UNIVERSITY OF CAPE COAST

AN EXTENSION TRAINING MODEL FOR IMPROVING CAPACITY OF SMALLHOLDER FARMERS AND AGRICULTURAL EXTENSION AGENTS IN RICE POST-HARVEST VALUE ADDITION IN SOUTHERN REGION, SIERRA LEONE

PHILIP JIMIA KAMANDA

2022

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BY

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Thesis Submitted to the Department of Agricultural Economics & Extension of the School of Agriculture, College of Agriculture and Natural Sciences, University of Cape Coast, in Partial Fulfillment of the Requirements for the Award of Doctor of Philosophy Degree in Agricultural Extension

OCTOBER 2022

DECLARATION

Candidate's Declaration

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

Candidate's Signature:……………………….. Date………..……………….

Name: Philip Jimia Kamanda

Supervisors' Declaration

We hereby declare that the compilation of this thesis was supervised by us in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast, Ghana.

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Name: Dr. Albert Obeng Mensah

ABSTRACT

Smallholder farmers in Sierra Leone have limited competencies in rice post-harvest value addition (RPHVA). They rely on traditional technologies to manually harvest and process their rice after harvest. The study aimed at developing an extension training model to improve the capacity of farming actors (smallholder farmers and Agricultural Extension Agents) for RPHVA with the intent to identify the competencies required and the appropriate methods of delivery. A mixed-methods approach was used to generate quantitative and qualitative primary data from four hundred (400) smallholder farmers, fifty (50) Agricultural Extension Agents (AEAs), and eleven (11) senior ministry officials (key informants). For the quantitative data, descriptive statistics, Borich needs assessment model, and the OLS multiple regression were used for the analysis while thematic analysis was used for the qualitative data. Key findings show a low level of competence of farmers, inadequate value addition resources for the actors, and low value addition activities. The rice market is imperfect, characterised by low profit and livelihood of the farmers. The context is characterised by peasant farming, with a high AEA to farmer ratio, and low motivation of AEAs. The major RPHVA training needs of the farming actors were packaging, marketing, milling, and drying of paddy rice. The majority of the actors prefer the group extension training methods. The Ministry of Agriculture and Food Security of Sierra Leone should emphasise packaging, marketing, mechanised milling and drying, group extension methods to promote RPHVA. Further, it should adopt a dynamic need-based training model to respond to the current and emerging training needs of actors in the RPHVA in Sierra Leone.

KEYWORDS

Agricultural Extension Agents (AEAs)

Competence

Key Informants (KIs)

Rice Post-harvest Value Addition (RPHVA)

Smallholder farmers

Training model

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DEDICATION

To my wife Jennifer, and children: Philip (Jr), Grace, Paul, Peter and Philippa.

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LIST OF ACRONYMS

ABCs	Agricultural Business Centres
AEAs	Agricultural Extension Agents
AfDB	Africa Development Bank
AGRA	Alliance for a Green Revolution in Africa
BADEA	Arab Bank for Economic Development in Africa
BES	Block Extension Supervisor
DAO	District Agricultural Officer
FAO	Food and Agricultural Organization
FBO	Farmer Based Organization
FEW	Field Extension Worker
GDP	Gross Domestic Product
GoSL	Government of Sierra Leone
GTA	Graduate Teaching Assistant
HDI	Human Development Index
IFAD	International Fund for Agricultural Development
IRB	Institutional Review Board
KIs	Key Informants
MAFS	Ministry of Agriculture and Food Security
MOFA	Ministry of Food and Agriculture
MWDS	Mean Weighted Discrepancy Score
NERICA	New Rice for Africa
NS.D.AP	National Sustainable Agricultural Development Plan
NGO	Non-Governmental Organization
OLS	Ordinary Least Squares

REC	Research Ethics Committees
RPHVA	Rice Post-Harvest Value Addition
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
S.D.	Standard deviation
SLARis	Sierra Leone Agribusiness and Rice Value Chain
SL-RVCP	Sierra Leone Rice Value Chain Project
SPSS	Statistical Package for Social Sciences
UCC	University of Cape Coast
US.D.	United States Dollars
VIF	Variance Inflation Factor

CHAPTER ONE

INTRODUCTION

Assessing the competence of smallholder rice farmers and Agricultural Extension Agents (AEAs) is a vital aspect of the entire cycle of agricultural development in Sierra Leone. The need to determine the competencies of smallholder farmers and AEAs will lay the basis for the development of an extension training model for rice post-harvest value addition in Sierra Leone. These two sets of actors, farmers and AEAs are the main promoters of sustainable rural and agricultural production, as technologies and information management processes evolve. They comprise the extension system's most important resources: their knowledge, skills and other associated work competencies are essential for technology transfer. Thus, they need continuous training in line with their training needs through a well-developed training model for rice post-harvest value addition. This chapter, therefore, focuses on the background of the study, statement of the research problem, the purpose of the study, research objectives and questions, research hypothesis, significance of the study, delimitations, limitations, definition of terms, and organisation of the study.

Background to the Study

Agriculture remains the backbone of Sierra Leone's economy, and it accounts for nearly 50% of the country's Gross Domestic Product (GDP) (Conteh, 2021). The sector hires about 70-75% of the total national active labour force between the ages of 15-64 years where the women population is predominant (Conteh, 2021). As of 2020, the overall population of the country was 7.9 million, with over half of the population living in rural areas, even though this is gradually reducing (Food and Agriculture Organization of the United Nations (FAO) and the International Telecommunication Union (ITU), 2022). Also, the Human Development Index (HDI) for the nation for 2019 was 0.452, placing it in the 182nd position out of 189 countries with weak human development indexes and a life expectancy of 54.7 years (Human Development Report, 2020).

Nearly all Sierra Leonean households consume rice as their main staple food, but the crop is cultivated at a subsistent level with low productivity (0.97t/ha) which is far below the demand for consumption (Graham, 2020). For example, statistics from the Ministry of Agriculture and Food Security (MAFS) show that the total rice demanded in 2018 was 1.6 million tonnes, as against local production of 700,000 tonnes (Demaree-Saddler, 2020). The land coverage of Sierra Leone is 72,300sq.km out of which only a 5.4million hectares have been potentially cultivable (Ighobor, 2014). The upland ecology consisting of 80.0% of arable land is best for the production of varying cash crops while the lowland with maximum fertility is also suitable for very high crop yields (Ighobor, 2014). This is against the backdrop that although the country possesses this enormous potential for self-sufficiency in rice, yet less than 10.0% of the land is under cultivation (Chenoune, Belhouchette, Paloma, & Capillon 2016). Diagne, Amovin-Assagba, Futakuchi, and Wopereis (2013) in their rice growing countries statistics survey in Africa realised that countries like the Democratic, Republic of Congo, the Central African Republic, and Sierra Leone were few, which have the lowest rice yields.

Given the importance of rice in the national nutritional intake and economy, the country spends a colossal amount of its meagre foreign exchange of U.S.D. 200 million (International Fund for Agricultural Development (IFAD), 2020) and over US.D. 240 million is spent on rice importation annually (Sierra Leone Country Guide, 2021). This expenditure is considered unacceptable given that Sierra Leone has enormous agricultural potential, with 5.4 million hectares suitable for rice cultivation. To achieve the food sufficiency goal, there is a need for rice value addition. The value addition within the agricultural value chain involves the production, storage, and processing of goods in the chain, from farm to food, and harnessing the practical experience and resources of the private sector through partnerships to improve trade outcomes and development (Fukunishi, Goto, & Yamagata 2013). The Government of Sierra Leone is accordingly seeking ways to improve rice production. As a matter of urgency, the New Direction Agenda of the Government of Sierra Leone with high priority in the Medium-Term National Development Plan aims at promoting domestic agribusiness that focuses on priority agricultural value chain, improvement in the livelihoods of the beneficiaries by enhancing their production and productivity.

In line with this effort, the Sierra Leone Agribusiness and Rice Value Chain (SLARiS) project seeks to address the myriad of challenges confronting the rice sector for production and productivity in Sierra Leone, through three main methods: 1) enhancement of agricultural input production and distribution systems; 2) agribusiness development, and 3) institutional capacity development and project management. Among the most widespread and recurrent challenges facing food security including poverty reduction in Sierra Leone is the severe lack of skilled staff in the areas of research and extension services (Koroma, Jalloh, Gogra, & Yokie, 2019). This situation has been much more critical over the last decade as scarce trained workers depart for employment outside the country to avoid the effects of the conflict (Koroma et al., 2019).

It is the belief that a supportive agricultural extension system through effective training and support services must be at the centre of developing strategies for improving rice production to meet the national and individual needs of the country. This agenda will contribute directly to the government strategy to support agribusiness and institutional capacity development. A major role is played by agricultural extension in educating farmers to improve productivity at the farm level (Idah, 2016). Agricultural extension is a system that promotes knowledge acquisition and technologies for farmers, their organisations, and other market actors to promote their engagement in science, agribusiness, education with other actors, and other related institutions and assist them in developing their own scientific, organisational, and management skills and practices (Danso-Abbeam, Ehiakpor, & Aidoo, 2018). In addition, Danso-Abbeam et al. (2018) reiterate that agricultural extension services enable technology transfer, fund rural adult learning, assist farmers in problem solving, and engage farmers in the agricultural knowledge and information system.

Agricultural extension programmes are the main channels for combating rural poverty and food insecurity. According to Tladi-sekgwama (2019), throughout the world, agricultural extension remains an important strategy for rural development; without an efficient extension service, a nation should not expect to achieve growth in agriculture. Agricultural extension programmes, therefore, promote a transition to farmers' knowledge and best practices. The traditional extension programme in many developing countries is conducted mainly by an extension officer who visits farmers or farmers' field schools with agricultural information geared toward production (Sanga et al., 2014). Farmers rely on information from the agricultural extension programmes for decision-making to preserve profitability and boost productivity and quality. The problem is that the needs of farmers are rapidly changing with a focus on not only production but also the uncountable number of issues affecting the whole value chain of their produce.

To mitigate this issue, the value addition concept now requires farmers, as actors in the value addition chain to access services of different types (market and technical) from other actors, which will include skills for mapping and negotiating services. Besides, farmers will need to increase their skills in the development of a product and its process, understand the flexibility of markets to meet the changing consumer demands, and improve their ability to respond to and customize products for consumers. In addition, they are to also ensure cost control and efficiency, manage risk effectively, optimise logistics and transportation/distribution systems, and work as part of all-inclusive structures that integrate the entire supply chain and ensure quality along the chain. Additionally, they are to learn how to gather and share information, develop attitudes toward collaboration, and build the capacity to trust and to be trusted.

The agricultural extension system in Sierra Leone, which builds the capacity of farmers in rice value addition, like many other developing countries, is confronted with many challenges. Few AEAs are serving many smallholder farmers. For example, in Kenya, the farmer-to-extension officer ratio is 753:1. It is even worse in Sierra Leone where the ratio is 1,200-1,400 farmers to 1 extension agent (Guo, Jia., Huang, Kumar & Burger (2015). The debate on whether such few AEAs can represent a larger community of farmers is unabated (Bitzer et al., 2016). For example, Bilali, Berjan, and Bodiroga (2015) reported that farmers find it difficult to gain new knowledge on their own to deal with farming problems. The reason being, a weak extension service delivery system, a lack of sufficient staff, and incompetent and untrained extension officials (Thabet, Dhehibi, Kassam, & Aw-Hassan 2016). The efforts supporting the rice value addition project will require major agricultural transformation to improve the production of smallholder farmers and market access. This effort must have two targets: farmers and the AEAs who work closely with them.

The smallholder farmers are to be supported through training by well trained and competent AEAs in rice farming techniques along the rice value chain. The development of effective agricultural value chains is therefore critical for poverty reduction and combating food insecurity in developing countries (Devaux, Torero, Donovan, & Horton, 2018). Though the government's capacity is limited in extension and technology, extension services, and measure to mitigate the limitations of AEAs are on course through the introduction of fast growing private agricultural businesses into a win-win situation in partnerships with farmers (Menezes, Ridler, & Murekezi, 2018). The country needs to move to value addition development by a market-driven approach.

The traditional, top-down approach that lacks the account for diversified land situations and the needs of farmers, in an era of rapid marketing, is the prevalent feature of extension services in most developing countries (Dhital, 2017). Although extension services are made available, in some instances, farmers find them not very useful as services have been devised without due diligence. As argued by Alliance for a Green Revolution in Africa (AGRA) (2017), agricultural liberalisation policies since the early 1980s have not seen much change in post-harvest activities and holistic approaches to dealing with agricultural issues are still neglected because of limited knowledge of the value chain in general. Extension systems in most developing countries including Sierra Leone are still characterised by weak linkages with research institutions; inadequate AEAs; lack of technical and managerial competence to successfully deliver products to value chains; and a lack of good training opportunities for the AEAs (Belay & Abebaw, 2004). As such, training as a means for farmers and AEAs to acquire specific skills to better perform their jobs is thus, needed (Saleh et al., 2016). This training should consider the socio-demographic characteristics of the farming actors that influence their competence in rice post-harvest value addition practices.

Following the preceding background, training smallholder farmers and AEAs in rice post-harvest value addition are paramount if the government of Sierra Leone is to succeed with its aim of improving food security and livelihood improvement through post-harvest value addition to rice. Training smallholder farmers and AEAs is an important part of the entire cycle of agricultural development, but it must be based on the training needs of the farmers and AEAs. Assessment of training needs describes the operational technique of gathering and reviewing evidence that informs decision-making where preparation is the right (or not) choice for optimising success for people, determining who should be trained and what curriculum should be taught precisely (Watkins, West Meiers, & Visser, 2012).

The training needs of smallholder farmers and AEAs vary from time to time as technologies and information management processes evolve. Bearing this in mind, the farmers and AEAs are always in dire need of several interventions. Thus, if farmers and AEAs are to improve their job effectiveness, training is needed, and they must, for that reason, get continuous in-service training in line with their training needs (Alibaygi & Zarafshani, 2008a). So, to conduct training, a training needs assessment must be undertaken to develop appropriate and need-based training programmes for farmers and AEAs (Ferreira, 2013).

Statement of the Problem

Sierra Leone has suitable environmental conditions such as abundant rainfall (3,000-5,000; 2,000-2,500mm/year) in the coastal area and the inland respectively, naturally fertile soils, sufficient sunlight, and river basins which make the country apt for the cultivation of a wide range of food and other economic crops (Graham, 2020). Nonetheless, the production level of rice is not keeping pace with the growing population, and the government, therefore, purchases 84.2% of the total quantity of rice consumed at the national level (The World Bank, 2014). Studies have shown that several factors are associated with the limited supply of rice among which cannot be unconnected with post-harvest value addition technologies. For instance, Kamara and Cooke (2015) in Sierra Leone have found that value-added prospects for rice in Sierra Leone are few, especially for locally produced rice. Smallholder rice farmers in the country mainly harvest their rice manually, including threshing, drying, milling, packaging, and storage operations at their disposal. Another study by Kamara and Mansaray (2015) in Sierra Leone also shows that notwithstanding farmers' access to improved facilities at the Agricultural Business Centres (ABCs) in their farming localities, the majority of the farming activities except milling operations are still done traditionally in the country. Thus, the call for extension support by farmers in rice post-harvest value addition in Sierra Leone is timely.

Subsequently, the Government of Sierra Leone is making efforts to improve rice production from its current 1.23 tonnes/ha to 2 tonnes/ha through several strategies (Demaree-Saddler, 2020). Additionally, the government has therefore made increased rice production one of its key development strategies, with the hope to achieve self-sufficiency and food security as the staple food of the country (Kumar & Kalita, 2017). Key among the strategies is; the African Development Bank (AfDB) US.D.11 million investment in the Agribusiness and Rice Value Chain Support Project, which primarily is to stimulate agribusiness development through rice production. The aim of the government is to produce an additional 900,000 metric tonnes (MT) of rice by 2023 (AfDB, 2020). Secondly, the Sierra Leone government has also received US.D. 34.12 million aid from the Islamic Development Bank (IS.D.B) and Arab Bank for Economic Development (BADEA) in Africa to support the rice value chain (Sierra Leone Regional Rice Value Chain Development Project (SLRRVDP), 2020). The Sierra Leone Rice Value Chain Project (SL-RVCP) project forms part of the Regional Rice Value Chain Program (RRVCP) with ten countries in the region as beneficiaries.

The current context of rice value addition in the country will, especially at post-harvest stages require AEAs to go beyond the traditional extension practice to help in the establishment and management of farmer groups that are involved in issues with sales, and collaborating with a wide range of service providers and other actors. Furthermore, the AEAs are to be obliged to seek solutions to the constraints that limit the efficiency and productivity of other actors in the chain, and the development of cooperative relationships among actors (Ammani & Abdullahi, 2015).

This intervention is important because, it is indicative that the inability of Sierra Leone to achieve food sufficiency and food security in rice production is partly due to poor value addition, which is also due to the lack of ability of smallholder farmers and AEAs to develop effective rice post-harvest value addition technologies. Bridging this gap means providing smallholder farmers and AEAs with the required rice post-harvest value addition competencies. At the moment, very little is known about the types of competencies and training needs smallholder farmers and AEAs in Sierra Leone have and require in rice post-harvest value addition. In addition, to seek the best ways to provide those required competencies and needs. Also, there is limited literature on the influence of the socio-demographic characteristics of the smallholder farmers and the AEAs on their competencies in rice post-harvest value addition. Hence, the need for this study.

Purpose of the Study

The purpose of the study is to determine an agricultural extension training model that can be used to improve the capacity of smallholder farmers and AEAs in rice post-harvest value addition in Southern Sierra Leone. The intent is to support the effort of the government in providing effective extension services toward rice development in Sierra Leone to achieve food security.

Specific Objectives

To achieve the purpose of the research, the following specific objectives were set to:

1. characterise the context of smallholder rice post-harvest value addition in the Southern Region of Sierra Leone, in terms of resourcing, value addition, marketing (input-output), extension services, the profitability of operations, and farmer livelihood;
2. assess the competencies of smallholder farmers and AEAs (farming actors) in rice post-harvest value addition in the Southern Region of Sierra Leone;
3. establish the relationships between the competencies of the farming actors (smallholder farmers and AEAs) and their socio-demographic characteristics in rice post-harvest value addition in the Southern Region of Sierra Leone.
4. determine the training needs that are appropriate for smallholder rice post-harvest value addition in Sierra Leone;
5. find smallholder farmers' and AEAs' preferences for training methods in rice post-harvest value addition, and
6. develop an extension training model for building the capacity of smallholder farmers and AEAs in rice post-harvest value addition in Sierra Leone.

Research Questions

The following research questions guided the study:

1. What is the state of smallholder rice post-harvest value addition in terms of resourcing, value addition, marketing (input-output), extension services, and profitability of operations and livelihood?
2. What are the competencies of smallholder farmers and AEAs in rice post-harvest value addition in the Southern Region of Sierra Leone?
3. What is the relationship between the competencies of farming actors in rice post-harvest value addition in the Southern Region of Sierra Leone, and their socio-demographic characteristics?
4. What training needs are appropriate for smallholder farmers and AEAs in rice post-harvest value addition?
5. What training methods in rice post-harvest value addition do smallholder farmers and AEAs prefer?
6. What training model can help build the capacity of smallholder farmers and AEAs in rice post-harvest value addition in Sierra Leone?

Research Hypotheses

The following research hypotheses below were tested at 95.0% confidence intervals or 0.05 alpha levels.

1. A null hypothesis $[H_0]_1$: There is no significant relationship between the competencies of smallholder farmers in rice post-harvest value addition and their socio-demographic characteristics (sex, age, educational level, income level, etc.).;
2. A null hypothesis $[H_0]_2$: There is no significant relationship between the competencies of AEAs in rice post-harvest value addition and their socio-

demographic characteristics (sex, age, educational level, income level, etc.),

3. A null hypothesis $[H_0]_3$: There is no significant difference between the competency levels of smallholder farmers and the AEAs in rice post-harvest value addition.

Significance of the Study

The findings from this study will inform policymakers in the Ministry of Agriculture and Food Security in Sierra Leone of the acquired and required competencies and training needs of smallholder farmers and AEAs in rice post-harvest value addition. This is key for boosting rice production levels, thereby increasing the quality of rice in the country. The findings will further identify and enhance the development of extension education methods that are appropriate for building the capacity of actors in smallholder rice post-harvest value addition. Also, it will create an understanding of which socio-economic characteristics of smallholder farmers and AEAs will help to determine their competence in rice post-harvest value addition. Lastly, the study outcomes will help to develop a need based extension training model that will be used by both smallholder farmers and AEAs to strengthen their capacity in rice post-harvest value addition in the Southern Region, and Sierra Leone by extension.

Delimitations

Agricultural extension services are provided by the public sector in all five regions in Sierra Leone although at different levels. However, the study targeted farmers with small holdings and AEAs in the Southern Region of Sierra Leone that are involved in rice post-harvest value addition activities. The reasons are that the Southern Region is a major rice growing area in Sierra

Leone, with the biggest rice development project and rice mill. Secondly, the region anchors Bo town which is the key rice trading centre in the Bo district (Famine Early Warning System, 2017). Finally, the region shares all the ecological attributes of the other four regions where farmers need extension services, especially, in rice post-harvest value addition.

