)

SDRLRP practice	Determinants					
	1=Relative advantage	2=Availability of technology	3=Compatibility	4=Ease of use	5=Observability	6=other
Preparation of land for rice production.						
Construction of bund for rice production.						
Ploughing or levelling land for rice production.						
Management of off-farm water for rice production						
Preparation of seed for growing rice.						
Preparation of nursery for raising rice seedlings.						
Planting of rice seedlings.						
Application of fertilizer.						
Weeding within the rice farm.						
Management of						

rice field.						
Harvesting of rice.						
Prepare land for rice production.						

43. For the field where you are practicing SDRLRP techniques:

Crop	Area acres	Production this year 2020/21		Production 5 years ago (2015)	
		Bags	*Kg*	*bags)*	*Kg*
Rice					

44. For the Field where you are **NOT** practicing SDRLRP techniques: (**note, if you are practicing SDRLRP techniques on all your rice fields, skip this**)

Crop	Area acres	Production this year 2020/21		Production 5 years ago (2015)	
		Bags	*Kg*	*bags*	*Kg*
Rice					

45. Have you observed any of the following changes as a result of adopting SDRLRP techniques?

Parameters	**Improving? 1 = yes 0 = no**	**If yes, Reason**	**Worsening 1 = yes 0 = no**	**If yes, Reason**	**Same as before? 1 = yes 0 = no**
Land preparation					
quality of rice					

grown for household consumption					
Area under crop					
Quality of rice for market					
Use of improved seed varieties					
Use of improved agronomic and post-harvest practices					
Use of fertilizer					
Food availability especially during the lean season					
Water holding capacity of land for producing rice					

46. How satisfied are you with Extension services? (TICK ONE)

1. Highly satisfied [ ]
2. Satisfied [ ]
3. Neither satisfied nor dissatisfied [ ]
4. Not satisfied [ ]
5. Highly unsatisfied [ ]

SECTION G: ACCESS TO INPUTS

47. Do you use any of the following inputs, for how long, and what are the sources?

Input	*1= Yes 0= No*	*Sources of input **(see code below)***	*The year started using input **(see code below)***	*Last 12 months*		*5 years ago*	
				The quantity used (Kg)	Amount spent	The quantity used (Kg)	Amount spent
Chemical fertilizer 1.NPK (15-15-15) 2. Urea 3.Sulphate of Ammonia 4. Others							
Agro chemicals							
1. Stump							
2. Surphosate							
3. Condemn							
4. Warrior							
5. Attack							
6. Alligator							
7. Others							
Tractor							
Improved seed of rice							
Other _____							

Codes Source: 1= Own farm; 2= other farmers; 3= Local market; 4= Rural agro-dealer; 5= Urban agro-dealer; 6= Seed company; 7= Extension worker

(government), 8= NGO; 9=Farmer group; 10= Cooperative; 99=Other (specify)

Codes Years: 0= Less than 1 year; 1= 1 year, 2= 2 years; 3= 3 years; 4= Four years; 5= Five Years 6=more than 5 years

48. How far do you have to travel to find an agro-dealer selling agro-inputs?

	1=Less than one km	**2=1-5 km**	**3=6-10 km**	**4=11-15 km**	**5=16-25 km**	**6=Over 25 km**
Improved Seed						
Fertilizer						
Agro-chemicals						

49. If there are agro-dealers in the area, how has the distance changed over the 5 years?
    1. Improved [ ]
    2. Worsened [ ]
    3. No change [ ]
    4. Don't know [ ]

50. How do you rate the quality of fertilizer/inputs available with your nearest agro-dealer?

Inputs	***1=Good quality***	***2=Average quality***	***3=Poor quality***
Seed			
Fertilizer			
Agro-chemicals			

51. Does your agro-dealer provide you with reliable advice on inputs?

    1. Yes [ ]

    0. No [ ]

52. If you buy inputs from agro-dealers, please indicate below:

Inputs	***1=Always***	***2=Sometimes***	**0=Never**
Seed			
Fertilizer			
Agro-chemicals			

53. If you do not buy seed and fertilizer from agro-dealers, what are the reasons? (TICK)

    1. Expensive [ ]
    2. Not always available [ ]
    3. Distance too far/difficult accessibility [ ]
    4. Insufficient inputs from agro-dealers [ ]
    5. Other (specify) [ ]