The study is restricted to the rice post-harvest stages which needed much attention in Sierra Leone. According to Kamara and Mansaray (2015), farmers in Sierra Leone continue to experience high losses from post-production activities in rice cultivation. Hence, the need to focus attention on rice post-harvest value addition.

Limitations

The lack of current empirical data on the total number of smallholder farmers in the region is a limitation. As a result, 157,114 farming households (Statistics Sierra Leone, 2016) were instead used to determine the sample size of the smallholder rice farmers. Furthermore, only eleven out of fifteen key informants (KIs) availed themselves for an interview. Meeting with four senior MAFS KIs comprising the Hon. Minister, two deputy ministers, and the permanent secretary was impossible due to their tight schedules. Nonetheless, every effort was sought to circumvent these limitations through triangulation or the use of multiple data sources.

Definition of Terms

Agricultural Extension. A process whereby MAFS's AEAs work with smallholder farmers to improve their livelihoods through sharing of improved knowledge and skills in the Southern region of Sierra Leone.

Agricultural Extension Agent. A public expert in agriculture who is professionally trained and skilled to provide technical and marketing information, access to inputs, and service providers for smallholder farmers in adding value to rice at post-harvest stages in their study areas.

Agricultural Extension Training Supports. These include materials such as inputs and capital resources; human resources like subject matter specialists (SMSs), service providers, extension agents, and infrastructure, finances/credits/grants needed for the training and its application.

Chiefdom. A geographical demarcation headed by a paramount chief from a ruling family who hails from that chiefdom created by the then British colonial administration in 1896 to assist in the central administrative functions in Sierra Leone.

Competency. The ability of smallholder farmers and AEAs to have improved knowledge and skills that can be put into rice post-harvest value addition practices.

Cottage industry. It is a small-scale enterprise/business a smallholder farmer embarks upon as a source of income. Examples include soap making, weaving, food and drinking bars, art and craft work, etc.

District. One of the sixteen parts of the country that contains several chiefdoms delineated by fixed geographical boundaries used for official purposes.

Extension training model. In this study, the extension training model describes how training contents and methods are assessed, structured, and organized to meet the local training needs of farmers.

Extension training needs. These are post-production technologies in rice value addition where farmers and AEAs require training.

Extension training needs assessment. It is an evaluation process of what competencies AEAs and smallholder farmers presently have, and what is required of them.

Household. People who generally live together, feed from the same pot and identify one person as the head of the household.

Land-grant colleges and universities. Higher institutions sustained and funded by the Morrill Acts of 1862 and 1890 and enlarged by the Act of 1887, the Smith-Lever Act of 1914, and subsequent legislation.

Micro-business. A small business owned and managed by a few members that contribute to their income. Examples are thrift and credit associations, and working groups.

Paddy rice. Rice grain harvested by farmers that is often in the husk or not yet processed into a clean form.

Post-harvest technologies. Post-harvest technologies are treatments given by smallholder farmers to rice in a well-coordinated set of activities from the harvesting stage to all handling techniques to improve the rice quality, consumable rice products, and shelf life.

Rice. Is the processed paddy whose paddy has been removed and sometimes made polished.

Smallholder farmers. Are farmers who have restricted access to production resources (land, labour, and capital), vulnerable to risks, and operate an average of 1.63ha of farmland or less (Fileding et al. 2015). They practice mixed cropping including rice at the subsistence level and sell out surplus produce to supplement their income.

Training. Giving skillful guidance to smallholder farmers and AEAs to achieve competence in performing their tasks in a better and more effective manner.

Post-harvest Value addition. The processes through which smallholder farmers as processors transform paddy through post-harvest activities e.g. (threshing, parboiling, drying, milling, polishing, sorting, packaging, labelling, storing, etc.). This is done by changing paddy/rice from its original raw state to a processed and value added commodity with an extended shelf life to attract high prices from buyers.

Value chain. Involves a set of actors (smallholder farmers, AEAs, processors, transporters, and marketers) and their activities at each processing stage that bring value added rice from the field to the consumers.

Southern Region. One of the five administrative regional divisions in Sierra Leone which contains four districts.

Organisation of the Study

The thesis is organised in nine chapters.

Chapter one introduces the research topic and provides a background to the study. It presents the statement of the research problem, the purpose of the study, research objectives, research questions, hypotheses, significance, delimitation, limitations of the study, the definition of terms, and organisation of the study.

Chapter Two presents a review of the related literature that is considered relevant to the study. The subsections under this chapter include the theoretical framework, review of concepts, and empirical framework. The theoretical framework presents the relevant theories that underpin the rice post-harvest value addition activities. The key concepts reviewed in this chapter include smallholder rice farmers, AEAs, rice value addition competencies, agricultural training needs, and the agricultural training model. The chapter further reviews empirical literature, which mainly captures the context of the smallholder farmers, competencies of smallholder farmers and AEAs, associations between the socio-demographic characteristics of smallholder farmers and AEAs and their training needs in rice post-harvest value addition, training content appropriate for smallholder and AEAs for rice post-harvest value addition, extension education methods appropriate for smallholder farmers and AEAs in rice post-harvest value addition. The chapter ends with the conceptual framework of the study.

Chapter Three explains the research methods that are used. It presents the research design, describes the study area, study population, sampling procedures, ethical considerations, data collection instruments, training of enumerators, pre-testing of the survey instruments, data collection procedures, processing and analysis of data, and choice of the model used for analysing the data.

The fourth chapter describes the demographic and socio-economic characteristics of smallholder farmers and AEAs and describes the context of smallholder rice post-harvest value addition in the Southern Region of Sierra Leone. The context issues include resourcing, value addition, marketing, extension services, the profitability of operations, and the livelihood of smallholder farmers in rice value addition.

Chapter Five describes the competencies of smallholder rice farmers and AEAs in the Southern Region of Sierra Leone. It begins with the assessment of rice post-harvest value addition competencies of smallholder farmers followed by the assessment of rice post-harvest value addition competencies of AEAs. The chapter further determines the difference between the socio-demographic characteristics of smallholder farmers and their competencies in rice post-harvest value addition in the Southern Region of Sierra Leone. Further, the Multiple Regression analysis is used to determine the relationship between the competencies of the smallholder farmers and their socio-demographic characteristics. This is followed by determining the relationship between the competence of AEAs and their socio-demographic characteristics in rice post-harvest value addition in the Southern Region of Sierra Leone. These are followed by tests of the hypotheses.

Chapter Six details the training needs of smallholder farmers and AEAs in rice post-harvest value addition. It further discusses the training needs of smallholder rice farmers and is followed by the training needs of AEAs.

Chapter Seven catalogues the appropriate extension education methods suitable for smallholder rice post-harvest value addition in Southern Sierra Leone. It specifically targets the appropriate extension education methods for smallholder farmer rice post-harvest value addition for farmers, and the appropriate extension education methods for smallholder rice post-harvest value addition for AEAs.

Chapter Eight presents the extension training model for training smallholder farmers and AEAs in rice post-harvest value addition in Southern

Sierra Leone for capacity building. It describes the generic and dynamic rice post-harvest value addition frameworks to train the farming actors. The generic value addition framework presents the contribution of the study to knowledge.

Chapter Nine presents a summary of research findings, conclusions, and recommendations based on the findings of specific research questions. The chapter ends by identifying gaps where further research could be conducted.

Chapter Summary

This chapter introduced the nature of the study by describing why the research was conducted. It offered the statement of the research problem and the purpose for which the study was conducted. The chapter further outlined the essential objectives that are specific to the study, research questions, and hypotheses. The significance of the study was followed by the study delimitations, limitations, and definitions of operational terms. How the study is organised forms part of the contents of this chapter.

CHAPTER TWO

REVIEW OF LITERATURE

Introduction

The purpose of the study is to determine an extension training model that would be suitable for agricultural extension training to enhance the capacity of smallholder rice farmers and AEAs in rice post-harvest value addition activities in Sierra Leone. The rationale is to facilitate the government's effort in providing effective extension support to achieve food security in Sierra Leone. To put the research problem into perspective, a thorough review of the theoretical framework, review of concepts, empirical review, and conceptual framework on the rice post-harvest value addition context were done.

The theoretical framework of the study

Two important theories underpinned this study. These are the Competency theory and Skill-gap analysis theory. The theories laid the theoretical framework foundation of this research. According to Man, Saleh, and Hassan (2016), one of the most famous training needs theories is the Skill-gap analysis theory. Therefore, it is essential to understand how each of these theories affects the daily practice of smallholder farmers and AEAs in the assessment of training needs in the development of the rice post-harvest value addition in Southern Sierra Leone.

Competency Motivation Theory (Harter 1978)

The competency motivation theory is a social concept formulated to describe the motivation of people to participate, maintain, and work hard in some clear context of achievement (Harter, 1978). The theory's basic premise is that people will be drawn to participate in tasks that they feel competent or knowledgeable in. Glaesser and Glaesser (2019, p.70–85) explain that "Competence in Weber's sense means legal responsibility with associated means of enforcement, whereas, in both linguistics and psychology, competence is understood to mean capability and readiness". Competence is required for all actors in the rice value addition processes for the improvement of the value of rice products irrespective of the processing stages. Competence motivation theory, therefore, centres on the idea that both farmers and AEAs are driven to undertake activities that will develop or demonstrate their skills (Norris & O'Toole, 2020). When farmers and AEAs successfully perform a challenging task and receive admiration from others for it, they will build their competence in that success. Success in that particular act will help them to recognise control over their performance. Being convinced, competence and control will increase the perception of competence motivation. The essential belief of the theory is that individuals participate in activities they feel competent to perform.

In Sierra Leone, to make more efficient the communication process with farmers and improve their social condition, one has to intensify the productivity of farms and help them to access capital. Farmers are motivated to form farmer group associations and register those associations with MAFS (Cadzow & Binns, 2016). In this way, farmers who have identified themselves with registered groups and networks will together easily gain government attention for access to training and inputs towards the attainment of rice post-harvest value addition.

Skill-gap Analysis Theory (Ovidio 2012)

The skills-gap theory states that individuals may have a discrepancy (gap) in their current skill to undertake an activity and the skill required for a future task (Ovidio, 2012). It is a method for assessing the discrepancy (or gap) between the current state or desired and the future state. Employers use it to determine the competencies a worker needs but may not yet possess in order to do their job or complete particular tasks successfully (Antonucci, & Ovidio, 2012). A skill-gap analysis is a process that involves understanding the present level of skill of farmers and AEAs that required training such that they will focus on the important skills they desire. The process involves analysing the promises of staff concerning what task he/she is to acquire by beginning each task with the use of professional judgments of the individuals. The idea is to determine the level through which the AEAs have already possessed the skills and to test performance measures and administer them to the farmers (Man et al., 2016). The skill gap can reduce the productivity level of an extension system and increase the running cost. Additionally, the skill gap can lower the profit margin of the organisation and may hurt the sustainability of the organisation. Therefore, finding innovative ways to enrich the performance of the AEAs and the farmers is very critical for any extension system, thereby ensuring the effective and efficient use of resources (Manjunath, & Shravan, 2019). The success of the extension programme is judgementally dependent on the knowledge of AEAs about the countless agricultural innovations they disseminate to farmers (Oladele & Tekena, 2010).

Review of key concepts of the study

This section reviews the key concepts that are considered salient for the study. They include smallholder rice farmers, AEAs, rice value chain competencies, extension training needs, and the agricultural extension training model.

Smallholder rice farmers

Smallholder farms account for around 500 million of the world's 570 million farms (Sam, Osei, Dzandu, & Atengble 2017). In Tanzania, smallholder farmers predominate the agricultural economy, with typical farmlands between 0.9 and 3.0 hectares and an annual crop of approximately five million, one hundred (5.1) hectares, of which 85.0% are food crops (Rugumamu, 2014). In Ghana, smallholder farmers are the ones that utilise conventional and manual tools in farming their 1-2 acres, mostly on family farms (Ababio-twi, 2019). Similarly, a smallholder farmer in Sierra Leone has partial access to production resources (land, labour, and capital) and cultivates an average of 1.63ha of farmland. Furthermore, smallholder farmers in Sierra Leone according to Chenoune et al. (2016) mostly grow rice for personal and home consumption. As a result, rice farmers are extremely sensitive to variations in rice production.

Agricultural Extension Agents

The origin of extension started in the 1860s when the United States Congress established the land-grant university system to host research projects of importance to farmers in rural America who could not afford higher education. In the early 1900s, the first AEAs began taking the university directly to the farm, assisting farmers in learning how to cultivate and manage their crops while also providing a better life for their farm families. For over 100 years, AEAs have been able to influence good change not only on farmers' farmland but in many other areas of life, via programmes on cross-cutting-edge research done by the land-grant tertiary institutions (Blake, 2005). In Malaysia, AEAs play a crucial role as AEAs in changing farmers' knowledge, skills, and attitude to accomplish the national purpose (Shah, Asmuni, & Ismail 2016). The AEAs will be more knowledgeable workers, providing farmers with advice and consulting services. Although the extension unit performs an important function in Sierra Leone, yet, the majority of farmers in this West African nation only operate small to medium-sized family farms that grow crops, raise livestock, and produce livestock products like milk (Ibrahim, Ganawah, & Kamara 2021).

Rice value addition competencies

According to Chiambo, Coelho, Soares, and Salumbo (2020), smallholder rice farmers in Angola continue to employ older production techniques with no innovations to produce rice, resulting in low yields. Rice and its vegetative parts have so many uses and can be converted into several by-products provided farmers require competent training in those areas after harvest. In the Gambia for instance, Gomez (2019) discovered that rice straw can be used as cow feed, as well as thatch for roofing houses, filling beddings/mattresses, making hats, and ropes, and as chicken manure, animal feed, paper, and fuel is also made out of the husk. Rice oil is utilised in soap making, and refined oil, like cottonseed oil, is probably used as a cooling medium. Some industries use rice bran wax, a by-product of rice bran.

In addition to these limited rice value addition knowledge areas, Managanta (2020) observed that the competence of farmers in paddy harvesting, and their ability to decide on the requirements for a ready to harvest paddy was found to be in the middle range with an average of 56.6%. The rice post-harvest competence in the collection of paddy from the field through sacks, drying process, estimation of the moisture content, storage, and the milling processes of the grain was within an average of 60.7% (Managanta, 2020).

Agricultural Extension training needs

In rice post-production processes such as threshing, milling, packaging, shipment, storage, and marketing, mechanisation is becoming increasingly an essential requirement for smallholder farmers. So, high productivity systems are aided by the use of sustainable mechanisation in post-production processes, which results in more efficient labour usage, operations that are completed on time, and more efficient field and off-field operations (Bhattacharyya et al., 2021). Very specifically, (United Nations Industrial Development Organization (UNIDO), 2016) outlined the post-harvest extension training needs in producing rice such as harvesting, threshing, winnowing/cleaning, drying, storage, and milling of the rice crop. In addition, a variety of features have been identified as influencing smallholders' access to training, services, and information in rural areas in Ghana (Danso-Abbeam, Ehiakpor, & Aidoo, 2018). These features include sex, age, educational status, locality and extension contact as examples of socioeconomic, demographic, and institutional characteristics that appeal to the extension training needs. Identifying these features affecting smallholder farmers' involvement in rice training programmes would offer useful insights to policymakers and organisations that address the training needs of smallholder farmers in developing countries.

An agricultural extension training model

The extension training model demonstrates how the training programme is built and coordinated" at the local level in an attempt to reach the specific objectives of the training (Caillouet, Harder, Bunch, Roberts & Radunovich 2022). The training needs assessment (TNA) is the first stage in all training model development endeavours – to conduct a suitable analysis of what needs are to be trained, the beneficiary, and the type of organisation (Salas, Tannenbaum, Kraiger, & Smith-Jentsch, 2012). The expected outcomes of this stage according to them include expected learning outcomes, guidance for the design of training and delivery, ideas to evaluate training and information about the organisational factors which will possibly assist or delay effectiveness in training. Hence, training creates a positive effect on the behaviour of the trainees and their working skills to enhance performance and for future beneficial alterations (Jehanzeb & Bashir, 2013). Training, therefore, builds an inherent understanding of the subject matter. According to Bukchin and Kerret (2020), this understanding is critical because farmers' adoption of technologies, and consequently their degree of knowledge or abilities in a given technology can be influenced by their context/environment. This is key for the adoption of the production and processing technologies of improved agricultural products because the context of the study serves as the primary driving force behind the agricultural expansion in low-income countries (Mihretie, Misganaw, & Siyum Muluneh, 2022). Conclusively, for the sustainability of every training effort, training support must be available. Hence training support refers to any practical or material assistance that is needed to make training and its application easier for the acquisition of information and skills (Issahaku, 2014).

Empirical review of the literature and Conceptual Framework

The empirical review of the related literature was done under the following subheadings; Context of the smallholder rice post-harvest value addition, competencies of smallholder farmers in rice post-harvest value addition, competencies of AEAs in rice post-harvest value addition, the relationship between the competencies of smallholder farmers and their socio-demographic characteristics, the relationship between the competencies of AEAs and their socio-demographic characteristics in rice post-harvest value addition, training needs of smallholder farmers and the AEAs in smallholder rice post-harvest value addition, training content appropriate for AEAs in rice post-harvest value addition, extension education methods appropriate for smallholder rice post-harvest value addition, and the extension education methods appropriate for AEAs in rice post-harvest value addition.

Context of the smallholder rice post-harvest value addition

Smallholder rice farmers in Sierra Leone are currently faced with some challenges to boost productivity and increase their income levels. Such limitations, among others, include lack of quality inputs (seeds and sufficient fertiliser), restricted access to extension services, low level of investments and working capital, hostile farmer-to-market linkages and climate change which exerts a lot of pressure on production (Menezes, Ridler, & Murekezi, 2018).

In Sierra Leone, food and loss of nutrients alongside the rice value chain, which may be attributed to ineffective or inefficient harvesting, poor storage facilities, poor processing, and handling materials are possible factors that affect the availability, cost, and affordability of rice (Njoro et al., 2013). To enhance agricultural sector growth and rural poverty reduction, Donovan, Franzel, Cunha, Gyau, and Mithöfer (2015) added that the agricultural value chain development has been progressively invigorated as one of the approaches by governments in the Sub-Saharan Africa region. Hence, knowing the need for training rice farmers helps to create effective policies and extension services that could further strengthen their skills and abilities to increase production (Kshash, 2016). Comparative analysis of both upland and lowland ecologies in Sierra Leone by Chenoune et al. (2016) suggested that average rice yields are 0.29t/ha and 0.34t/ha in upland and lowland ecologies respectively. For labour use and the average size of farmland, farmers averagely spend 121 days/ha and 90 days/ha; and cultivate an average of 0.99ha and 0.66ha from upland and lowland respectively. Moreover, the socio-economic characteristics of farmers are also vital in determining rice post-harvest value addition.

Below describes the context of the smallholder rice farmers in Sierra Leone:

Resources used for rice post-harvest value addition

Resourcing is an act of seeking and delivering financial assistance, labour, skills, and other related materials that are required for a particular intervention. According to Suvedi and Kaplowitz (2016), there are different types of resources. These include capacities, skills, training, knowledge and influence; national public and private NGO assets; (land, infrastructure/ buildings, vehicles, equipment, roads, irrigation facilities, etc.); leadership skills and personal social networks; external donor supports (private and public). In reality, agriculture and social protection can be mutually compatible and supportive. On one side, smallholder agricultural initiatives enhance access to natural resources, productive inputs, infrastructure, financial resources, and markets to expand employment prospects for smallholder farmers. Social security, on the other hand, offers monetary or in-kind assistance to help vulnerable farming families. Recent research has suggested that social protection together with agriculture will alleviate poverty and hunger in rural areas more efficiently, along with stimulating economic development (FAO, 2020). This encourages farmers to spend more time and resources on constructive practices, expand their involvement in social networks and improve their capacity to effectively handle risks.

A study by Adisa, Famakinwa, and Adeloye (2020) however, revealed a high adoption level of eight improved rice processing technologies out of eleven that were disseminated to the farmers in Nigeria. The use of milling machines (Mean=4.54) ranked the highest followed by the use of mat or tarpaulin to thresh paddy (Mean=4.44), sieve to separate immature grains, residual dirt and stones (Mean=4.32). Farooq, Ishaq, Shah, and Karim (2010) discovered that AEAs in Singapore cited a lack of resources (24.0%), communication challenges (11.0%), limited literature (8.0%) and the nonexistence of in-service training (5.0%) on improved technologies as limiting factors.

In Sierra Leone, one-way smallholder farmers as entrepreneurs reward themselves for the shortage of money is to involve in 'bootstrapping' practice. This simply means that smallholder farmers start investment with very little capital rather than relying on external funding which is hard to come by. Harrison, Mason, and Girling (as cited in Jones & Jayawarna, 2010) alluded that bootstrapping provides the individual with an innovative and miserly method for managing and organising resources. Resource constraints identified by Kamara (2018) in Sierra Leone include illiterate smallholder farmers, limited training of AEAs, absence of credit facilities, few and old AEAs, limited funding, great price for technologies, the untimely release of funds by the local district councils and donor partners. In addition to value addition effort in Sierra Leone, inadequate resources such as mobility, fuel, computers, and accessories are most often officially given to AEAs. Some of the AEAs own these resources by themselves. Even those that have official motorbikes, these resources are usually too old and inadequate for use by the AEAs in the field. As for those who use their personal computers and motorbikes, no maintenance opportunities or compensations are offered to the owners for the use of those resources for official functions (International Fund for Agricultural Development (IFAD), 2020).

Rice post-harvest value addition

Quality rice or value added rice concerns itself with the whole and broken grains, polishing, shape, size, colour, chalkiness, aroma, and weight of the grain. Damaged kernels, foreign materials like dirt, stones, and the moisture content of the grains are also other important considerations that affect value addition to rice. The consistency of the grain of rice can be "superficial" but can be altered by labelling and packaging, which ensures that if buyers and consumers wish to obtain the desired benefits from rice, they need to be extremely careful with their choices (Ehiakpor et al., 2017). By paying more money for the rice with the preferred attributes, buyers also communicate their expectations for product quality.

Value addition to rice is maximised when smallholder farmers mechanise their farming activities rather than over-relying on their traditional practices. Amponsah et al. (2018) in Ghana reveal that the use of sickle and panicle selections were the major harvesting techniques by farmers to manually harvest their rice even though over 50.0% of the farmers prefer the sickle with more than half of them using it. The use of a combine harvester (51.0%) was the most commonly used technology to thresh paddy, followed by the use of “bambam” (thresh paddy by impact method) by approximately 36.0% of the farmers. Other methods include bag beating (11.0%) and the use of a mechanical thresher practiced by only 2.0% of the farmers. In drying paddy, tarpaulin or plastic sheets proved to be the most frequently used method with more than half of the farmers that have adopted the practice of drying their paddy on concreted/cemented platforms. The majority of the farmers (63.9%) stored their paddy for between 3 and 6 months before they mill it. The most extensively adopted milling technology was the use of mechanical hullers by more than 80.0% of farmers.

Traditional rice harvesting and handling activities in Sierra Leone inherently predispose grain to a low value. During such operations, rice stalks are cut in bulk, often along with weeds, and left in the field for several days to weeks to be cured (Kamara & Cooke, 2015). Insect, bird and rodent pests may be more revealed when field curing, threshing and drying are in progress. In certain cases, grains are unprotected from mud and moisture, contributing to differing amounts of quantitative and qualitative post-harvest losses.

Also, excessive hand threshing with sticks and unchecked sun drying will lead to grain cracking and additional contamination. Traditional hand milling, using wooden mortar, pestle, and winnowing fans, provides a small opportunity to correct many of these grain quality problems. Maybe, with the high prevalence of subsistence practice at these stages, the main challenges of grain quality in Sierra Leone are in field production and processing (Kamara & Cooke, 2015). These factors are likely to limit the value of most local rice products. Different actors, including producers, village merchants, wholesalers, and rice millers, are still worried about their fair price in addition to enhancing the quality of rice in India (Pavithra, Singh, Nasim, Sinha, & Mishra, 2018). The rice value chain focuses on different value addition strategies to ensure improved pricing and demand-supply balance. After harvesting, threshing, cleaning, bagging, storage, transporting to the markets, selling to the marketers, selling to the millers, millers transform paddy into rice, by maintaining different qualities and grading occurs (Evans et al., 2018). Rice millers start the process as actors to mill, bag and transport to various markets, where rice sellers do the job of rice marketers (Cramb, 2020).

In adding value to an agricultural commodity like rice, the farmer will first need to establish a healthy relationship with his clients thereby maintaining a constant supply of high rice quality (Pirmatov, Galova, & Horska, 2018). Furthermore, the farmer is to also ensure that rice must be in high demand over a long given period.

Rice post-harvest value addition activities by smallholder farmers

Post-harvest technologies are well-coordinated set of activities in the rice cultivation cycle from the harvesting stage to all handling techniques or treatments value chain actors give to rice in improving quality and rice products for consumption and shelf life (Ila'ava, 2015). The production of high quality rice grains requires suitable post-harvest technologies to reduce both processing and grain storage losses.

Below are the major rice post-harvest activities smallholder farmers undertake in the study area.

Harvesting of rice

Rice harvesting is the practice of collecting rice grains or paddies that have achieved their physiological maturity (Ila'ava, 2015). The harvest takes place in the form of pulling, plucking, slashing and cutting straws or panicles. Excessive drying of paddy in the field owing to poor practices or a shortage of labourers may cause significant losses before and during harvesting (Winterbottom, 2010). For upland ecologies where rice is cultivated primarily in mixed cropping with other crops, harvesting is still done by panicle selection with a tiny knife. Farmers in the lowlands with pure stands of rice use bigger knives or sickles as new technology. After harvesting, many farmers keep the rice on the field to dry. This is recommended to avoid drying after threshing, especially where drying floors are not available. The harvesting time of rice is usually assessed by changes that occur in both the vegetative and economic parts of the rice. The change will be in the form of visual appearance, smell, colour, size, and moisture content. Rice harvesting is mostly done with a knife rather than a handheld sickle in Sierra Leone, demonstrating that traditional tools constitute the bulk of the production activities of smallholder farmers (Tarway-twalla, 2013). The fundamental challenge in rice harvesting for smallholder farmers is the manual harvesting process with a sickle or other types of rice cutting knife, followed by placing the cut paddy on the wet soil until they are picked up and transported to threshing sites by the labour force (Tinsley, 2012).

Transportation

Transportation is a significant task during the rice value chain since commodities, such as processing and storage facilities have to be conveyed from one point to another. Failure to have a proper transport system will lead to rice being damaged by bruising and spillage losses (Kumar & Kalita, 2017). In Tanzania, harvested paddy was brought to homesteads by hired trucks, bicycles, and wheelbarrows after being neatly placed in baskets, bags (polythene), and even wrapped in pieces of fabric (Ahmed & Adisa, 2017). In Sierra Leone, locally made baskets are commonly used by women to transport paddy to processing sites (Wertz & McNamara, 2016).

Threshing

After the harvesting of the matured paddy followed by transportation from the field to the threshing site, threshing is the next activity that follows (Ketut & Swastika, 2012). Threshing is typically carried out by whacking rice manually against a hard surface, like whacking boxes as practiced in Ghana. In most whacking operations, however, 10-15% of the rice grain is left behind and farmers redo the straw to harvest the leftover grains (Tinsley, 2012). The process of threshing is meant to extract the paddy grains with the least damage to the grains from the straw. The physical separation of paddy from the rice straw and panicles is known as threshing. Rice can be threshed by hand, foot, or by simply swinging, beating, and whipping on a framed object (Government of Papua New Guinea (GoPNG), 2015). This threshing process according to Kiaya (2014) will very certainly be incomplete if the paddy is threshed before it is sufficiently dried. Furthermore, threshed moist rice, heaped up or stored (in a barn or sacks) is considerably more susceptible to microorganism infestation, limiting its preservative potential.

Parboiling

Parboiling is a process where paddy rice is soaked, steamed, and dried as a major rice processing technique for improvement in the milling and cooking quality of rice. In other words, it involves a process that consists of soaking, heating, and drying processes aimed at modifying the treatment and qualitative behaviours of rice (Dutta & Mahanta, 2012). Parboiling paddy improves the quality of rice in several ways. For instance, Meresa, Demissew, Yilma, Tegegne, and Temesgen, (2020) observed in Ethiopia that there is a reduction in the mean value of broken grains when the soaking temperature together with the time for steaming increases for rice varieties.

Drying

The drying process as a post-harvest activity influences rice yield significantly during milling and for the general quality by reducing the content of moisture content in the paddy to the appropriate level. Generally, the content of moisture of paddy must be reduced from 14.0-22.0% during harvesting to approximately 13.0% for storage to lessen the rates of respiration and growth of mould, including deterring the growth of fungi and insects according to Mukhopadhyay and Siebenmorgen (2017, as cited in Tong, Gao, Luo, Liu & Bao, 2019). The conventional way of drying harvested paddy is by drying it in the sun though there are alternative means (Padua, 1999). The grain is either kept in the field to dry after harvest but before threshing or laid out on mats or pavements after threshing. Farmer Field School (FFS) smallholder rice farmers in Tanzania put paddy rice on wide floorcoverings to dry in the open air at their homes to achieve a relatively acceptable moisture content level of the crop, as confirmed by knowledgeable farmers (Ahmed et al., 2017).

Mostly, during the rainy season, when there is no "synthetic" drying facility, it is common for grains to germinate and rot if not dried (Kumar & Kalita, 2017). Where there is a slight delay in the drying process, the wet grain may get darker. Farmers are therefore made to accept that the summer grain, which can be sun dried directly after processing has a whiter and brighter quality (Kumar & Kalita, 2017).

Milling

Milling involves the process of separating or removing the husk from the paddy rice (dehusking) and the bran (polishing) to produce the edible part (endosperm), the whitening process, and grading of rice for consumption (Hamzah et al., 2019a). In other words, the milling of rice refers to the process whereby paddy rice is transformed into milled rice (Ketut & Swastika, 2012). To avoid undue breakage of the kernel and to enhance recovery of the paddy, this process must be performed with caution. Rice processing entails several distinct activities, each of which has an effect on the quality of the finished product and hence market value (Baker, 2014). Cleaning and drying, de-husking, polishing, whitening, grading, and sorting are all parts of the process, withed-husking, and polishing constituting "milling." However, the actual milling procedure often eliminates the germ and a part of the endosperm as fractured or powdery products, thereby minimising the number of grains recovered in the process (Atungulu & Pan, 2014). The amount of losses during milling on the edible portion of the grain depends on so many variables such as the genotype of paddy, the state of paddy during milling, the degree of milling required, the type of rice mill used, the operators, the infestation of insects among others (Bodie et al., 2019). Most traditional rice millers in West Africa generate low rice superiority and purity, with a diverse mix of varieties and high rates of broken grains, resulting in poor cooking quality (Soullier et al., 2020). As for quality, pricing, and scale, traditional rice value chains struggle to compete with structured import rice value chains. In Sierra Leone, the majority of smallholder rice farmers mill their rice grains using their hands with mortars and pestles and hand-woven winnowing fans (Kamara & Cooke, 2015).

The husk or shell, milled rice or the edible part, germ, bran, and the broken are what emerge during the milling process (Bodie et. al., 2019). The by-products come out of the mill as combined or isolated, depending on the rice mill used. Usually, milling is achieved when the paddy is dried (approximately 14.0% moisture content). When the paddy is light and wet, milled rice becomes powdered. During the milling process, very dried, brittle grain can crack and yield fractured and powdery products. Milling damages may be of a qualitative and quantitative type. The low recovery of rice during the milling process both indicates quantitative or qualitative losses, whereas loss of quality is manifested by low milled rice recovery or an appreciable percentage of broken grains in the milled rice.

Packaging

Before storage, the winnowed paddy makes marketing in a competitive context difficult (Barungi & Odokonyero, 2016), or cleaned paddy is packaged into 50kg, 25kg, or 10kg bags in Nigeria (Toluwanimi, 2012). Research has shown that farmers do not properly package or label milled rice, which rice is packaged without being graded after it has been milled. Rice is also packaged in inconvenient-to-handle packaging (often polythene bags) that tears easily (Coles et al., 2003). The packaged rice is not easily identified because the packets are not labelled, in terms of quantity (package size), grade/quality, packer's name, address, variety, and packing date, among other needed marketing features.

Storage

To extend the shelf life and economic value of rice, storage of rice is an important factor in rice post-harvest handling (Tong et al., 2019). Rice that is stored is preferable to raw rice because stored rice has greater milling and sensory quality, and an increased taste of fresh paddy, (Tong et al., 2019). The endogenous enzymatic reactions to starch, proteins, and lipids are closely linked with changes in the quality of the rice grain during storage (Tong et al.). These alterations often depend on the conditions of storage (cleanness, temperature, humidity, and duration) and the nature of rice (paddy, brown, or polished rice). During storage, rice bags are not to be directly placed on the floor (GoPNG, 2015). Rice bags should be laid on racks 20cm above the floor level. Many smallholder farmers are forced to sell their rice as soon as it is milled because of a lack of adequate storage facilities, regardless of prevailing market conditions or low prices in Uganda (Barungi & Odokonyero, 2016).

Marketing of value added rice

Many West African countries have a growing dependence on rice imports for which rice transportation and market play key roles. Although marketing according to Kiaya (2014) may occur at different stages in the agro-food chain, particularly at some stages in processing, it is the last and most important component in the post-harvest system. Furthermore, it is strongly intertwined with transportation, which is a critical link in the chain. Since there are difficult transportation systems in the country, limited quantities of rice are therefore brought to Sierra Leonean markets by smallholder farmers making marketing costs usually very high. For example, local rice is normally purchased every week by assemblers where smallholder farmers come with their rice from their nearby villages. Very few farmers manage to sell up to 50kg bags of rice, as the quantities they normally bring to the market are very low. Asante-Poku and Ang (2013) claim that local including imported rice is sold in urban markets in Ghana, but imported rice dominates the scene due to the irregularity in local rice supply.

As for Sierra Leone, the marketing of rice is traditional and involves interaction among assemblers, wholesalers, and retailers (Ton & Consultancy, 2011). Paddy is generally sold and processed by women retailers who process paddy at small-scale toll mills after parboiling. Like in most other African countries, there are two types of agricultural markets in Sierra Leone: everyday community markets, and periodic markets "Lummur" (Graham, 2020). Many other day-day markets have roofed buildings where agricultural commodities are sold. Due to limited space, however, some agricultural products are marketed around the market structures and on the roadsides. Finished goods are typically sold in various sections of the market in makeshift sheds. Usually, there are no well constructed market shelters as with periodic markets (except daily markets, which also serve as periodic markets). Most of the smallholder farmers sold paddy to small-scale village collectors for around US$ 0.25/kg (US$ 250/t) (Chhun, Vuthy, & Keosothea, 2020). The loading cost of rice, materials (bags, twine, and containers), and transportation are borne by the village collectors, to a total of around US$3.4, or 1.4% of the farm gate price. For the quantity of rice sold, more than 80.0% of the rice consumers who participated in buying from the Lion Mountain locally produced rice in Sierra Leone desired 5 and 10 cups packages as compared to buying in large bags from the marketplaces (Sierra Leone Opportunities for Business Action (SOBA), 2017). Also, buyers appreciate the smaller package for convenience in carrying as compared to the 50kg bag weight to avoid tearing apart the poor plastic bag package.

The majority of smallholder farmers in Africa practice either subsistence farming or largely operate in local markets since they lack a strong network in comparison to profitable markets at provincial, national, or global levels (Bjornlund et al., 2020). Because of this reason, the potential to raise productivity by investing in inputs remains significantly very low, thereby engulfing smallholder farmers into a poverty trap. Consequently, their ability to leap from subsistence to commercial farming is incredibly becoming a challenging task (Global Agriculture and Food Security Program (GAFSP), 2014). Inputs are the resources expended to accomplish an assignment, which normally requires time, money and commitment. For example, Coltrain, Barton, and Boland (2000) suggested that farmers must have access to multiple marketing outlets to avoid failure in the marketing process of rice since it costs a farmer commitment, time, and hard work to produce rice.

As for the marketing challenges of rice, Nkwabi, Ravinder, Dev, Samriti, and Subhash (2021) perceive that the low price of rice is a key market challenge for 38.95% of rice farmers in Tanzania. Farmers throughout the study region are affected by the low price of rice, which may be inferred. Price volatility has been identified as a secondary key marketing concern for rice producers in that region. In addition, the weak transport infrastructure in Ethiopia prevents AEAs from reaching a large number of farmers within a specific region according to a recent report on the state of extension (Bachewe et al., 2018). Ethiopia's dysfunctional food markets are mostly brought on by a lack of market knowledge, bad road conditions, and excessive transaction costs.

Extension services for rice post-harvest value addition

The link between those that generate and use research outputs and technologies is the agricultural extension and advisory services (Hollinger & Staatz, 2015). West African region experienced a sharp drop following the structural adjustment programme and the disappointment of the Training and Visit (T&V) approach, which has led to many countries adopting diverse approaches with no idea as to which approach works best. In Ghana, there is a variety of constraints facing the Ghanaian agriculture Ministry (MoFA), as the key source of information for farmers. The limited agricultural extension agent-farmer ratio is one of these constraints. Feder, Willet, and Zijp (2001) noted that for developing nations, government extension services provide coverage (the ratio of AEAs to farmer population) between 1:1,800 to 1:3,000. The ratio in developed nations like European, North America, and Asian countries are around 1:400 on average (Blum & Szonyi, 2014).

The ratio of AEAs to farmer groups and farmers is 1:45 FBOs and 1:1,250 farmers in Ghana, indicating that more AEAs are needed to spread modern farming methods more quickly and efficiently (Rock, 2019). Approximately 73.0% of the farmers receive extension services, with farmers in rural areas having the highest rate of access with Brong-Ahafo, Ashanti, Eastern, and Western Regions the most access, and farmers in the Volta Region with the least access to services (Rock, 2019). In comparison with Sierra Leone, the agricultural extension agent-to-farmer ratio according to Ibrahim, Ganawah, and Kamara (2021) presently stands at 1:2,100 as opposed to the recommended 1:500-800 agricultural extension agent-to-farmer ratio (Blum & Szonyi, 2014). On this assertion, Conteh et al. (2015) discovered that only a modest amount of 26.0% of farmers have access to extension services in Sierra Leone.

Okorley (2007) describes AEAs in Ghana as field officers who, regularly, are in frequent contact with farmers. In partnership with the farmers and other actors, they transform extension methods at the district level into operations at the field level. They support farmers in the diagnosis of problems relating to agriculture and farming and proffer solutions to those problems. Each agricultural extension agent is assigned to work with a village cluster within a particular geographical region known as an operational area. Saleh and Man (2017) note that sources of agricultural information are pivotal in agricultural development. The key sources of agricultural information include using computers, attending special agricultural training courses, reading agricultural bulletins, and books, radio and TV programmes, dialoguing with knowledgeable agricultural colleagues, agricultural universities/colleges, agricultural research institutes, media documents on CD format and workplace internet constitute. Bitzer (2016) studies on *insights for innovative thinking* found that compensation and incentive systems in public extension services in developing nations encourage AEAs to carry out routine extension assignments that are determined by senior-level managers.

Profitability from rice value addition

The difference between in monetary value of the cost of the rice produced by the farmer and the total cost of labour producing them is the profitability of operations (Stuttgen & County, 2018). Saravia-matus, Aravindakshan, Sieber, Saravia, and Gomez (2021) note from their findings that increasing access to the market, crop reorientation, and altering the allocation of labour supply can be more functional than the transfer of technology for the enhancement of efficient subsistent production, particularly so if the outside support leads to further specialty on rice rather than market oriented crops in Sierra Leone. High prices which are paid for rice may also accelerate the improvement of robust linkage among rice producers and marketers. This will be advantageous for additional market actors like the government and private sectors (McKenney, Yemshanov, Fraleigh, Allen, & Preto, 2011). The situation will, however, vary seasonally which justifies rice storage and helps determine the time the farmer sells or stores his/her crops

(Trevor & Lewis, 2015). Generally, prices are lowest just after the harvesting period when the supply of rice is in abundance. These incentives allow smallholder farmers to increase the quality and quantity of the commodity, thereby maximising the wellbeing of both the customer and the producers (Quarmine, 2013). In their buying decisions, customers face trade-offs because money is scarce and there are multiple options. The key challenge is, how to produce adequate and affordable local rice that meets the consumer preferences of their fast growing population in Ghana (Ehiakpor, Apumbora, Danso-Abbeam, & Adzawla 2017). Rice that is locally produced has to compete with imported one that has higher quality in terms of physical appearance and characteristics of the grains including size, aroma, and colour. In Tanzania, the total revenue obtained from selling paddy less the production charges was Tanzanian Shilling (TZS) 1484175.3 equivalent to US.D.163/ha (Exchange rate 1TZS~US.D. 2301) (Kulyakwave, Xu, Yu, Sary, & Muyobozi, 2020). This emphasises the argument that there is profit in rice farming in that particular study area since the operation costs were recovered by farmers. Even though the majority of the farmers market their paddy at farm gate prices, significant gross profit is realised by those farmers. Relatively high profits are realised by 70.0% of the farmers who cultivate rice in the rain fed ecologies in Tanzania (Kulyakwave et al. 2020).

Livelihoods of farmers

Ellis's 1998 and 1999 (as cited in Bosompem, Kwarteng, & Ntifo-Siaw 2011) state that the Model for Sustainable Living (SL) describes livelihoods as the resources, operations and access that define the lives of individuals or households. Natural, physical, financial, human, and political/social are the five specific categories of resources that form livelihood properties. With each resource, the related stakeholders decide on a particular selection of terms, photographs, scenarios, or metrics to represent the best and worst scenarios in their opinion. A study by Kuang, Jin, He, Ning, and Wan (2020) in China observe that the majority of farmers have natural and market risks as their greatest challenges when managing their agricultural activities. In a specific term, natural risks were reported by almost 76.0% of the farmers, whilst more than 63.0% reported exposure to market risks. Additionally, the farmers asserted that they were exposed to technological risks, policy and information during their farming activities by 32.59%, 25.0%, and 29.46% respectively (Kuang et al.2020).