SECTION H: ACCESS TO FINANCIAL SERVICES

54. Do you receive credit/loan to purchase inputs? (TICK)

Inputs	***1=Yes, in cash***	***2=Yes, in-kind***	**0=No**
Seed			
Fertilizer			
Agro-chemicals			

55. If you applied for Credit, from what source and the amount received?

Source of Credit	**Tick √**	**Amount received (GH¢)**
Neighbour		

Farmer Group		
Cooperative Bank		
Commercial Bank		
Friend/Relative		
NGO/MFI		
Agricultural Finance/bank		
Village Bank		
Informal Moneylender		
Agrodealer		
Input subsidy (estimate value)		
Other (specify)		

56. If you did not apply for credit, what are the reasons? (TICK)

1. High-interest rates [ ]
2. Non-availability of credit institutions [ ]
3. Lack of procedure awareness to access credit [ ]
4. Other [ ] (specify)……..

SECTION I: "BEFORE" AND "AFTER" IMPACT OF THE SDRLRP PROJECT ON THE LIVELIHOOD OF BENEFICIARIES

57.

	BEFORE THE PROJECT					**AFTER THE PROJECT**				
ITEMS	**1=Very Low**	**2=Low**	**3=Moderately High**	**4=High**	**5=Very High**	**1=Very Low**	**2=Low**	**3=Moderately High**	**4=High**	**5=Very High**
Human capital										
Access to extension services										
Rice productio										

n skills										
Technical knowhow										
Managing land for rice production										
Water management										
Soil management										
Marketing skills										
Packaging skill										
Innovative and creative thinking										
Knowledge on sustainable rice farm management										
Natural capital										
Access to land										
Effective use of										

land for rice production										
Effective use of water for rice production										
Ability to pay 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 farmers ' cooperative										
Networkingwith other production group (NGOs and civic group)										
Networking with trade unions										
Financial capital										
Access to banks										
Access to credit unions										
Personal										

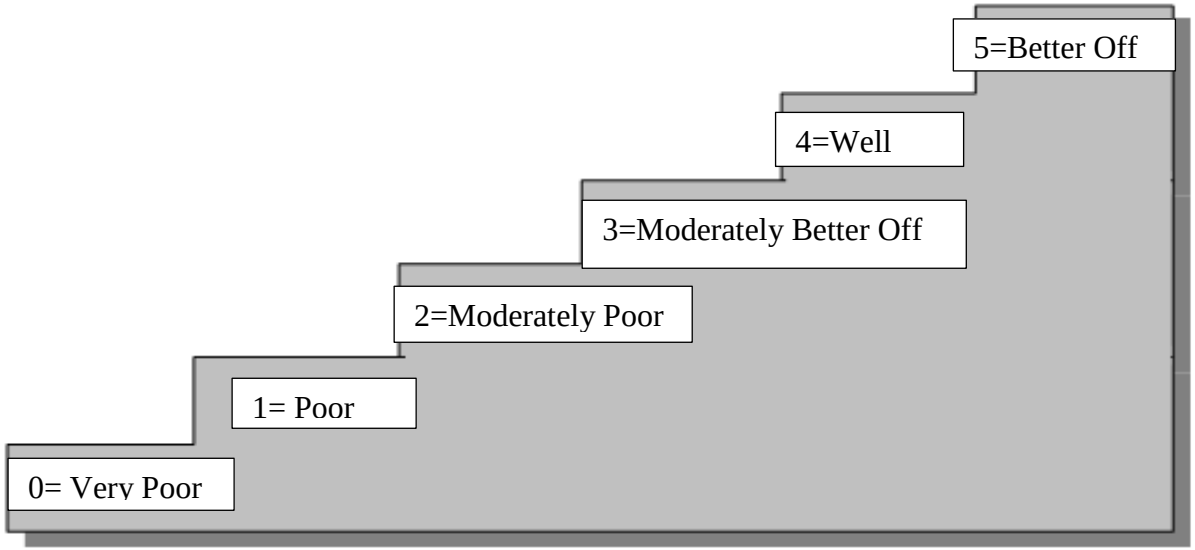
savings										
Access to Government subsidies										
Access to government grants										
Physical capital										
Ease of Transporting product										
Access to established market										
Accessible roads										
Access to farm implements										

SECTION J: SDRLRP PROGRAMME IMPACT ON HOUSEHOLD

58. Have you observed the following changes in your household over the past year (2020) compared to 5 years ago (2015) in:

Parameters	**Improving? 1 = yes 0= no**	**If yes, Reason**	**Worsening? 1 = yes 0 = no**	**If yes, Reason**	**Same as before 1 = yes 0= no**
Purchase of household items					
Children's health					
Crop yield					
Payment of medical bills					
Payment of children school Expenses					
Saving money for future					
Access to a regular healthy meal					
Payment of rent					
House maintenance					
Income					

59. Imagine six steps, where on the bottom step (1) stand the poorest people, and on the highest step stand the richest IN THIS COMMUNITY (Show the picture below)



60. On which step were you in 2015 _____?
61. What is your current position 2021 _____?
62. Would you attribute your current position to SDRLRPP?
    0. No [ ]
    1. Yes [ ]
    2. Partially [ ]

THANK YOU VERY MUCH!

APPENDIX B: KEY INFORMANT INTERVIEW GUIDE

As part of the process of validating beneficiary knowledge, effectiveness levels and perceived impact of SDRLRP Project, selected stakeholders were interviewed to elicit their views and perceptions.

Also, the stakeholders' satisfaction levels on identified variables including application of SDRLRP Project techniques, production and productivity levels, participation in project design and implementation, production, access to inputs, finance and information, processing and marketing and impact on income livelihood among others, were assessed. Issues that were addressed with the KII include:

i. What were the resources (inputs) used to implement the SDRLRP project?

ii. In your opinion, to what extent were the project resources used to achieve the objectives of the SDRLRP Project?

iii. What is your perception about the effectiveness of the project structure and output/outcome delivery mechanisms?

iv. what is your opinion about the Project implementation processes for delivery of outputs and outcomes of the SDRLRP Project?

v. What is your position on the relevance, design and implementation structure of the SDRLR Project?

vi. What institutional and community knowledge management structures and system on the promotion of SDRLRP Project technologies among farmers and farmers groups are used?

vii. What policies and investment environment are created for the promotion of SDRLP Project?

THANK YOU VERY MUCH!

APPENDIX C: FOCUS GROUP GUIDE

As part of the process of validating beneficiary knowledge, effectiveness levels and perceived impact of SDRLRP Project, selected farmers were interviewed to elicit their views and perceptions.

Issues that were addressed with the FGG include:

i. What is your perception about the effectiveness of the project structure and output/outcome delivery mechanisms?

ii. what are the factors that influenced your adoption of the SDRLRP technologies?

iii. Why did you not adopt some of the SDRLRP technologies?

iv. What is the relevance of the SDRLR technologies to you?

v. What have you gained from adopting the SDRLRP technologies?

vi. What have you learned from participating in the SDRLRP project?

vii. Is there anything else you want to say?

THANK YOU VERY MUCH!

APPENDIX D: ETHICAL CLEARANCE

UNIVERSITY OF CAPE COAST
INSTITUTIONAL REVIEW BOARD SECRETARIAT
TEL: 0558093143 / 0508878309
E-MAIL: irb@ucc.edu.gh
OUR REF: UCC/IRB/A/2016/1204
YOUR REF:
OMB NO: 0990-0279
IORG #: IORG0009096

13TH JANUARY, 2022

Mr. Gabriel Owusu
Department of Agricultural and Extension
University of Cape Coast

Dear Mr. Owusu,

ETHICAL CLEARANCE – ID (UCCIRB/CANS/2021/31)

The University of Cape Coast Institutional Review Board (UCCIRB) has granted Provisional Approval for the implementation of your research titled **The Impact of Sustainable Development Rainfed Lowland Rice Production Project (SDRLPP) on Small-Scale Rice Farmers in the Ashanti and Northern Regions of Ghana.** This approval is valid from 13th January, 2022 to 12th January, 2023. You may apply for a renewal subject to submission of all the required documents that will be prescribed by the UCCIRB.

Please note that any modification to the project must be submitted to the UCCIRB for review and approval before its implementation. You are required to submit periodic review of the protocol to the Board and a final full review to the UCCIRB on completion of the research. The UCCIRB may observe or cause to be observed procedures and records of the research during and after implementation.

You are also required to report all serious adverse events related to this study to the UCCIRB within seven days verbally and fourteen days in writing.

Always quote the protocol identification number in all future correspondence with us in relation to this protocol.

Yours faithfully,

Samuel Asiedu Owusu, PhD
UCCIRB Administrator

ADMINISTRATOR
INSTITUTIONAL REVIEW BOARD
UNIVERSITY OF CAPE COAST