Characteristics of the farming actors

This section is subdivided into two parts: a) the characteristics of the smallholder farmers, and b) the characteristics of the AEAs in rice post-harvest value addition in the study area.

The socio-demographic characteristics of the smallholder farmers

Smallholder farmers globally constitute approximately 1.5 billion population which includes 75.0% of the poorest people in the world (Davis & Franzel, 2018). A huge body of knowledge exists on the personal characteristics of smallholder farmers in related agricultural extension activities. The demographic characteristics include sex, age, marital status, educational level, and size of a household. The socio-economic characteristics are the type of land ownership, the main source of income for the smallholder farmer, access to rice processing machines, access to credit facilities, contact with smallholder farmers/AEAs, FBO membership, length of farming/extension experience, and market access.

Sex and access to extension services, financial services, and land rights

Agricultural extension and rural advisory services both play an important role in transferring knowledge of new approaches and technologies to smallholder farmers. Yet, these services tend to engage more with male farmers, and there is little evidence that the needs and requirements of women farmers are met. Rural advisory services and agricultural extension programmes play a major role in transmitting information to smallholder farmers about emerging techniques and technologies. These programmes majorly target male farmer interaction, however, and there is no proof that the needs of woman farmers and requirements are being fulfilled (Jafry & Sulaiman, 2013). The disparity in access to financial services across countries is also heterogeneous (Ameyaw & Maiga, 2015).

Women often need credit to hire farm workers, buy work-saving equipment or buy food during the season when their food supplies are depleted. As a result, Adamu (2018) observes in Nigeria that agriculture does not function very well in most developing countries since women in Nigeria have no access to resources and opportunities to be more productive. According to Balana and Oyeyemi (2022), some smallholder farmers in Nigeria may not participate in the credit market because they cannot get credit, but rather because they may be risk-averse or lack access to sufficient information about potential loan sources or the terms of the credit that is already available.

In addition, customary land and heritage procedures discriminate against women and a lack of established women's land rights under communal ownership means that women are not involved in land ownership, buying, or sale (Kuusaana et al., 2015). Women are not represented enough in land-based institutions. Again, international conventions on women's rights have not been implemented into law or domestic policies.

Traditionally, men have heritage over land and women earn rights to land by staying with a male relative or partner (Ameyaw & Maiga, 2015). In rural Sierra Leone, women generally are not allowed to inherit or have control over land. They have less access to land, power over it, and land tenure protection than men, resulting in less willingness to invest in agriculture and growth beyond the subsistence level (Division, 2018; Menezes, Ridler, & Murekezi, 2018).

Several studies have shown the dominance of men in farming. For example. Rice technology adoption impact study on the incomes of rice-producing households in Northern Ghana, Wiredu, Asante, Martey, Diagne, and Dogbe (2014) discovered that 76.84% of farmers were males and 23.16% were females. The reason, according to the authors, was that the bulk of the sampled households was male-headed. Many other studies have clearly shown that women perform vital roles during farming in general and rice production in particular (Raney et al., 2011). Even so, women still do not influence the agricultural research and development agenda and they are accountable for their concerns. A study by Kroma, (2002) in Sierra Leone showed that rural women play more significant roles than men when it comes to processing rice after harvest. Also, a higher level of efficiency among male rice farmers than their female counterparts was observed by Addison et al. (2016). Accordingly, the male rice farmers attained a high mean technical efficiency (0.981) than that of the females (0.717) which significantly exceeded by 0.264.

Age of farmer

Franzel et al. (2020) argue that efforts dedicated to providing young people with employment through increasing their participation in agriculture are because educated young people do not find agriculture attractive. The average age of rice farmers according to Hussaini, Oladimeji, Sanni, and Abdulrahman (2021) in Nigeria is 46 years with a standard deviation of about 10. Similarly, Mwololo, Nzuma, and Ritho (2019) discovered a significant proportion of the sampled farmers between the ages of 41 to 50 years indicating that the majority of the farmers were of middle age. This is the economically active category that can withstand stress which translates into a high productivity level for the farmers. Furthermore, Mwololo et al. (2019) in their study of one hundred and sixteen households in Kisii and Nyamira counties in Kenya noted that the average age of farmers is 48 years.

In sub-Saharan Africa, the youth have opportunities to develop into producers and food suppliers in meeting the demands of the growing domestic market in Africa (Hussein & Suttie, 2016). Yet, owing to the extensive opinion held that farming is a difficult job and provides limited opportunities as an escape route from poverty, a high amount of young people from rural communities choose to relocate to big towns and cities for employment in the casual services division (Hollinger & Staatz, 2015).

Marital status

Kamara (2018) averred in his examination of the nature and effectiveness of research and extension agricultural innovation systems rice study in Sierra Leone that 94.5% of farmers were married, 3.5% were widowed and only 2.0% were single. Several similar studies in Sierra Leone including that of Conteh, Yan, and Moiwo (2015) have shown that 81.0% of farmers were married leaving the rest in a single, divorced, or widowed status. The results reflect the suggestion of Ayanwale and Amusan (2014) in their analysis of gender in rice production efficiency study in Nigeria that most of the farmers (73.3%) were married. Provided that members of the family are available for farm activities, these findings have ramifications in providing family labour for rice production. In addition, marriage improves the technical efficiency of farmer households, because families provide a significant source of labour in rural community settings (Rasheed et al., 2020). The use of family labour is thus, reasonable for most families because no wages are paid.

Educational level

Ruhinduka, Alem, Eggert, and Lybbert (2020) observe that young farmers are relatively more educated than the elderly ones in their smallholder rice farmers' post-harvest decisions in Tanzania. However, a study by the Demographic and Health Survey (DHS), (2019) in Sierra Leone shows that 79.0% of the respondent farmers have some level of education. On the other hand, a study by Tarway-twalla (2013) in Liberia shows that 37.0% of smallholder farmers have no form of education, whereas 5.0% have a degree or college education. Twenty-six percent (26.0%), have completed elementary school, and 30.0% have completed high school. On the whole, rice-growing smallholder farmers who were better educated and attended more association meetings and field demonstrations were more inclined to use part or all of the technology options available to them in rice production in Ghana (Tsinigo & Behrman, 2017). The above empirical shreds of evidence on education as a predictor of the rate of adoption of agricultural technologies are overwhelming. It is therefore not surprising that education and training are usually important components of extension related programmes or projects in developing countries.

Size of household

The size of a household can positively influence the participation of smallholder farmers in rice post-harvest value addition. Households serve as a source of family labour that supplements the efforts exerted by farm household heads (FAO, 2015). Family labour provides the household with the opportunity to apportion responsibilities among members thereby, saving time and costs for other economic activities. A study by Sammeth (2010) shows that an average household in Sierra Leone has approximately seven members. Smallholder households are often big. Nonetheless, the demerit of a larger household size demands that household heads expend more money to provide food and other related needs of the members. This higher expenditure that is often linked with larger household size normally renders it a resource constraint, hence the need for donor support (Martey et al., 2013). Several studies have estimated an average smallholder household size of seven individuals (FAO, 2015; Kulyakwave, Shiwei, & Yu, 2019; Chenoune et al., 2016; Konja, Mabe, & Alhassan, 2019). For example; smallholder households in countries such as Bangladesh and Kenya have an average of seven members, two of whom are under the age of 14 (FAO, 2015). Kulyakwave, Shiwei, and Yu (2019) assert that the majority of smallholder household heads of rice farmers comprise males even though they have fewer rice yields as compared to their female household heads. The key explanation for this difference is the fact that most men have off-farm work and their rice fields are usually, certainly given less attention. Similarly, Ahmed, Ying, Bashir, Abid, and Zulfiqar (2017) also support that a household has an average of seven individuals in rural Pakistan, including two wage earners. The head of the household is usually a man. On the other hand, if there is no male in the household, a woman acts as the head of the family.

Type of land ownership

In 1961, Sierra Leone became a sovereign state, but the postcolonial era aspects of colonial rule remain. In compliance with these rules, landlords are recognized by law as "natives" and have usufructuary rights thereon. A twofold proprietorship structure characterises the land tenure system of Sierra Leone. Private land ownership/freehold tenure is acknowledged in the western region, including Freetown. Regions throughout the other country (i.e. Provinces are held under customary tenure as a community and are controlled by customary principles and usage by traditional heads managing them on behalf of their communities (Government of Sierra Leone (GoSl), 2019). The caretakers of the land are Paramount Chiefs and the Chiefdom Councils, who are responsible for the land and the indigenous community. The country presently has outdated land survey data supporting a legally confusing dual land tenure structure, which creates, amongst others, frequent land disputes and obstacles to investment for large farmer companies. The Sierra Leone

Land Policy of 2017 which is supposed to help address the remaining land problems, has still not been fully enforced (GoSL), 2019).

Thus, the land is acquired and managed by family members, villages, town councils, clans, or landholders from one generation to another and each family member has access to a piece of land for farming. Consequently, non-indigenes who wish to acquire land, be they nationals or foreigners of Sierra Leone often experience several vague conditions and frequently changing ones (Fraser & Mittal 2017). On the whole, 75.5% of the people live in rural communities (provinces) and are ruled by traditional land tenure structures. These structures are recognised as the key legal body of land transactions for the majority of the population by the current 2015 National Land Policy of the country, improved to encourage and support their proper development into a modern, efficient system of land tenure (Akiwumi, 2018). In rural Sierra Leone, the major socio-economic asset owned by smallholder farmers remains the farming land, and so, agriculture is not just an economic activity, but culture, like in most other Sub Sahara African settlements (Yengoh & Armah, 2015). Both access and ownership of land by women were key questions in Liberia before the 14-year conflict (Tarway-twalla, 2013). Conversely, in certain regions of Liberia, following the war, access for women to land has expanded dramatically, so far as women are almost equal to their male counterparts.

Hence, farmers who owned land to farm, have a greater propensity to stay as local rice farmers, as opposed to those who operate on leased farmland (Markussen, Fibaek, Tarp, & Tuan, 2019). A single plot of land traditionally consists of a rice farm. On the other hand, the close of the war in 2002 in

Sierra Leone followed by the high influx of refugees from the cities and neighbouring countries, led to limited uplands for everyone to farm, and therefore, farmers who grow rice find themselves forced to expand on lowlands to meet their family's growing rice needs (Chenoune et al., 2016). Young people may also be landless or be entitled to secondary use only if family lands have to be fragmented among many siblings, according to their tradition. It may lead to small, scattered and economically inefficient plots of land. Young people are seldom considered in land use decisions that are usually made by the aged (AGRA, 2015).

The major sources of income for smallholder farmer

In developing nations, where over 70.0% of the food insecure population lives in rural areas (Von Loeper et al., 2016), poverty is widespread among smallholder farmers. This observation indicates that poverty stands out as the main source of food insecurity in developing countries; as poverty restricts the agricultural size and reduces the capability of buying non-produced food. The income of farming families is seldom derived from a single source because smallholder farmers frequently cultivate a wide variety of crops (some for food, some for sale) as well as a variety of other revenue generating activities throughout the year (Waarts et al., 2019). In Sierra Leone, a study by Kamanda, Momoh, Motaung, and Yila (2022) on New Rice for Africa adoption factors by smallholder farmers found that farming is the main source of income for 82.7% of the respondents. Only 8.7% engage in commerce, while 6.0% rely on family members as their primary source of income.

Access to rice processing machines

In Arica, smallholder farmers have no access to improved post-harvest knowledge and lack both tools and the skills to use them to add value to their harvested crops (James et al., 2011). The implementation of advanced technology for rice production and processing produced by the application of science and technology has been shown to guarantee increased and sustainable rice production (Norman & Kebe, 2004). Approximately 69.0% of rice farmers according to Hussaini, El, Hirst, Salyers, and Osuji (2021) indicated ineffective rice processing methods in Nigeria.

Farmer Based Organisation (FBO) membership

The 2010-2015 Smallholder Commercialisation Program (SCP) supported smallholder farmers through the National Sustainable Agricultural Development Plan (NS.D.AP) through the creation of Farmer Based Organisations (FBOs) and Agribusiness Centres (ABC). This included approximately one hundred and twenty-two thousand, five hundred (122,500) farmers, 30.0% of which were headed households, (GoSL, 2019) have suggested that farmers in Sierra Leone who contacted AEAs and participated in FBOs and the village network activity have graduated faster than those who did not. FBOs provide farmers with bargaining leverage in the marketplace, provide cost-effective distribution services of extension programmes and offer an avenue for mobilised participants to impact policies that impact their livelihoods. Private sector organisations set up farmer based organisations to lessen the cost of working with farmers, increase the amount and quality of farm products, and boost farmers' credit recovery. Governments set up farmer based associations to enhance the quality of rural services. National initiatives aimed at encouraging rural citizens also provide blueprint systems in the form of cooperatives and product organisations (Vercillo, Kuuire, Armah, & Luginaah 2015).

Length of farming experience

The activity level and skills of producers that are involved in rice production can be assessed due to their number of years in farming. Ampadu-Ameyaw, Omari, and Owusu (2017) in Ghana show that the majority of farmers (70.0%) have more than six years of experience. Amponsah, Addo, Dzisi, Asante, and Afona (2018) discovered that farmers who have twenty years and more of rice farming experience were only about 27.0% whereas most of the farmers have below twenty years of farming experience in rice production.

Access to markets

Diversified marketing facilities remain a massive challenge to smallholder farmers (James et al., 2011). Financially challenged farmers usually sell their produce to petty traders soon after harvest at farm gate prices, which does not require transportation of the harvested produce by the farmers (Dillon & Dambro, 2017). In Ghana, indirect marketing of paddy rice (selling to intermediaries or collectors) and direct marketing are the two primary marketing strategies (selling to processors). Farmers can sell their rice crops through one of these strategies (Donkor, Garnevsak, Siddique, & Donkor, 2021). Smallholder farmers with extra produce are frequently imprisoned in poverty due to a lack of market access (Von Loeper, Musango, Brent, & Drimie, 2016). Market involvement is required by smallholder farmers to increase their agricultural earnings, however, owing to the inadequacies of rural markets in developing countries, this is sometimes difficult to achieve (FAO, 2015). There are two reasons why markets are important to smallholder farmers. The primary reason is to have access to inputs, which is a problem in most rural areas. Farmers in Sierra Leone get input supplies from small traders who loan items in exchange for rice during harvest season. Secondly, Spencer et al. (as cited in Kamara, 2018) note that the price that is negotiated is often lower than the open market price during harvest time in Sierra Leone. Farmers, therefore, sell their harvest after it has been harvested. However, for smallholder farmers in developing nations, access to markets has been a big issue.

Disability or physically challenged nature of smallholder farmers

In Sierra Leone, the disabled/physically challenged individuals constituted 93,129 which represents 1.3% of the total population (Kabia & Tarawally, 2017). This figure portrays a fall as compared to results obtained from the 2004 census, which revealed a prevalence of disability level of 2.4% certainly due to the high level of amputations perpetrated by the rebels during the eleven-year-old civil strife before the 2004 census. Out of the national 1.3% disability level, the Southern Region recorded 24.4% as the fourth out of the five regions in terms of the disabled population living in the region.

Abled body individuals believe that those with disabilities are incapable of performing farm work (Telemans & Coe, 2013). It is also believed that individuals with impairments are physically or mentally unable to perform farming practices. This is a misleading statement as Gomda and Sulemana (2021) discovered in Ghana that 33.0% of 156 people with disabilities (PWDs) were found to be actively participating in farming with the provision of labour. Such disabled individuals assist with farming chores like groundwork, seed sowing, land clearing, reaping crops, and many others on the farms that are owned by the family members of their households. Smallholder farmers who have physical and visual impairments are seen as unable to move around the agricultural farmland. Because of communication difficulties, people who have hearing and learning impairments are often assumed incapable to understand farming techniques. "Due to mistaken assumptions about disabilities being "contagious" or carrying curses, some may not wish to interact with disabled individuals" (Telemans & Coe, 2013).

The socio-demographic characteristics of the AEAs

Sex of AEAs

The sex ratio of the male and female extension agents is mostly not proportional in most developing countries. According to Due, Magayane, and Temu (1997) in Tanzania, two-thirds of the village extension officers are males in the evaluation of the views of female AEAs by smallholder farmers. Similarly, a study by Antwi-Agyei and Stringer (2021) in the Upper East region of Ghana in improving the effectiveness of agricultural extension services showed that AEAs constituted 93.8% of males and 6.3% of females in the study area.

Age of AEAs

The majority of the AEAs are of the middle age category as most youths are not attracted by the agricultural extension service delivery system. In a study by Mustapha, Man, Shah, Kamarulzaman, and Tafida (2022), they noted that the age distribution of respondents revealed that the bulk of the AEAs (77.1%) were between the ages of 31 and 50. Those aged between 21-

30 years and over 50 years old made up 13.8% and 16.3% respectively of the population with the median age of the respondents being 41 years.

Level of Qualification of AEAs

The educational level of AEAs is essential for the effective use of rice post-harvest value addition technologies. For instance, Olorunfemi, Olorunfemi, and Oladele (2020) in a study concluded that the majority (92.5%) of extension agents have a Higher National Diploma (HND) or higher level of education that incorporated AEAs in the spread of climate-smart agriculture initiatives in Nigeria. A study by Ramjattan, Chowdhury, and Ganpat (2020) in Trinidad and Tobago noted that the majority of the AEAs have university education; 27% of them have diplomas, 26% have associate degrees, 24% have undergraduate degrees, 18% had postgraduate degrees, and 5% had other qualifications (secondary school education alone).

Years of experience

The duration of working experience varies among AEAs due to their appointment date. According to a study by Ramjattan et al. (2020), the range of working experience for extension agents in Trinidad and Tobago is 29% for those with 1 to 5 years, 34% for those with 6 to 10 years, and 37% for those with 11 years or more. Also, Olorunfemi, Olorunfemi and Oladele (2020) assert that AEAs with a greater average of 9.35 years of work experience are believed to have developed their capacity in putting agricultural strategies into practice. Wulandari (2015) in Indonesia accounts that AEAs have an average working experience of up to 25 years, and the range is from 1 year to 37 years. About half (53%) have working experience of more than 25 years, 30.4% have working experience of 21 to 25 years, 10.5% have working experience from

16 to 20 years, and 1.7% have working experience of 10 years to 15 years. The AEAs who have less than 10 years of experience are 4.4%.

A reliable source of post-harvest and marketing information

The main sources of technical information for AEAs are themselves according to a study by Oyegbami (2018) in Nigeria (79.1%), followed by television (37.5%), friends and neighbours (32.2%), and the internet (13.1%). This suggests that AEAs obtain information about agriculture from a variety of sources. They will learn more about new technology, enhance farming techniques, and boost production if these sources are adopted and used properly.

Post-harvest losses

Post-harvest losses of rice are defined as the losses that occur to rice owing to rice spillage, human negligence, and incompetence in the handling operations of rice during and after harvest (Hamzah et al., 2019a). A key factor that affects the availability of food, as well as food prices and price fluctuations, is the high level of measurable and qualitative losses that occur at any given stage of post-harvest; a segment that embraces all activities between rice harvesting and consumption. Definite infrastructure, like local storage facilities and modest processing facilities, will help to control or minimise food losses which translates into the improvement of the financial or nutritional values of crops, followed by ensuring food safety (Venkatesan, 2016; (Global Agriculture and Food Security Program (GAFSP), 2014).

The key challenge farmers face in developing countries such as Iraq is the high level of post-harvest losses they incurred between 30.0% and 80.0% of their crops before they reach the final consumer (Haleem, 2018). Post-harvest losses consist of improper settings of a harvesting machine, mishandling of rice during transportation, inefficient processing equipment (parboiling, drying, milling) that may result in broken rice grain, improper storage facilities resulting in unpleasant odours, discolouration, and insect attacks (Hamzah, Ahmad & Shahar, 2019b). In Sierra Leone, organisational inequality serves as the most evidential proof in the post-harvest processing of rice. As the country's staple crop, rice occupies a position of critical significance in the alleviation of hunger and food insecurity but requires considerable post-harvest processing before it is ready for consumption. Yet postharvest technologies for agricultural rice products, particularly those grown by subsistence farmers, have received the least attention from public sector research and extension (Kroma, 2007).

Smallholder rice value addition activities undertaken by smallholder farmers in Sierra Leone consist of mainly manual harvesting of rice, transportation, threshing, drying, milling, packaging and storage operations usually done by subsistence smallholder farmers by the use of the most convenient methods available to them. These simple rice processing and handling techniques customarily come with significant consequences for postharvest losses and the quality of rice grain (Kamara & Cooke, 2015). During the harvesting season, a high percentage of smallholder farmers do not have access to combine harvesters, and therefore harvest with sickles and thresh by hand. As a result, there is a significant loss as the available amounts of rice for sale are reduced, lowering earnings and thereby, contributing to the growing incidence of poverty within rural Northern Ghana (Adu-gyamfi, 2015).

The farmers' socio-demographic characteristics however contribute to the high post-harvest losses that occur. In other words, post-harvest losses are one of the difficulties generally facing farmers in undeveloped countries like Iraq (Haleem, 2018). These losses could be seen during harvesting, packaging, transportation, wholesale of retail, and delays in various processing stages. Lack of adequate professional knowledge is the major reason for losses during and after harvest. Furthermore, Taiwo and Bart-Plange (2016) add that rice losses by farmers are caused primarily by late harvesting and threshing times, heavy reliance on the traditional threshing methods, an excessive downpour of rain during harvesting and drying periods, absence of mechanical dryer, excessive or inadequate parboiling rather than steam paddy, high deterioration of hulling and polishing percentage, and lack of technical expertise in the Volta Region of Ghana.

Competencies of smallholder farmers in rice post-harvest value addition

Messick (as cited in Glaesser & Glaesser, 2019) defines competence as what a person knows and can do in a particular way where both knowledge and skills are needed either by instructing the learner or by experience and otherwise. Further, the authors stated in the same paper that competence is the 'knowledge of an individual and what he can do under ideal situations. Azevedo, D'Amours, and Rönnqvist (2009) define skill as a specific form of capacity that is typically inherent among people or teams that are useful in some unique circumstances or linked to using specialised resources, whilst knowledge is the collection of the belief system of an individual concerning casual occurrences.

Extension as a non-formal means of education provides advisory services by the use of an educational process to assist farmers to acquire knowledge and skills to effectively catch up with their own needs and problems they face in their very socio-economic contexts (Khan, 2016). Nowadays, a key universal challenge that requires farmers' competence is how to make food security possible for the world growing population and ensure long lasting sustainable development (Man et al., 2016).

The competence of smallholder farmers is synonymous with their participation in rice development projects as limited variables exist in the assessment of the socio-demographic factors that determine the competence of farmers in rice post-harvest technologies. For instance, Martey, Asante, Wiredu, and Annin (2013) discovered in Ghana that farmer characteristics like age, level of education, marital status, access to the income of the household head, price of rice in the market, knowledge about the rice varieties, access to credit facilities, farm sizes, all significantly determine farmers' level of participation in rice farming. Similarly, a significant correlation exists between the knowledge sharing ability rather than competence in post-harvest technologies of rice farmers and farming experience. A study by Siriwardana, Abeywickrama, Kannangara, and Jayawardena (2015) shows that farmers' farming experiences have a positive influence on knowledge sharing with a correlation coefficient of 0.209 in Sri Lanka.

In Nigeria, a study by Adisa, Famakinwa, and Adeloye (2020) indicated that farmers demonstrated the following skills; milling of rice (Mean=4.54, S.D.=1.19), threshing paddy on mat/tarpaulin, removal of dirt/stones, immature grains (Mean=4.32, S.D.=1.22), prevention of paddy from falling on the bare ground when heaped, threshing and winnowing times (Mean=4.16, S.D.=1.43) and dry paddy to maintain 13.0-14.0% moisture content (Mean=3.69, S.D.=1.60).

Competencies of AEAs in rice post-harvest value addition

Ghimire (2016) identified eight core competencies of AEAs in Nepal. These include competencies in planning and implementing programmes, communication skills, programme evaluation, educational and informational technology, personal and professional development, diversity and technical subject matter expertise. The AEAs need specialised competencies to skillfully perform their work. Given the global continuous change in knowledge and skills, only through regular training can AEAs keep up with the times (Saleh & Man, 2018). The few perceived competencies of AEAs outlined by Tester and Langridge (2010) include teaching skills, agricultural marketing, conducting group sessions as their current competencies, and writing skills; whilst their required competencies were knowledge management, communication skills, entrepreneurship/apprenticeship skills and curriculum creation. Additionally, a study by Bahua, (2018) identified the AEAs' competencies in Kabila and Tilongkabila sub-districts in Bone Bolango Gorontalo in Indonesia as thus: (1) their ability to design an extension programme, (2) their ability to implement the extension programme and (3) their ability to manage the available extension information. A study by Haleem (2018) however, posited post-harvest technologies as the highest ranked training needs of the AEAs in Iraq.

The competence of AEAs is key in the extension delivery system. Thus, the effectiveness of any extension service depends on the competence level of the AEAs in the technology. Given this fact, little or no literature is found on the socio-demographic factors which determine the competence of AEAs in rice post-harvest value addition. In support of this view, Akpotosu, Annor-Frempong and Bosompem (2017) identified socio-demographic characteristics as independent variables which include training, location, duration of use of the internet, age and the educational level of the AEAs as best predictors of internet competence which has an adjusted R-squared value of 0.563 in the regression analysis.

Relationships between the competencies of smallholder farmers in rice post-harvest value addition and socio-demographic characteristics

Older farmers are more competent and experienced in selling agricultural goods than younger farmers (Markussen et al., 2019). In Sierra Leone, (Mansaray & Jin, 2020) observed that the mean age of farmers is 45 years in their study to examine food security issues in the country. The more smallholder farmers advance in age, the greater their rice post-harvest value addition competencies (all things being equal) and this means that older farmers face more risks than younger farmers (Nouman & Syed, 2013). For choice of ecology, many individual farmers take full advantage of wetland ecologies for their socioeconomic gains. For instance, the majority of Ghanaian farmers rely on swamplands for agricultural activities and this provides them with an income and improved livelihood (Baffoe et al., 2021). Rice cultivation, for example, is mostly done in the lowlands, and rice farmers are largely reliant on this environment, which accounts for around 78.0% of domestic rice yield in Kenya (Njinju et al., 2018). Since this type of ecology is characteristic of high rice yield, farmers will be encouraged to carry out their anticipated rice post-harvest value addition activities to some extent. Roy, Shivamurthy and Radhakrisha (2013) observed significant associations between the level of education, source of income for the family, post-harvest knowledge, extension service contact, attitude toward value addition, membership in self-help groups (SHG) and their knowledge of value addition as the dependent variables in Bangladesh. Likewise, a significant association occurred between the educational level, post-harvest knowledge, attitude toward value addition and participants' skill level as the dependent variables.

Relationships between the competencies of the AEAs in rice post-harvest value addition and their socio-demographic characteristics

Limited literature exists on how the socio-demographic characteristics of AEAs particularly relate to their competence in rice post-harvest value addition. In addition, the technical skills and competencies required by AEAs differ depending on their expertise (Suvedi & Kaplowitz, 2016). A forestry extension worker, for example, must have basic technical knowledge and abilities that differ from a livestock extension agent. Similarly, a community health worker or nutrition extensionist will require a wide range of technical knowledge and skills. Regardless of specialty or professionalism, Suvedi and Kaplowitz (2016) have grouped competencies under four broad extension programming functions every extension worker must possess. These include programme planning, programme implementation, programme evaluation and communication and informational technologies. However, several studies have shown relationships between the socio-demographic characteristics of AEAs and other dependent variables, unlike competence. For instance, Abdullahi, Abu, Danwanka, Oladimeji and Abdulrahman (2017) observed that socio-demographic characteristics like age, education, specialisation and working experience have a relationship with extension personnel training needs activities in their study of the socio-economic factors that influence the training need among extension personnel in Nigeria. In addition, findings by Tata and McNamara (2016) in the United States show that socio-economic factors like gender, age, educational qualification, and internet access influence the challenges AEAs face in using farm books. Also, Victor, Anayochukwu and Olive (2019) discovered that the level of education and working experience were the strongest predictors of AEAs' job satisfaction in Nigeria.

Training content appropriate for farmers in rice post-harvest value addition

Training programmes are typically underfunded, and the capacities of service providers too are very limited (FAO, 2014). Accordingly, a training needs assessment can be determined externally. Often, what is good for the farmers, or is necessary, will promote their eagerness to follow the training sessions organised for them (Pierre-andré, Aurelie, Ejolle, Bénédicte, & Jean-claude, 2010). The training content/manual for smallholder farmers on post-harvest management practices of rice consists of harvesting, threshing, winnowing, drying, storing and milling of the paddy FAO (as cited in UNIDO, 2016).

Moreover, rice harvesting and threshing processes differ greatly from farmer to farmer and country to country. Mechanisation levels vary greatly from country to country. The processes might be manual, animal powered, or mechanical. On the other hand, the training of farmers also contributes essentially to the development of human resources in agriculture. For farmers, their basic training needs include crop wise information namely; improved crop seed, inter-cultural operation, right fertilisers, soil testing equipment, irrigation facilities, new farming implements, plant protection practices, cultivation of mushrooms, poultry production, sources of credit information and animal husbandry (Rahman, Alimuzzaman, Khan, & Hoque, 2018). Some of the major post-harvest training needs of farmers for rice value chain development in Ghana include better agricultural technologies in rice production, improvement in the quality of rice products, effective record keeping, marketing of rice and business management (Ampadu-Ameyaw et al., 2017). A study by Alarima et al. (2014) in Nigeria revealed in priority order, the training needs of farmers in Nigeria as management of water (95.50%), power tiller management and operation (93.20%), and laying out of Sawah and its design (88.60%) as the important areas where training was needed for Sawah farmers.

Training content appropriate for AEAs in rice post-harvest value addition

One of the most effective tools in agriculture is the training of AEAs to bring about the best in the farming actors. In line with this claim, Sajeev, Singha and Venkatasubramanian (2017) therefore define training as a process to acquire innovative skills, attitudes and knowledge for entering into a vocation or to improve one's productivity level in an organisation or enterprise. Man et al. (2016) also define training as the step-by-step development of the attitude, knowledge, skill and behavioural pattern of an individual that is required for adequate performance in a given job or task. In operationalising this fact, AEAs, consequently, require training for effective performance in their tasks. In this light, the training of AEAs is a fundamental requirement for the overall agricultural production process (Saleh et al., 2016). Due to the need for today's global sustainability, AEAs should be more knowledgeable to meet the growing demands of the diversity of farmer populations (Alibaygi & Zarafshani, 2008b). The appropriateness of training content is situationally driven because what seems to be appropriate for one individual or country might be inappropriate for another even if they both exist in identical agroecological locales (Mkonda, & He, 2017). The success of extension training courses entirely rests on their approaches to design and delivery. This involves the technology, resources and time required for AEAs to train farmers as the essential factors, the objectives, training outcomes, implementation structure, and evaluation procedures (Mkonda, & He, 2017). After the employment of the AEAs, their weakness or complete lack of training to plan a teaching programme poses an undesirable effect on the success of the extension services (Man et al., 2016). Hence, assessment of the training needs of AEAs is a fundamental requirement for a successful extension programme. Such AEAs' training needs are gaps between what is required for the job and performance (Nongtdu, Bordoloi, Saravanan, Singh, & Singh, 2012). The training needs assessment will enable the organisation to identify the type of training that might be needed for AEAs to close the gap that exists in their current skill level and the skill level that is required of them. According to Ferreira (2013), training needs assessment is an organisational process to collect and analyze data that will enhance deciding on whether training is the best option (or not) to improve the performance of the individuals, determine who is to be trained and what content exactly should be taught. Cekada (2010) added that TNA is the process by which training needs are identified in the organisation for the improvement of the performance of the employee.

Identification of training needs has always been the task of outside training operators. Therefore, it is characterised by the analysis of outside training operators of the situation (often external) and the objectives that they are pursuing (always sectorial, often determined by their institutional requirements). Yet, a study by Haleem (2018) in Iraq shows that the most significant component wherein AEAs required extensive (high-level) training was in post-harvest technologies. Even so, the name of the crop and the specific post-harvest operations were not stated, hence the need for this study.

In addition, Saleh and Man (2017) also identified post-harvest technologies among a list of training needs of AEAs. However, the post-harvest technologies were not directed at any one particular crop or specific value addition stage. Furthermore, Cahyono and Agunga (2016) observe in Indonesia that nearly all the AEAs (95.2%, n=120) who implemented the participatory extension approach were highly in need of yearly in-service training in enhancing their performance in their job.

Extension education methods appropriate for smallholder rice post-harvest value addition

In Africa, the conventional perception of an agricultural extension was largely centered on expanding production, increasing yields, training smallholder farmers and transferring new knowledge (innovation) to farmers (Davis, 2008). According to Tata and McNamara (2016) the modern definition of agricultural extension now involves all programmes that promote contact with knowledge, and information systems for farmers, their organisations and other market actors; encourage their contact with researchers, education, agri-business enterprises and some other related organisations by helping farmers in developing their professional, organisational and leadership skills and best practices.

Communication methods for rural education currently involve personal exchanges, group processes (including farmer field schools), mass media (largely radio), mixed-media advertising, traditional media combined with online streaming accessible from community telecentres and distance learning. On this note, therefore, the extension structure in Sierra Leone is predominantly pluralistic, drawing resources together from public institutions and stakeholders, universities, research institutions, NGOs, civil societies and the private sector. The extension unit of the government is the Ministry of Agriculture and Food Security (MAFS), which is responsible for providing farmers with public extension services (Amadu, Silvert, Eisenmann, Mosiman, & Liang, 2017). MAFS consists of seven basic divisions, which include (Crops, Livestock, Forestry, Agricultural Engineering and services, (Planning, Evaluation, Monitoring and Statistics Division-PEMSD), Agricultural Extension Services and administrative support at district levels).

Van Den Ban and Hawking (as cited in Ampadu-Ameyaw, Omari, & Owusu, 2017) assume that extension education explores extension methods and problems. They contend that extension education is dedicated to translating the findings of the study into farmers and passing on the challenges of farmers to research institutes. Furthermore, Van Den Ban and Hawking (as cited in Ampadu-Ameyaw et. al. 2017) adopted that extension education explores extension methods and problems. A study by the above authors in Nigeria outlined the following education and communication methods used: face-to-face, demonstration, group discussion, radio discussion, formal lectures, audio-visual aids, newsletter, television set, handbill, bulletin, leaflet, magazine and newspaper. Nonetheless, Baral, Paudel, Adhikari, Sudedi and Jaishi (2018) observed in Nepal that the respondents favoured the group approach/method of innovation diffusion with a mean score of 0.78 ranking as first because it allowed them to interact more with one another and offered support in selecting new rice types. In addition, the application of appropriate teaching methods provided a solution to increasing issues in rice production. Ayanda (2019) also noted that (93.11%) of the farmers rated Management Training Plot (MTP) or result demonstration as the most preferred training method for increasing their capacities in rice production in Nigeria.

Extension education methods appropriate for AEAs in rice post-harvest value addition

Different extension strategies have evolved during the last couple of decades in various countries for agricultural development. These include a training and visiting (T&V) approach, demonstration farm, producer meeting and field day (Iran, Bangladesh), educated and committed communicators (US), visits by AEAs, preparation and distribution of training materials, farmer groups, farmers to extend their production activities (India, Camerón, Malawi), participatory problem-solving approaches (Zimbabwe) and the use of virtual media (Kundhlande et al., 2015). The strategies used by the AEAs to maximise the usage and potency of their methods are determined by the society or community structures, the behavioural pattern of the individuals who comprise the society, religious perceptions, tradition, people's mental consciousness, and literacy level (Onwubuya et al., 2015). The UNIDO, (2016) outlines the following useful hints for developing a training course. Whom am I trying to train? (Number of learners and their educational backgrounds), what am I focusing on? (Topic, anticipated learning knowledge, abilities and behaviours), what do they now know about this particular topic? (Pre-existing knowledge, misunderstandings), how will I give the training to them on the subject matter? (which learning techniques are accessible, how much time is available, how can we access field and farm scenarios, and what additional practical learning possibilities are available), how can I include flexibility to deal with unforeseen circumstances? (Prioritising actions such that essential aspects of the programme are still addressed if anything takes longer than planned). How will I know whether the trainees have grasped the information? (Informal and formal appraisals, questioning tactics, participant feedback).

A study by Mwaura, Wangia, Origa and Oliver (2020) in Kenya revealed that AEAs choose group methods to reach out to farmers with 44.0% of the male AEAs using training/demonstration and 45.0% using group excursions and visits. Female AEAs (63.0%) used training and demonstrations. More than half of the male AEAs (54.0%) prefer the use of print media as a mass media approach and 65.0% of the female AEAs use field days. On the other hand, according to Ahmed and Adisa (2017), the individual method ranked first with a grand mean of 2.45, seconded by the group method (2.39) and mass media (2.37) in their observed effectiveness study of agricultural extension methods, used to disseminate improved technologies to rice farmers in Kogi State, Nigeria.

Conceptual Framework of the Study

The conceptual framework of the study was developed from the specific objectives and the theoretical and empirical reviews of the related literature of the study. To lend credence to the extension training model development for improvement in the capacity of smallholder farmers and AEAs in rice post-harvest value addition in Southern Sierra Leone, the study used the framework as presented in Figure 1. The framework has two main components: the training needs assessment and the training process. The needs assessment component presents an array of rice post-harvest value addition context issues, the competence and knowledge gap of the actors and the training contents and methods needed for extension delivery in rice post-harvest value addition for smallholder farmers in Sierra Leone. The training process involves the provision of training support without which training and its intended purpose cannot be achieved.

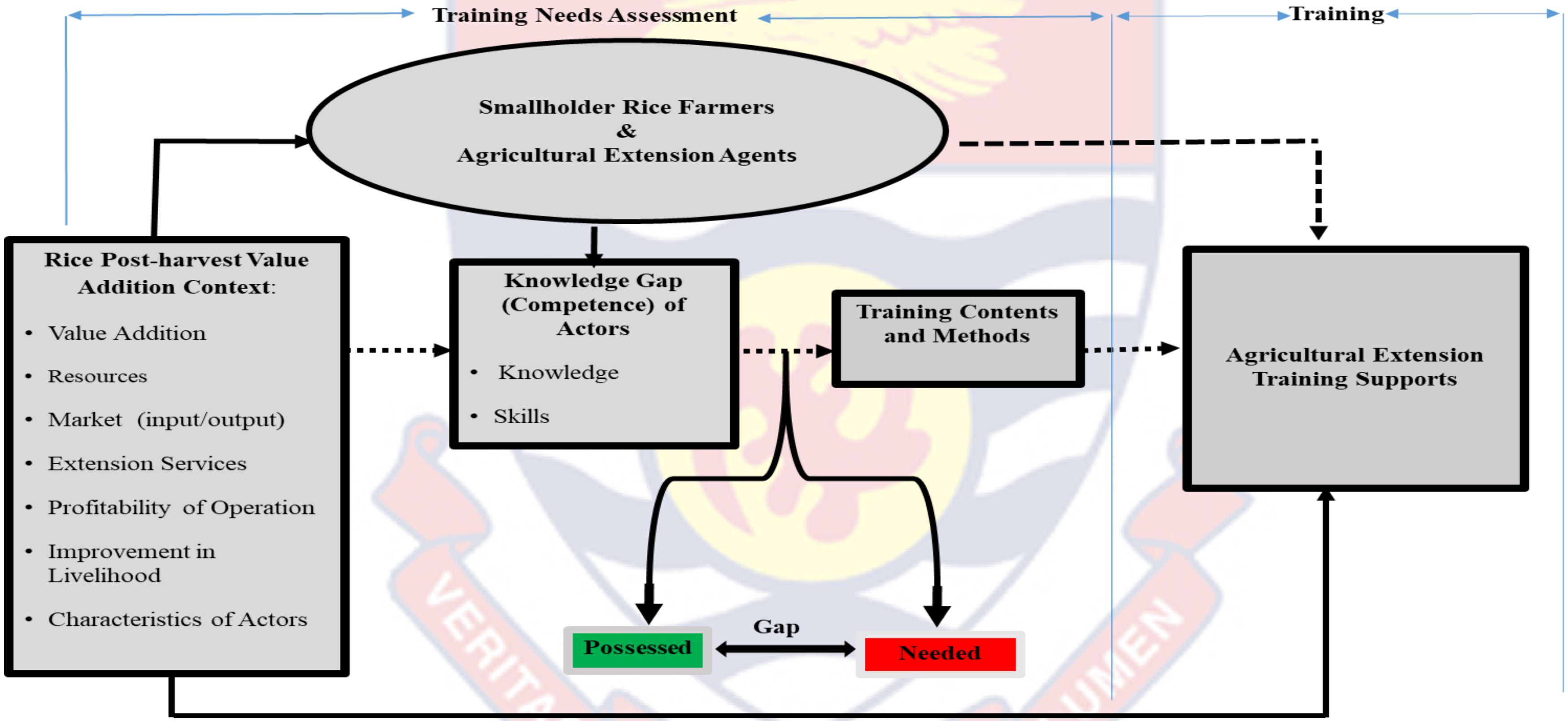


Figure 1: Conceptual framework of the extension training model for improving the capacity of the farming actors in RPHVA
Source: Author's Construct (2021)

The first part of the framework, the training needs assessment, evaluates the rice post-harvest value addition context- the external factors surrounding rice post-harvest value addition in Sierra Leone. They include the availability of resources for post-harvest value addition, level of post-harvest value addition, market availability for value added rice, extension services for post-harvest value addition, the profitability of operations and livelihood improvement of the farmers. The context also assesses the characteristics of farmers and extension agents.

The second part of the training needs assessment is internal conditions of assessment of the knowledge possessed and needed by both smallholder farmers and AEAs to determine the knowledge or competencies gap in rice post-harvest value addition through the use of the Borich needs assessment model (Goli et al. 2022). The Borich needs assessment model provides an assessment of preferred training methods and a list of prioritized training contents and methods. By the competency theory, Halbritter, Benge and Mackkowiak (2021) successful extension service is based on the identification of the actual needs, in this case (rice post-harvest value addition of smallholder farmers and AEAs). The prioritisation of the training areas helps in the identification of the most important areas for training and the key methods to use in delivery. This is also in line with the skill gap analysis theory which suggests that training should target discrepancies and important skills that are desired by trainees (Milhem, Abushamsieh, & Aróstegui, 2014).

The second part of the framework of the extension training model for improving the capacity of smallholder farmers and AEAs in rice post-harvest value addition is the training process. This involves the provision of training support which is made up of both materials (inputs – capital, service providers) and human resources (e.g. subject matter specialists (SMSs), extension agents) needed for the training and its application by farmers.

Summary of the Chapter

The chapter reviewed the related literature starting with the socio-demographic characteristics of smallholder farmers and AEAs. The key basic concepts in the development of an extension training model in rice post-harvest value addition in the Southern Region of Sierra Leone have also been discussed. The chapter has further discussed the theoretical frameworks that underpinned the study. These include the competency motivation theory and the skilled-gap analysis theory. The empirical review and competencies of smallholder farmers and AEAs have been thoroughly discussed. The conceptual framework which was derived from the specific objectives and the theories informing the study has also been examined in this chapter.

CHAPTER THREE

RESEARCH METHODOLOGY

Introduction

This chapter discusses the procedures the study followed. It started by providing a philosophical view to justify the approach utilised for the study. It ranges from the research design, study area, study population, sampling procedures (sample size determination), data collection instruments (training of enumerators, pre-testing of instruments, moral/ethical considerations) and data collection procedures, to data processing and analysis. The chapter further describes the appropriateness of the procedures that were used in collecting and analysing data, thus consolidating the reliability and validity of what the findings present.

Research Design

The word research design means drawing a tentative outline, a blueprint and a scheme, planning, or arranging a strategy to research with thorough knowledge of research methodology (Peniel & Seminary, 2016). It enables certain guidelines and procedures to pursue authentic and relevant investigations with a professional standard. It is a logical and systematic plan for collecting data, management and analysis of data prepared for a study. A descriptive research design was used for this study. This design strives to gather information in a methodical way to describe a phenomenon, circumstance, or population. Instead of focusing on the why, it explicitly assists in addressing the what, when, where, and how the issues are related to the study problem.

The choice of a research design is therefore often influenced by the type of research philosophy of the researcher. There are three types of research philosophies. These include; positivism, post-positivism (constructivism), and pragmatism.

- Positivism - The epistemology of positivism is founded on the notion that science is the sole means to discover the truth and how knowledge is obtained and evaluated. The positivist derives truth from previous experience. Positivism is a philosophy which holds that only information that is "factual" and obtained by the senses, including measurement, is reliable. The focus is on gathering quantitative data that can be analysed, classified into frequencies, and reported using percentages and other descriptive statistical techniques like mode, mean charts, and graphs.
- Post-Positivism (Constructivism) - The findings of research on a topic may differ from one researcher to the other because they see reality from different perspectives. Post-positivists use their thought in applied research. The post-positivist considers qualitative methods as valid approaches to research. The Qualitative research approach is descriptive in nature because it deals with non-numerical and unquantifiable things.
- Pragmatism - Truth is not viewed as an immutable concept in pragmatism; rather, it is viewed as a flexible tool for interpreting the reality of the natural world. Instead of what might be deemed to be totally and objectively "true" or "real," the pragmatists' epistemology holds that truth is "what works." According to pragmatists, there are numerous ways to see the world, and no one point of view can ever fully represent all possible realities when undertaking research. When it comes to research,

pragmatists combine many techniques and methodologies (mixed methods) within the same study. The philosophy involves the application of "what works" to seek answers to the research questions (Almalki, 2016). Pragmatism, according to Kaushik and Walsh (2019) is a paradigm of research that finds its philosophical foundation in the historical contributions of the philosophy of pragmatism and as such, embraces a plurality of methods.

This research, however, embraced mixed-methods research by combining both the quantitative and qualitative research approaches. The choice of mixed methods is guided by a pragmatic philosophical view that the researcher shares. The numerous merits of the design provide instinctive appeal for new researchers since it allows them to get deeply engrossed within the data, nurtures creativeness as it does not start with testing an existing hypothesis, but uses the empirical data to generate concepts and theories; ability to conceptualise as conceptualisation separates the relevant from the irrelevant, systematic data analysis; and provision for richness and depth of data (Hussein, El, Hirst, Salyers, & Osuji, 2014).

More specifically, a convergent parallel mixed method was considered. From Demir and Pismek's (2018) account, the convergent parallel mixed method requires the researcher to concurrently carry out numerical and qualitative elements in the same phase of the research process, thereby equally weighing the methods, analysing the two components independently, to interpret the results together. The design recommends the collection and analysis of data to progress in tandem as the ideal way because it enables the researcher to analyse and sample data in parallel for concepts and theories to be developed in an inductive, grounded manner. Because of this reason, this model is usually challenged and not practicable, mainly when interviews are the primary sources of data collection method as well as the brevity of the time frame available (Timonen, Foley, & Conlon, 2018).

From this background, mixed methods research exists in the middle of both qualitative and quantitative continuum because it integrates elements of both approaches. Thus, the method embroils collecting, analysing and interpreting quantitative and qualitative data in a single study or in a series of studies that investigate the same underlying phenomenon (Leech, Dellinger, Brannagan, & Tanaka,2010). By using mixed methods, the researcher merged both quantitative and qualitative data to provide a comprehensive analysis of the research problem (Kaushik & Walsh, 2019). It focuses on understanding the world or a phenomenon practically as opposed to the extremist positional views on positivism and constructionism. The mixed methods approach is used to gather quantitative and qualitative data and to answer the research questions and hypotheses.

Under the quantitative approach, the research adopted a descriptive cross-sectional survey. A descriptive study, according to Aggarwa and Ranganathan (2018), is designed to define how one or more variables are distributed, with no regard to any of the causal or other hypotheses. This type of study, regardless of its subtypes, is usually straightforward to conduct. Ponto (2015) stated that research by the survey is the collection of information from a sample of individuals through their responses to questions. With the cross-sectional survey, a descriptive study may generalise the findings from a representative sample to a larger target population (Omair, 2015). The best way to collect data using this method might be a survey. The survey allows researchers to collect potentially enormous volumes of data in a short period by obtaining depth of details from the respondents (Muhammad & Kabir, 2018) among various advantages of surveys. A survey, according to Apuke (2017), is a form of quantitative research that is concerned with a sampling of the questionnaire, questionnaire design and questionnaire administration to generate data out of the population under study, and then make analysis better to understand the behaviours/characteristics of that population.

In the qualitative approach, an in-depth interview was used to gather data from participants. Though there is an assumption about qualitative research, which claims that while sample sizes are fewer, the analysis would be more cost-effective. In some cases, it may be so, but in the majority of cases, qualitative research can yield a large amount of data that the time spent analysing the data adds greatly to the total cost (Smith & Bowers-Brown, 2010). Yet, a distinguishing feature of qualitative analysis is that it is commonly viewed as 'inductive', i.e. concepts and theories appear to evolve and emerge from evidence rather than being set in place before data is gathered (Smith & Bowers-Brown 2010). In collecting data for this type of research, an audio recording is done which must be transcribed verbatim even before the analysis of research data commences (Sutton & Austin, 2015).

Study Area

Location

The Southern Region (Figure 2) is one of the five regions or provinces of Sierra Leone. The region covers a geographical land area of 19,694 km² with a population of 1,438,572 (Statistics Sierra Leone, 2015). It is divided into four districts (Bo, Bonthe, Moyamba, and Pujehun). Its capital and administrative hub is Bo, which is also the country's second biggest and second most populous city after the capital, Freetown. The Mende ethnic group makes up the majority of the population in the region. Bo district has 575,478, Bonthe has 200,781, Moyamba has 318,588, and Pujehun district has 346,461 as their respective populations (Statistics Sierra Leone, 2015). The Region is flanked in the far northwest by the Western Area, in the northeast bordering with the Northern Region, in the east, by the Eastern Region and in the southeast by the Grand Cape Mount County, Liberia.

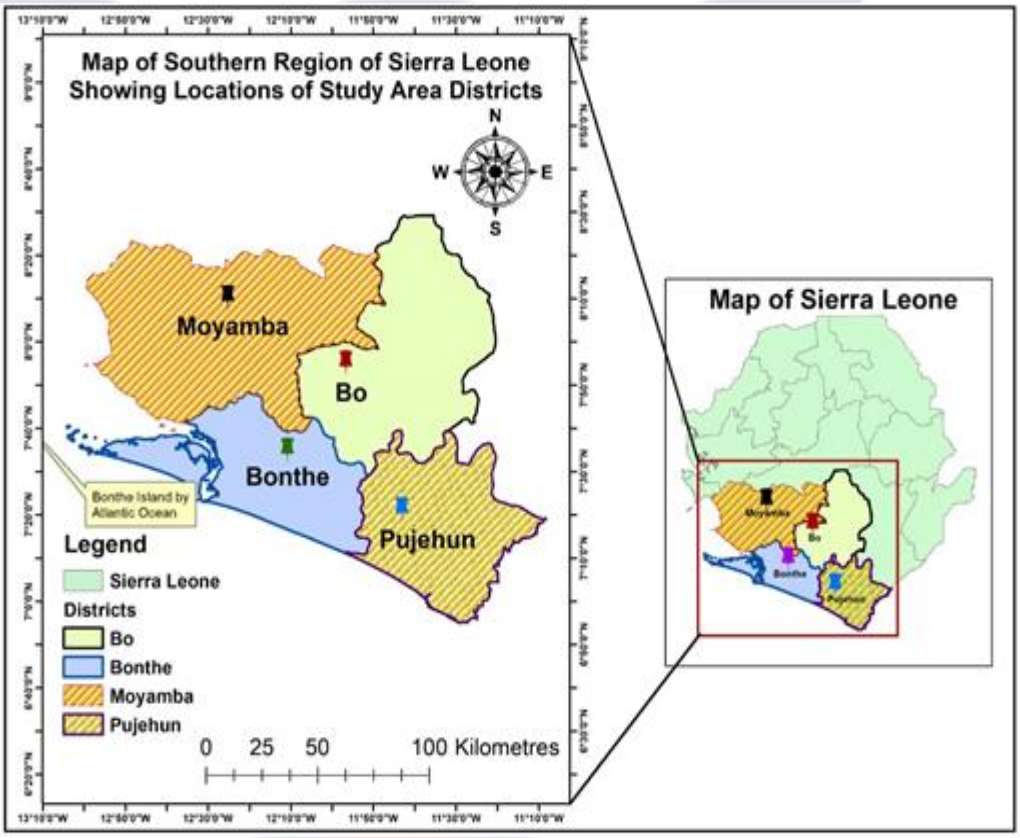


Figure 2: Map of Southern Region showing locations of study area districts.

Source: Moseray (2021): ICT Centre, Njala University, Sierra Leone

Vegetation

As a large geographic community, the Southern Region contains a wide variety of typical Sierra Leone vegetation visible from one district to another. The overwhelming majority of the region's landscape exhibits a mosaic characterised by bush fallows (farm bush), with enormous stretches of farm bush (agricultural fallow vegetation) (Mansaray, Lappia, Sinnah, Turay, & Vanessa, 2016). Swamps are an essential part of the ecosystem. The main source of swamp inundation is the network of the major rivers and their tributaries and streams found in the Region. Swamps are critical agricultural substrates, especially for local rice production.

The increase in mineral extraction activities, over the previous two decades has harmed the swamp ecosystem and rendered large areas of swamp unsuited for rice farming by destroying swamp ecology which has resulted in significant environmental damage. Indeed, according to anecdotal information, some local respondents confirmed that rice production has declined dramatically in swamps affected by mining activities, albeit agricultural activities are steadily regaining momentum. Most forests are secondary, except for a few sacred groves and a stretch of gallery forest along the river banks, which appears to be diminishing due to its thinness in most spots. Some gallery forests are discovered in places that are said to be continuous with riparian ecologies, which are critical ecosystems for a variety of reasons. Though the forest extent is modest and under constant threat of degradation and depletion due to logging, agriculture and artisanal diamond mining, the forests remain the primary hosts of the majority of the wildlife species found therein.

Climate

The region hosts Sierra Leone's transitional rain forest savanna woodland agro-climatic region. A high mean annual rainfall of 2500-3000 mm and a moderately low (290+/-30mm) water deficit spread over 100-200 days transitional is associated with the rainforest savanna woodland agro-climatic area (Mansaray, et al. 2016). The climate of the region is generally defined as a wet tropical monsoon, with only one wet season each year. The yearly rainfall average is approximately 2,540 mm (Mansaray et al. 2016). The majority of this rain, falls between mid-April and mid-November, with August often being the wettest month, despite the fact that the rivers reach their maximum discharge in mid-September. Approximately half of the annual precipitation (1,460 mm) reaches groundwater or runoff, resulting in stream and river flows (Mansaray et al. 2016). Rainfall contributes to streamflow over a long time, from the beginning of May to the end of November. River discharge is lowest in March and April and progressively increases in May. It is not until late July that groundwater levels begin to climb appreciably.

Soil

The geology of the Region is part of Sierra Leone's Basement Granite and Acid Gneiss Terrain. The Leonean Granite and Gneiss Terrain of West Africa comprises the floor rocks to the widespread gravel occurrences (Mansaray, et al. 2016). The valley of the rivers contains both contemporary and paleo deposits of diamondiferous gravels. A wide range of alluvial facies, including a high terrace, middle terrace, low terrace, swamp and river depositional habitats, may be found across the Region. Because of the alluvial deposits, the greater artisanal mining activities are restricted to the lower terrace facies, swamp facies and the current river system. Prospective gravel horizons consist of the lower terrace, middle terrace, upper terrace and swamp facies. The middle and upper terraces are terrestrial, chemically weathered, and relatively in-situ regolith landforms that produce a lateritic residuum with a ferruginous (haematite and goethite) gravel horizon, numerous pisoliths and nodules and diamonds. In contrast to the lower terrace gravels, a relatively thin overburden permits simple access to these gravels, which are somewhat.

Figure 2 shows Sierra Leone's map and the location of the Southern Region which hosts Bo, Bonthe, Moyamba and Pujehun districts as the study areas.

Population

The targeted population for this study comprised smallholder rice farmers and the public AEAs in the Southern Region of Sierra Leone. Also, the senior MAFS officials were part of the study population as key informants (KIs). For the quantitative design, the smallholder rice farmers from the 157,114 farming households (Statistics Sierra Leone, 2016) and the AEAs in the Southern Region formed the population. The AEAs include both those at the districts and sub-district (chiefdom) levels. The senior MAFS officials/KIs on the other hand, at the headquarters and district levels, formed part of the population for the qualitative design.

Sampling Procedures

The sample sizes were determined under this section. Three sample categories were required for the survey. These were smallholder farmers, AEAs and the key informants.

Sampling procedures for the quantitative study

Two samples were selected under this approach. They include the smallholder farmers and the AEAs.

The sampling of smallholder farmers

The selection of smallholder farmers was based on a sampling frame. Determination of the sample size of smallholder farmers was done through the use of Yamane's (1973, p.886) formula as a sampling technique for this study.

Sample Size (n) = $N/1 + N(\alpha)^2$

Where: N=sample frame/size of the population, n=sample size, α=margin of error/level of precision at 95% confidence level.

Note: N (# of chiefdoms and households of crop farmers in the Southern Region) = 51 chiefdoms and 157,114 Households (Statistics Sierra Leone, 2016). Bo district has 15 chiefdoms and 53,431 households, with Bonthe district (11 and 21,942), Moyamba district (14 and 45,718), and Pujehun district (11 and 36,023) chiefdoms and crop farming households respectively (Statistics Sierra Leone, 2016). A sample frame of 157,114 households of rice farmers was considered in the absence of the individual sample frame of rice farmers in the Region.

Therefore, the sampling procedure of farmers occurred in a multi-stage random sampling technique manner in each of the four districts in the Region (Bo, Bonthe, Moyamba, and Pujehun) to proportionally select the sample chiefdoms on the understanding that:

- Forty one out of fifty five chiefdoms were first selected on a proportional basis from the four districts in the region through the use of a sample size determination formula.

- Secondly, based on a simple proportional random sampling technique, farmers were selected from the four districts. This method was to ensure fairness by conducting a proportional selection of sample size (n) of farmers since all districts and chiefdoms do not have an equal number of farmers.

Below shows the multi-stage random sampling technique used to select sample farmers.

Stage 1: Proportional random sampling of chiefdoms from the districts

The researcher used a sample determination formula to determine a total of n (45) out of N (51) chiefdoms from the four districts. The proportional sampling random technique was also effected to effectively determine and randomly select the total number of sample chiefdoms. Names of the chiefdoms were put into strata (districts). In doing so, the names of all chiefdoms in each district were computed for a lucky deep to randomly select chiefdom samples.

Table 1: Proportional sampling of chiefdoms from the districts

Strata	**Districts**	**No. of chiefdoms per district**	**Sampling of chiefdoms**	**Sampled chiefdoms**
1st stratum	Bo	15	$\frac{15 \times 45}{51}$	13
2nd stratum	Bonthe	11	$\frac{11 \times 45}{51}$	10
3rd stratum	Moyamba	14	$\frac{14 \times 45}{51}$	12
4th stratum	Pujehun	11	$\frac{11 \times 45}{51}$	10
Total		**51**		**45**

Source**:** Field Data, Kamanda (2021)

On separate pieces of paper, the names of the chiefdom were written, folded and put into an enclosed bag. Each folded paper that was meant to represent a sample was randomly selected and assigned to meet the required sample size of chiefdoms in that particular district for this study.

Stage 2: Sampling of sections and farming communities in the study area

The sampling procedure for chiefdoms, sections and towns/villages was also randomly done by using the same formula. Each chiefdom is divided into sections, therein towns/villages are found. A list of names of these sections and communities was computed from the field to select the required number of sample communities. A list of the sections and communities was created before the researcher and the enumerators got to the field for the data collection exercise.

***Stage 3:* Proportional sampling of rice farming households**

At this stage, since all the chiefdoms do not have an equal number of farmers, it was so discrete enough to select the samples proportionally from the use of Yamane's (1973, p.886) formula as a sampling technique for this study.

Sample Size (n) = $\boldsymbol{N/1+N(\alpha)^2}$

Where: N=sample frame/size of the population, n=sample size, α=margin of error/level of precision at 95% confidence level.

By substitution into the above formula,

$$n = \frac{157{,}114}{1+157{,}114(0.05)^2}$$

$$n = 400$$

Therefore, n = 400 households = 400 smallholder rice farmers.

Each selected household, thus, provided one smallholder rice farmer as a sample element for this study totalling 400 respondents.

In selecting the total sample size of farmers, the researcher first randomly selected farming households from each section and community since each sampled household provided one rice farmer as a sample for this study. By so doing, a list of towns/villages in each chiefdom computed in stage two was required to reflect the number of sample farming households in every chiefdom and district.

The total number of sample farmers = Four hundred (400) farming households = Four hundred (400) rice farmers as each household provided one rice growing farmer as a respondent. Table 2 below shows how the sample size of farmers was sampled.

Table 2: Proportional sampling of farming households in the study area

District	Total number of registered household of smallholder farmers per district	Proportional sampling of households	Sample size of households
Bo	53,431	$\frac{53431 \text{ x } 400}{157{,}114}$	136
Bonthe	21,942	$\frac{21{,}942 \text{ x } 400}{157{,}114}$	56
Moyamba	45,718	$\frac{45{,}718 \text{ x } 400}{157{,}114}$	116
Pujehun	36,023	$\frac{36{,}023 \text{ x } 400}{167{,}114}$	92
Total	157,114		**400**

Source: Field Data, Kamanda (2021)

To achieve an additional 10.0% to the number of farmers per chiefdom for their total sample size, rounding up to the nearest whole number brought about an additional forty (40) respondents to the actual sample size of four hundred (400) of the study. This was a necessary inclusion because according to Israel (1992), a 10.0-30.0% addition is recommended for the sample size to augment the unforeseeable field challenges in meeting the exact targets within the available budget and time. Table 3 shows how the additional 10.0% increase in sample size (farmers) was selected (Israel, 1992).

Table 3: Selection of sample farmers

District	Number of sample farming households per district	Number of sample chiefdoms per district	10% of sample farming household	Number of respondents per chiefdom	+ 10% sample size of farmers per district
Bo	136	13	13.6	12	150
Bonthe	56	10	5.6	6	62
Moyamba	116	12	11.6	11	127
Pujehun	92	10	9.2	10	101
Total	400	45	40		**440**

Source: Field Data, Kamanda (2021)

The sampling of the Agricultural Extension Agents

A census of fifty-four (54) AEAs comprising four District Agricultural Officers (DAOs), twenty-one Block Extension Supervisors (BESs), and twenty-nine Field Extension Workers (FEWs) categories from the four districts were purposively selected to form the sample size of this study. In Sierra Leone, AEAs are intermediaries between research and farmers in their decision-making roles. They are to ensure that appropriate knowledge is applied to meet the needs of farmers including the best result for sustainable production and general rural community development. A subject matter specialist also known as the District Agricultural Officer (DAO) heads the extension division of the district. Each district is divided into blocks made up of chiefdoms of about three-four blocks. Each block is further subdivided into circles headed by a FEW who closely supervises the smallholder farmers at the farm level and reports to the BES. The BES in turn reports to the (DAO). The division of the districts, blocks, and circles varies from district to district. Bo district for example is divided into six blocks that are headed by six BESs and twelve FEWs. The Moymaba, Bonthe, and Pujehun districts are all divided into five blocks. The total number of FEWs depends on the total number of circles in the districts since each block is divided into circles and a circle is headed by a FEW. Quite recently, the number of FEWs in the field is dwindling owing to aging and retirement criteria for AEAs which government is to address by recruiting more trained and qualified staff.

Sampling Procedures of Key Informants for the qualitative study

For the in-depth interview with the senior MAFS officials as key informants (KIs), a census was also done to target eleven (11) headquarters staff and four (4) DAOs at the provincial level to have a record of their scarce population of fifteen (15) personnel. Unfortunately, the sample size for this method was limited to eleven (11) since four (4) headquarters staff did not participate in the interview owing to their busy schedule. All of the total key informants that participated in the study include the following: Director of the Agricultural Extension Services Division, Assistant Director of the Agricultural Extension Services Division, Acting Director of Crops, Personal Assistant to the Chief Agricultural Officer and Monitoring and Evaluation

Officer, Personal Assistant to the Hon. Minister of Agriculture and Forestry, Director of Internal Audit, Assistant Director - Human Resources Manager, District Agricultural Officer, Bo, District Agricultural Extension Officer, Bonthe, District Agricultural Officer, Moyamba and District Agricultural Officer, Pujehun.

These form the sample size of the qualitative study. In total, seven (7) senior MAFS officials as key informants at headquarter level and four (4) from the district level totalling eleven (11) were interviewed using an in-depth interview approach.

Data Collection Instruments for quantitative data

Being a mixed-methods study, different data collection instruments to collect data for this study were used. The researcher first presented the drafted instruments to professionals/experts including both supervisors and two other academic staff of the department to determine their content validity. Following this process, the application letter for ethical clearance (Appendix D) together with research instruments (Appendix A, B, C) and other relevant application documents were submitted to the Chairperson of the Institutional Review Board (IRB) of the University of Cape Coast for further review before the issuance of the certificate of ethical clearance for data collection.

For the quantitative method, the research instruments were: 1) a closed-ended/structured interview schedule for rice farmers, and 2) a questionnaire for the AEAs. With the qualitative method, an in-depth interview guide was used for the key informants. Details of the research instruments are provided in the following sections (Appendices A and B).

Structured interview schedule for rice farmers

The interview schedule for the rice farmers has four sections, A, B, C, and D (Appendix A). These are described as follows:

Section A: Personal information on farmers

The demographic and socio-economic characteristics of the smallholder farmers are under this section. The need for assessing these characteristics is to show how they influence the rice post-harvest value addition competencies of smallholder farmers and AEAs in rice post-harvest value addition. The demographic characteristics of the AEAs include sex, age, marital status, educational level and household size of the farmer. The socio-economic characteristics are the source of farm labour, main occupation, other livelihoods/entrepreneurial activity, type of land ownership, access to processing machines, access to extension service, years of working experience, total yearly average yield, the quantity of rice sold, the main source of income, and total annual income.

Section B: Context of the smallholder rice post-harvest value addition

The goal of this section is to assess the types of resourcing, value addition, marketing, and extension services provided by the AEAs, the profitability of operations, and farmer livelihood. For example, for the value addition aspect, one would like to know whether farmers undertake any of the stated rice post-harvest value addition activities. If yes, to what extent (1=To a small extent, 2=To some extent, 3=To a moderate extent, 4=To a great extent, 5=To a very great extent) they are undertaking the practices on a five-point Likert scale.

Section C: Competencies of smallholder farmers in rice post-harvest value addition.

This section deals with determining the competencies of smallholder farmers in rice post-harvest value addition in the study area. Under this section, the importance and competence of every technology to the smallholder farmers were measured on a 5-point Likert scale to come up with their training needs in rice post-harvest value addition in the study area. The Borich needs assessment model was used to determine the training needs of smallholder farmers.

The Likert-type scale ratings for measuring importance were: 1=unimportant≤1.45, 2=less important=1.46-2.45, 3=moderately important=2.46-3.45, 4=important=3.46-4.45, 5=very important≥4.46. Similarly, the ratings for measuring competence were on a scale of 1=Incapable≤1.45, 2=Less capable=1.46-2.45, 3=Moderately capable=2.46-3.45, 4=Capable=3.46-4.45, and 5=Highly capable≥4.46.

Section D: Extension education methods

The extension education methods were investigated in this section. The emphasis of this section is on establishing which extension education methods are appropriate for smallholder rice post-harvest value addition in Sierra Leone.

Questionnaire for Agricultural Extension Agents

The data collection instrument (questionnaire) for the AEAs was subdivided into the following four sections; sections A, B, C, and D (Appendix B). These are described as follows:

Section A: Personal Information on Respondents

This section comprises both the demographic and socio-economic characteristics of AEAs. The need for assessing these characteristics is to determine how they might affect the competencies of the AEAs in rice post-harvest value addition. The demographic characteristics of the AEAs for this study include sex, age, and their highest educational levels. The socioeconomic characteristics investigated were years of agricultural extension working experience, number of years of post-university capacity building skills on the job, how often AEAs visit farmers, other livelihood activities, the total annual income level of AEAs, and a list of motivations and challenges AEAs encounter in pursuit of their work.

Section B: Context of the smallholder rice post-harvest value addition

The goal of this section is to assess the types of resourcing and extension services provided by the AEAs. The five different response options on the 5-point Likert type scale with a neutral point in the middle were related to measuring the level of consensus of AEAs distinct enough to get respondents' responses that were devoid of any confusion. For example, the scale measured how adequate (1=Unavailable, 2=Inadequate, 3=Adequate) the resources to AEAs in working with farmers to add value to rice at post-harvest stages.

Section C: Competencies of AEAs and their training needs

Under this section, the knowledge and skills of the AEAs were assessed to come up with the gaps in rice post-harvest value addition in the study area. The Borich needs assessment model was used to determine the competencies of the AEAs. This section described how the competencies of smallholder farmers in rice post-harvest value addition in the study area were assessed.

The Likert scale ratings for measuring competence were: 1=Incapable, 2=Less capable, 3=Moderate5, 4=Capable, and 5=Highly capable. The ratings of the Importance scale were: 1=Unimportant, 2=Less important, 3=Moderately important, 4=Important, and 5=Very important.

The importance and competence of every technology to AEAs were measured on a 5-point Likert scale to come up with their total training needs in rice post-harvest value addition in the study area.

Section D: Extension Education Methods

The emphasis of this section is on establishing the extension education methods appropriate for smallholder rice post-harvest value addition in Sierra Leone. These methods include Individual extension or face-face, Group, and Mass media extension methods.

Data Collection Instrument for the qualitative method

In-depth interview guide for senior MAFS officials (KIs)

The data collection instrument, an In-depth Interview Guide (Appendix C) used to obtain qualitative data from the key informants comprised the following four sections:

Section A: Personal Information on Respondents. Both demographic and some socio-economic characteristics of the officials were investigated. The purpose of investigating these personal characteristics is to underscore the depth of agricultural extension knowledge they possess.

Section B: Views of the senior MAFS officials in RPHVA. Views of the KIs were sought in the context of smallholder rice post-harvest value addition in terms of providing resources, and value addition. These were worth noting because MAFS through the extension division is the vehicle, which mobilises resources to AEAs and subsequently to farmers. Therefore, a direct encounter with the officials will demystify the widespread claim that extension programmes in the country are poorly resourced. This is also in tune with the role the ministry is playing towards value addition activities to rice in particular.

Section C: Assessment of the competencies of the AEAs. Through proper cross-examination, the assessment of the competencies of the AEAs by the KIs was a stepping stone to having in-depth knowledge of the inadequacies of the AEAs. The deficiency gap in the knowledge and skill of the AEAs is not unknown to the ministry officials, hence, the need for this interview.

Section D: Development of the RPHVA training model. Respondents helped in the determination of the training content appropriate for smallholder rice post-harvest value addition in Sierra Leone in developing a training model in RPHVA. As extension programme benefactors, a participatory approach to assessing the training content for the AEAs was a stitch in time and will hence render the recommendations from this study an all-inclusive intervention.

Training of enumerators

Training of enumerators was done on May 15, 2021, following the issuance of an ethical clearance (Appendix D) by the Institutional Review Board of the University of Cape Coast on May 11, 2021. Training the enumerators preceded pre-testing the instruments and the real collection of data exercises. The data collection exercise started on May 19, 2021 and ended on July 17, 2021. In gathering the data, the researcher employed the assistance of four enumerators including two graduates and two Higher Diploma Certificate holders in General Agriculture, with experience in working as

AEAs and who have participated in previous farm data collection, were recruited for the exercise. These enumerators were given a day's training on the effective use of the survey instruments for inputting the raw data. Additionally, such individuals that collected quantitative data from farmers, in particular, understood the local dialects of the respondents. The importance of the training was to increase the level of competence of the enumerators towards the use of the instruments. Moreover, it was to ensure the attainment of credible data in meeting the aim of the study.

Pre-testing the survey instruments

Pre-testing the survey instruments for the farmers and AEAs was a requirement for the survey. Therefore, the instruments were pre-tested in January 2019, in the Kenema district in the Eastern Region among forty (40) rice farmers (10.0% of n), and ten (10) AEAs (20.0% of n) with similar background characteristics as those in the study area. Pre-testing ensured that the instruments were both valid and reliable for the collection of research data.

Validity of the Instrument

An instrument is said to be valid when it consistently achieves relevant, accurate, and precise data for a particular study (Sarantakos, 2013). Face, content, and construct validity were considered in ensuring that the instruments accurately and precisely measured what they were intended to measure (Sarantakos, 2013; VanderStoep & Johnston, 2009). Whilst the face validity was certified by the rice farmers, enumerators, AEAs, the researcher, and other colleague students, the content and construct validity were guaranteed by the supervisors of the thesis by ensuring that all objectives, constructs and variables were operationalized for measurement.

Reliability of the Instrument

The reliability of an instrument is the degree to which an instrument produces consistent, replicable estimates of what is developed to measure (Krabbe, 2017). The Cronbach's alpha reliability coefficients from the pre-tested data for smallholder rice farmers were computed for the determination of the internal consistency/reliability of the items in the quantitative instruments measured on a 5-point Likert-type scale. The Cronbach's alpha coefficient was computed by correlating the score for each Likert scale item with the total score of items for each observation (smallholder farmers or AEAs), by comparing it to the variance for all item scores of the individuals:

Hence;

$$\alpha = \left(\frac{k}{k-1}\right)\left(1-\frac{\sum_{i=1}^{k}\sigma_{y_i}^2}{\sigma_x^2}\right)$$

…where: k refers to the number of scale items

$\sigma_{y_i}^2$ refers to the variance associated with item i

σ_x^2 refers to the variance associated with the observed total scores

Table 4: Cronbach Alpha reliability test coefficients

Constructs	Cronbach's alpha reliability coefficients	Number of items
Value addition activities	0.942	15
Quality of extension services	0.822	5
Farmers' livelihood	0.619	5
Harvesting paddy	0.746	6
Heaping of harvested paddy	0.971	3
Threshing of paddy	0.786	8
Transportation of paddy	0.674	8
Parboiling of paddy	0.713	8
Drying of paddy	0.714	8
Milling of paddy	0.926	5

Source: Pre-Test Data (2021)

The above Cronbach's alpha reliability coefficients show that almost all of the constructs/items in the instruments measured Alpha level to be equalled to or more than 0.7 were considered reliable and therefore accepted.

The exercise further granted the researcher an opportunity to determine the appropriateness of the instrument in terms of reliability before the actual survey began. It further necessitated the identification of omissions, or ambiguous questions, which were corrected, and to discover new concepts, the meanings of which that were not very clear to the respondents.

Ethical considerations

Ethics or moral philosophy as a branch of philosophy deals with addressing issues of morality bothering on standards like right or wrong, good or bad (Vanclay et al., 2013). The Institutional Review Boards (IRBs) or Research Ethics Committees (RECs) are speedily becoming a formidable force for the general working environment in most institutions of higher learning such as universities (De Wet, 2010). The ethical element remains to be a vital requirement for governing research processes that are available in our institutions of higher learning. Research governance according to Adu-gyamfi (2015) is all about the procedures that are established during the research process to cope with or lessen the risk for both researcher and the participants.

The principles demand that people are to be respected, maximize benefits, minimize harm and assign equal treatment to subjects of the study. According to Vilma (2018), the three general ethical principles quoted by Belmont Report include the following:

Autonomy. This principle states that individuals have the right to determine whether or not to participate in any activity. This implies that total autonomy is when the research participant is made to fully understand what he/she is being asked to do, makes an informed judgment concerning how the participation will affect him/her and decides to freely participate without coercion. The caveat to maintaining autonomy is whereby the researcher seeks the consent of the participant including the complete nature of the research (risks, benefits, alternatives and delayed opportunity for questioning before participation by the participant (Sen & Nagwanshee, 2016).

Beneficence. This principle describes the researcher's obligation to maximize profit for the participant thereby minimising the risk factor or harm caused to the participant. A frank assessment of realistically expected risk is compensated by a full risk or profit estimation (Shah, 2011).

Justice. This lays a premium on the impartial selection of research participants. For example, avoid populations of research participants that are not fairly selected to participate. Typical examples include prisoners or children that are institutionalized.

The completed research proposal, application form and research instruments were more than once submitted to the Institutional Review Board (IRB) for review. Before the commencement of the study, ethical clearance was sought from the review board of the University of Cape Coast, Ghana following the approval of both the application and data collection instruments (Appendix A, B, and C). The approved ethical clearance letter (Appendix D) is attached as evidence to show that the study was granted the required permission by the University to relate with the respondents in an ethically friendly manner.

For this study specifically, the ethical issues governing the conduct of the process are as follows: informed consent, anonymity and confidentiality. Regarding informed consent, the survey respondents were informed of the reason for the study and the potential consequences of their participation in the study. The study, therefore, obtained approval from the individual respondents. It removed respondents who wished to withdraw from the survey and were not coerced or compelled in any way to engage in the survey. In terms of anonymity, respondents were told that they would not be named with their answers as part of the analysis. The analysis excluded personal data or identifiers that are likely to connect the data to the actual respondents. The respondents were also promised anonymity in that the information they submitted as part of the analysis will remain confidential. No other person will have access to the data that was obtained from the study area, aside from the research team and the supervisors of this study. For confidentiality, critical data, which will be easily lost, was locked up with a password.

Data Collection Procedures

All data collection exercises lasted for approximately eight weeks. This duration was because of the vast geographical spread of the study area that was covered including the high number of respondents to be reached.

Quantitative method

For the quantitative data, closed-ended questions/structured interview schedule was done with the smallholder rice farmers and their responses were recorded in the instruments by the enumerators. In parallel, the enumerators also administered questionnaires to the AEAs and their responses were recorded by themselves. Four enumerators with the use of the two instruments collected the quantitative data from the two sampled populations (farmers and the AEAs). Approximately, an average of sixty minutes was spent to complete an instrument since enumerators had to travel on commercial motorbikes to distant and sometimes hard-to-reach places to locate respondents in their different communities.

Qualitative method

Qualitative data collection from key informants such as the senior MAFS officials started a week later by the researcher himself after the enumerators had started the quantitative data collection exercise. The researcher had to supervise the enumerators for about a week for him to be confident that the enumerators were conversant with the administration of the instruments. The researcher also ensured that the enumerators were capable to obtain and record credible data from the respondents into the instruments. Following this conviction, the researcher too proceeded to collect qualitative data from the senior MAFS officials (key informants) with the help of a voice recorder at both headquarters and district levels within ten working days. By so doing, the consent of the respondents was first sought for the interviews to be recorded except for one who welcomed the interview but declined for his voice to be recorded.

Processing and Analysis of Data

Processing and analysis of quantitative data

The quantitative data that were collected from the field were cleaned, analysed, edited and coded to get rid of all outliers, which had the potential to affect the validity of the results. This was done by carefully examining the responses to the question for ambiguity and ensuring not to unnecessarily alter the original idea of the respondent through the help of the Statistical Package for Social Science (IBM SPSS) version 25.0 software. The raw data after processing were then analysed. Descriptive statistics which involved the use of frequency counts, percentages, means and standard deviations were calculated to describe the socio-demographic characteristics of the smallholder farmers and AEAs.

The first objective which sought to characterise the context of the smallholder rice post-harvest value addition (resourcing, value addition, marketing (input-output), extension services, the profitability of operations, and farmer livelihood) in the Southern Region of Sierra Leone were analysed using descriptive statistics like frequencies, percentages and mean. In determining the profitability of farming operations (profit was calculated by subtracting the total production cost from the total farm revenue). Variables like area of farmland and weight of rice yields of the targeted years were reported by farmers in acres and bushels which were later converted into hectares and kilograms respectively for analysis. Production costs include the estimated cost of land, labour and farm inputs whereas revenue is the amount of money generated from the sales of rice after harvest.

The second study objective required the evaluation of the competencies of the smallholder farmers and the AEAs in rice post-harvest value addition in the study area by assessing their mean competencies and standard deviations of all the constructs containing different technology items.

Objective three which sought to determine the relationship between the competencies of smallholder farmers and their socio-demographic characteristics; and the competencies of AEAs and their socio-demographic characteristics in the study area were analysed using multiple linear regression (Pallant, 2016; Tabachnick & Fidell, 2013). The competence of the actors was used as the dependent variable where sex, age, level of education, household size, the variety grown, the main source of income, ecology, land ownership type, years of farming experience, FBO membership, the key source of information, access to credit, main occupation, the main source of income and alternative livelihood as the dependent variables.

Multiple regression statistical analysis was done to compute the best-fitting straight line for the data set (Gravetter & Wallnau, 2005; Griffith, 2010; Pallant, 2016). The regression line was presented in a linear equation as follows: $Y = a + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_3X_4 + \ldots\beta_nX_n$.. Where '$\beta$' was the beta coefficient, 'a' was the Y-intercept (constant), 'X' was the independent variables (socio-demographic characteristics of farmers) and Y was the competency of the farmers in rice post-harvest value addition technologies.

The study determined the specific line that provides the best-fit line that explains the variations in the competencies of smallholder farmers in the study area. An alpha level of 0.05 was set to test the significance of the hypotheses and the relationships among the variables. Fifteen independent variables were used for the analysis (Table 5) and were dummied.

Table 5: Variables and their measurement included in the OLS Model

Dependent Variable	Unit of measurement	Sign	Explanation
Competence of smallholder farmers	5-Point scale		Knowledge and ability of smallholder farmers to perform a task
Independent variables			
Age of farmer (X_1)	Number of years	+	Age at last birthday
Level of Education (X_2)	Education level	+	Higher education increases the level of competency
Main source of labour (X_3)	Family = 1, Others = 0	+/-	Labour sources (family, individual, hired, rotatory)
Type of education (X_4)	Formal = 1, In-formal = 0	+/-	Type of education attained (Formal, Non-formal, Informal education)
Sex (X_5)	Female = 1, Male = 0	+/-	Sex of respondent
Variety (X_6)	Improved = 1, Others=0	+	Rice variety grown (Improved, local, both)
The key source of information (X_7)	AEAs=1, Others=0	+	AEAs, media, colleague farmers, traders/marketers, service providers
The main source of income (X_8)	Monthly income of the farmer	+	Higher income increases competency
Alternative livelihood (X_9)	Farming=1, Others=0	+	Formal employment, micro-business, cottage industry
Type of ecology (X_{10})	Upland=1, Others=0	+	Upland, IVS, Boliland, mangrove
Type of land ownership (X_{11})	Personal=1, Others=0	+	Personal, family, rented, leased
Access to credit (X_{12})	Yes=1 No=2	+/-	Financial aid for farming
Main occupation (X_{13})	Farming = 1, Non-farming = 0	+/-	Primary Occupation of Farmers
Years of farming (X_{14})	Number of farming years	+	Long years of farming increased competence
Member of FBO (X_{15})	Member =1, Not member = 0	+/-	Membership to FBO

Source: Field Data, Kamanda (2021)

Collinearity diagnostic test from the competencies of smallholder farmers and their socio-demographic characteristics in rice post-harvest value addition

A collinearity diagnostic test was conducted to examine the variance inflation factors (VIF) and the tolerance of the independent variables used in the regression analysis. Pallant (2016) posited that there exists collinearity in a study when the independent variables in the regression analysis are excessively correlated to one another such that they influence one another. Likewise, O ‘Brien, (2007) noted that collinearity can increase the estimates of parameter variance in a model in which no variables are statistically significant although R^2 may be large. Collinearity can lead to strange results from the study in the attempt to understand how each independent variables relate to the dependent variable. Furthermore, VIF measures the amount by which the parameter estimate is inflated as a result of the independent variables being highly correlated.

In the event of a collinearity issue, the VIF will be very large for the variables used. It will therefore mean that some variables must be deleted to adjust the VIF and tolerance values. In a study, Akpotosu, Annor-Frempong, & Bosompem (2017) emphasised that VIF close to 10 calls for concern whilst tolerance of 1 depicts no issue of collinearity. However, a tolerance value of zero shows that a severe sign of collinearity issue exists. Pallant (2016) argued that correlations of 0.80 or above would imply the violation of the assumption of multicollinearity. The study, therefore, examined the collinearity by estimating the VIF and tolerance values of the independent variables. The result of multicollinearity is presented in Table 6. It could be ascertained from the results of the multi-collinearity diagnostic test that the variables reported a VIF of 1. The meaning of this is that there are no issues of multi-collinearity among the variables used to run the regression analysis. Hence, the variables were used in the regression model.

Table 6: Multi-collinearity diagnostic test values for smallholder farmers

Independent variables	VIF	Tolerance
Main source of labour	1.057	.946
Alternative livelihood	1.054	.949
Key source of Information	1.035	.966
Main source of income	1.017	.983

Source: Field Data, Kamanda (2021)

Objective four which dealt with determining the training needs appropriate for smallholder rice post-harvest value addition in Sierra Leone was analysed by using themes, Borich needs assessment model which involved the computation of mean, standard deviation and the Mean Weighted Discrepancy Score (MWDS) of every item under each construct. The MWDS is an effective method of identifying the training needs of farmers and AEAs. Therefore, MWDS was calculated to describe the overall rankings for each of the competencies (Knowledge and Skills) of the respondents. The instrument allowed smallholder farmers and AEAs in rating items on a 5-point Likert-type scale of their perceived level of importance; 1=unimportant, 2=less important, 3=moderately important, 4=important, and 5=Very important. The ratings of the perceived competence scale were also: 1=incapable, 2=less capable, 3=moderately capable, 4=capable, 5=highly capable.

The Borich needs assessment model can be used to determine the training needs of smallholder farmers and AEAs. This assessment done with the use of this model is a self-evaluative process that depends on the judgments of the trainees on the importance of a particular technology and their level of competencies in those technology areas (Borich, 1980). The Model is centered on the skills needed by individuals and groups for effectiveness needed for future decision making on the use of human resources. Borich, therefore, recommended training programmes to use this model by engaging the two extreme ends: the existing (the measured attitudes, skills, and competencies of trainees) and what is to be (the goals of the training programme) (Saleh & Man, 2018). The Model comprises four phases (1) listing of competencies; (2) surveying of the respondents; (3) ranking of the competencies; and (4) comparing high priority competencies with the content of the training programme (Zarafshani et al., 2008).

The adoption of the Borich Needs assessment model helped to determine the competencies of the smallholder farmers and AEAs for this study. To determine the MWDS, the researcher followed the following statistical steps.

A discrepancy score (DS), or the difference between the importance rating and the competence rating was calculated for each farmer and agricultural extension agent for each competency item, by subtracting the competence rating from the importance rating.

A weighted discrepancy score (WDS) was calculated for each respondent and each value addition competency by multiplying the discrepancy score by the mean importance rating.

A MWDS for each of the competencies was calculated by taking the sum of the weighted discrepancy scores (WDS) and dividing it by the total number of observations/respondents. To further explain the variations between and among the variables, the researcher employed means and standard deviations to estimate the relationships between competencies. Additionally, the Borich (1980) needs assessment model was used to determine the training needs of farmers and AEAs by determining which areas of competency farmers and AEAs need training. The calculated mean weighted discrepancy score (MWDS) identifies the priority areas where training was most needed for the respondents.

Thus, the Borich Needs Assessment Model is shown below:

MWDS = [(Iith − Cith) × Xi/N

MWDS = [(Importance − Competence) × Importance Mean] / N,

Where:

I = importance rating for each item; C = competency rating for each item; X_i = Mean of the importance rating; N = number of respondents/observations.

Using the MWDS, the training needs of smallholder farmers and AEAs were then ranked (Alibaygi & Zarafshani, 2008b; Borich, 1980).

Objective five sought to determine the extension education methods considered appropriate for smallholder rice post-harvest value addition in Sierra Leone and Objective six sought the development of an extension training model to build the capacity of smallholder farmers and AEAs in rice post-harvest value addition in Sierra Leone.

Table 7 below summarize the data analysis techniques for each of the study objectives.

Table 7: Summary of statistical techniques/tools used to analyze objectives

Objective	Statistical Tools for Analysis
One	Frequencies, percentages, Means, standard deviations and thematic analysis of quantitative data
Two	Means, and standard deviation
Three	Multi-collinearity diagnostic test, OLS multiple linear regression, ANOVA, and Independent sample t-test
Four	Means, standard deviation, Borich needs assessment model.
Five	Frequencies, percentages
Six	Policy framework

Source: Author construct, Kamanda (2021)

Processing and analysis of qualitative data

Qualitative data that were collected through an in-depth interview guide from the senior MAFS officials were also cleaned, organised, edited and coded to get rid of all outliers, which might have the potential to affect the validity of the results. Qualitative research especially, one collected from an in-depth interview guide produces a large volume of data. According to Weis and Willems (2017), the basic purpose of data processing and analysis is to eliminate details.

A voice recorder was used to capture the voices of both the interviewer and the interviewee. Irrespective of how comprehensible the transcript will be when it is read back, all voice recordings were transcribed word for word/verbatim (Sutton & Austin 2015). Once the full text was completed, the researcher read and did the aforementioned while listening to the recording;

corrected all spellings and other errors; made anonymous the transcripts so that it became impossible to identify the respondent from anything that was said (e.g. names, places, significant events); insert notes for pauses, laughter, discomfort looks, inserted any punctuation such as commas and important events.

The in-depth interview guides were manually transcribed and the recurring themes were chosen and analysed. The process involved drawing relationships between the categories of responses and the most recurring themes that were considered for analysis. The data obtained from the field after analysis were classified and tabulated to gather information intended to answer the research goals and questions set out in the study as recommended by Yin, (2009). The researcher used reflexivity, bracketing and intuition to separately put presumptions about the phenomena under investigation.

Summary of the Chapter

The research methods and the procedure used to carry out the study are discussed in this chapter. The chapter described the research design, description of the study area, the population, the sampling procedure, and data collection instruments. Mixed methods research comprising quantitative and qualitative research approaches with a pragmatic philosophy was used. A descriptive cross-sectional survey and in-depth interview were used for the quantitative approach. The study populations for the quantitative approach are made up of smallholder farmers and AEAs. Sample sizes of 400 smallholder farmers were selected using a multi-stage random sampling procedure and 50 AEAs were censused from the study areas. For the qualitative approach, 11 key informants of MAFS were also censused. Quantitative analytical tools with the aid of SPSS version 25.0 software were used to calculate percentages, means, and standard deviations to perform a multi-collinearity diagnostic test, multiple linear regression, ANOVA, Independent sample t-test and Borich needs assessment model.

Thematic analysis was employed as a qualitative tool for the qualitative data. The results for both quantitative and qualitative analysis are presented in tables and figures. Other sub-headings that were dealt with under this chapter include training of enumerators, pre-testing of instruments, a test of validity and reliability of instruments, ethical considerations, data collection procedures, and processing and analysis techniques.

CHAPTER FOUR

CONTEXT OF SMALLHOLDER RICE POST-HARVEST VALUE ADDITION

Introduction

This chapter presents and describes the socio-demographic characteristics of the study respondents' farmers and AEAs and the rice post-harvest value addition context in the Southern Region of Sierra Leone. The chapter further presents the findings and discussions of objective one which seeks to characterise the context of smallholder rice post-harvest value addition in the Southern Region of Sierra Leone. It thus describes rice post-harvest value addition in terms of resourcing, value addition, marketing, extension services, the profitability of operations and farmers' livelihood.

Socio-Demographic Characteristics of Farmers

For the smallholder farmers, the socio-demographic characteristics are divided into two sub-sections: 1. Demographic characteristics and 2. Socioeconomic characteristics.

Demographic Characteristics of Farmers

Table 8 presents the results of the demographic characteristics of the respondents' farmers. These include sex, age, marital status, highest educational level, size of household and position in the household. The sex distribution of the farmers shows that 74.0% of males and 26.0% of females were involved in this study. The results suggest that there are more men involved in rice farming as reported by Wiredu (2014). Also, partly consistent with this result were the findings of Wiredu, Asante, Martey, Diagne and Dogbe (2014) who reported that 76.84% of males and 23.16% of females were involved in their impact study of rice technologies (NERICA) involving rice producing households in Northern Ghana.

Table 8: Demographic Characteristics of smallholder farmers

Socio-demographic variable	Frequency (f)	Percentage (%)
Sex		
Male	296	74.0
Female	104	26.0
Age (completed years)	**Mean=43.09, S.D.=8.33**	
20-29	18	4.5
30-39	128	32.0
40-49	177	44.2
50-59	59	14.8
60+	18	4.5
Marital status		
Single	14	3.5
Married	334	83.5
Co-habiting	15	3.8
Divorced	12	3.0
Widowed	25	6.2
Highest educational level (n=191)		
Informal education	106	26.5
Non-formal education	103	25.8
Primary	22	5.5
Junior Secondary School (JSS)	65	16.3
Senior Secondary School (SSS)	43	10.8
Technical/Vocational	47	11.8
Tertiary	14	3.5
Household size	**Mean=10.10, S.D.=4.46**	
1-5	44	11.0
6-10	183	45.8
11-15	128	32.0
16-20	32	8.0
20+	13	3.2
Position in the household		
Household head	305	76.3
Spouse of household head	68	17.0
Member of household	27	6.7

Source: Field Data, Kamanda (2021)

The mean age of the farmers was 43.09 years with a standard deviation (SD) of 8.33 years. Less than half (44.2%) were aged between 40 and 49 years while 4.5% were aged 60 or more years old. The minimum and maximum ages were 24 and 65 years respectively, indicating that the majority of rice farmers are adults. The findings reflect that of Mansaray and Jin (2020) who reported the mean age of farmers as 45 years in their study which examined the food security issues of rice farmers in Sierra Leone. Most of the respondents (83.5%) were married, 3.8% were cohabiting, while 6.2% of the farmers were widowed. Consistent with this result were the findings of Kamara (2018) in his rice agricultural innovation systems study in Sierra Leone who concluded that the vast majority of rice farmers (94.5%) were married, whilst a small proportion of 3.5% was widowed and only 2.0% were singles. Similar findings were also obtained by Conteh et al. (2015) in their determinants of grain storage technology adoption in Sierra Leone. The study revealed that 81.0% of the sampled farmers were married whilst the rest were living as singles, divorced or widowed status. These findings validate the importance bestowed upon marriage in the rural farming settlements in Sierra Leone.

Regarding their level of education, the findings also reveal that more than half of the sampled farmers (62.3%) lack formal education. About a quarter of the farmers have informal education (26.5%) while about another quarter (25.8%) have non-formal education. The rest (47.7%) have some form of formal education with 16.3% having Junior Secondary School (JSS) level, 10.8% having Senior Secondary School (SSS) level, 11.8% having a Technical/Vocational level, and only 3.5% having a tertiary level education.

The results suggest that less than half of the farmers have received some form of formal education. Studies by DHS (2019) in Sierra Leone and Tarway-twalla (2013) in Liberia have reported similar results that more smallholder farmers do not have formal education.

From the results, the average household size of farmers was 10 members with nearly half (45.8%) having a household size of 6-10 members and 3.2% having 20 or more members. This finding is however in sharp contrast with that of Sammeth (2010) who discovered in Sierra Leone that the average household size of smallholder farmers is seven. The majority of the respondents (76.3%) are household heads and 17.0% are spouses. These results are not too different from the statistics of Sierra Leone, where 72% of the household population is male-headed (Statistics Sierra Leone, 2016).

Socioeconomic Characteristics of Farmers

Table 9 shows the socioeconomic characteristics of smallholder farmers in the study area. Farming is found to be the main source of income for the majority (86.5%) of farmers. Yet some of the farmers (8.2%) have commerce as their main source of income. Nearly three-fourths of the farmers (74.8%) have micro business as their main alternative livelihood activity and 18.0% have cottage industries. Primary occupations among the farmers include farming (77.8%), teaching (4.8%) and trading/business (9.8%). The results are not surprising as similar findings were reported by Kamanda et al. (2022) in Sierra Leone that 82.7% of the respondents make their living mostly from farming, 8.7% of the smallholder farmers were into petty trading and 6.0% rely on support from family members. The results are consistent with the findings that because smallholder farmers cultivate a wide variety of crops (some for food, some for sale) as well as a variety of other revenue generating activities throughout the year and therefore, their income is not derived from a single source (Waarts et al., 2019).

About two-fifths of the farmers (41%) have 10-19 years of farming experience followed by less than 10 years (33.0%), whereas 19.3% and 5.0% have 20-29 years and 30-39 years of experience respectively. The mean years of farming experience were 14.06 with a SD of 8.37 years, which implies that the rural farmers have enough experience in farming. The result however contradicted that of Ampadu-Ameyaw, Omari and Owusu (2017) in Ghana which shows that the majority of farmers (70.0%) have more than six years of experience.

More than one-third of the farmers (38%) cultivate both local and improved varieties, whilst 35.8% cultivate local varieties only, followed by 26.2% cultivated improved varieties of rice. The results did not support the findings of Ragasa et al. (2013) who discovered in Ghana that imported rice is highly preferred (95%) by sampled customers who were better familiar with imported types and 71% eat imported rice and never tried local rice.

The results show that the sources of farm labour include family (49.0%), hired (38.5%), and rotatory (12.3%) (Table 9). The results suggest that rice farmers have different sources of labour but most of them use family labour. The results again show that less than half (37.5%) of the farmers have developed farmlands, while only 29.8% have stumped farmlands. From the results (Table 9), the majority of the farmers (61.5%) have farmlands owned by their families, and nearly a fifth (23.8%) own their farmlands. The results support the idea that land is acquired and managed by family members, villages, town councils, clans, or landholders from one generation to another and each family member has access to a piece of land for farming (Government of Sierra Leone (GoSl), 2019).

The results again show that while 38.3% have farms with upland ecology, (40.8%) have inland valley swamp farms. While the lowland with the highest fertility is also appropriate for very high crop yields, the upland ecology, which has 80.0% of arable land, is better for the production of a variety of cash crops. Also, less than half (44.8%) of farmers are members of farmer groups and their sources of information on rice post-harvest value addition are the AEAs (60.3%), local mass media (6.3%) and colleague farmers (33.0%). Cadzow and Binns (2016) discovered that farmers are encouraged to form farmer group associations and register those associations with MAFS in Sierra Leone to improve the effectiveness of communication with farmers, improve their social conditions, increase agricultural output and assist them in accessing financing. The above results also suggest that AEAs are the most reliable source of information on rice value addition.

The findings are similar to those of (Fadiji, Atala & Voh, 2005) in Nigeria who discovered that out of the nine (9) sources of knowledge, the respondents listed only the three most frequently used sources which include radio, extension agents and other farmers. Although the majority of the farmers (80.5%) do not have access to credits, few however, receive cash (6.5%) as credit, 72.0% receive in-kind and 5.8% receive both cash and in-kind types of credits. The above findings support those of Conteh et al. (2015), who discovered that just a meagre 26.0% of Sierra Leonean farmers have access to extension services.

Table 9: Socioeconomic Characteristics of Smallholder Farmers

Socio-demographic variable	Frequency	Percentage
Main source of income		
Farming	346	86.5
Employment	15	3.8
Commerce	33	8.2
Family remittance	6	1.5
Alternative livelihood activity		
Formal employment	29	7.2
Micro business	299	74.8
Cottage	72	18.0
Primary occupation		
Farming	311	77.8
Fishing	23	5.8
Skilled work	5	1.3
Teaching	19	4.8
Trading	39	9.8
Employment	3	0.8
Farming years	**Mean=14.06, S.D. 8.37**	
<10	132	33.0
10-19	164	41.0
20-29	77	19.
30-39	20	5.0
40+	7	1.8
Variety of rice cultivated		
Improved Varieties	105	26.2
Local Varieties	143	35.8
Both Varieties	152	38.0
Source of labour		
Family	196	49.0
Hired	154	38.5
Rotatory	49	12.3
Individual	1	0.2
Percentage of post-harvest value addition by farmhand/labour		
<20	48	12.0
20-40	86	21.5
41-60	76	19.0
61-80	65	16.2
81-100	125	31.3

Table 9: Socioeconomic Characteristics of Smallholder farmers (Continued)

Farming years	Frequency	Percentage
Developed farmland		
Yes	150	37.5
No	250	62.5
Stumped farmland		
Yes	119	29.8
No	181	70.2
Land ownership		
Personal	95	23.8
Family	246	61.5
Rented	42	10.5
Leased	17	4.2
Farm ecology		
Upland	153	38.3
Inland valley swamp	163	40.8
Boli land	73	18.2
Mangrove	11	2.8
Membership in farmer based organisation (FBOs)		
Yes	179	44.8
No	221	55.2
Source of information on rice post-harvest value addition and marketing		
AEAs	241	60.3
Local mass media	25	6.3
Colleague farmers	132	33.0
Traders/marketers	2	0.4
Type of credit received		
None	322	80.5
Cash	26	6.5
In-kind	29	7.2
Both	23	5.8

Source: Field Data, Kamanda (2021)

Disability or physically challenged nature of smallholder farmers

The study reveals that 7.2% of the farmers have different forms of disability in the study area (Figure 3). These forms of disabilities range from a physical disability (3.3%), eye defects (3.0%), deafness (0.5%), mental illness

(0.3%) and deaf and dumb related (0.3%). These findings from the study area, the Southern Region with 7.2% of the disabled smallholder farmer population is higher than the national average of 1.3% in Sierra Leone (Kabia & Tarawally, 2017). The study supports the findings of Gomda and Sulemana (2021) in Ghana that there is a considerable number of people with disabilities (PWDs) in farming, whose needs should be considered in agricultural development planning.

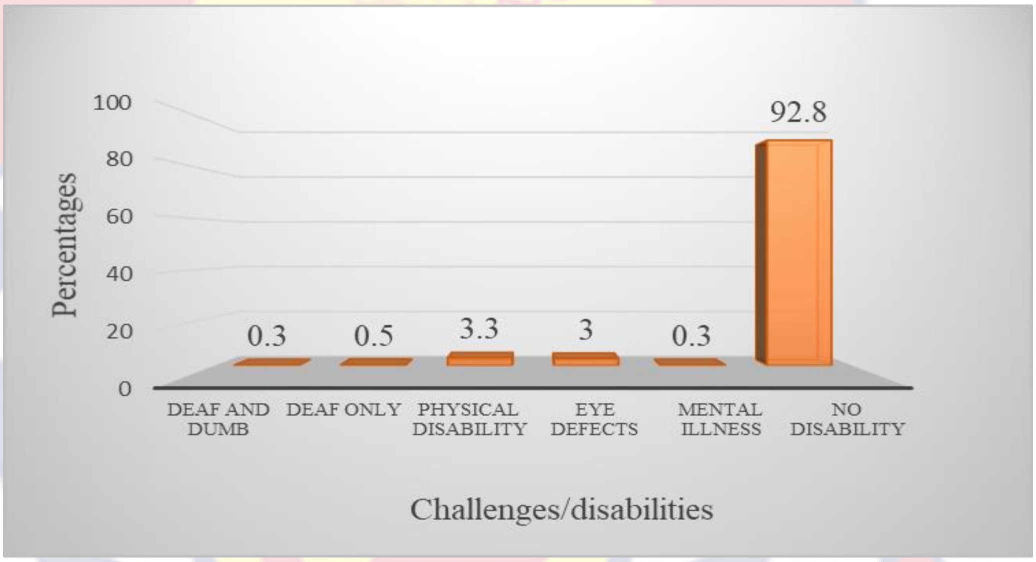


Figure 3: Types of disabilities of smallholder farmers

Source: Field Data, Kamanda (2021).

Characteristics of the Agricultural Extension Agents

Out of the fifty (50) AEAs that participated in the study, the results in Table 9 show that the majority (84.0%) are males. This suggests most AEAs in the study area are males. This finding is similar to other findings in Africa such as in Tanzania and Ghana. Due, Magayane, and Temu (1997) in Tanzania found that two-thirds of the village extension officers were males and Antwi-Agyei and Stringer (2021) in their study to improve the effectiveness of agricultural extension in Ghana also found that 93.8% of the AEAs were males.

The results also show that the mean age of the AEAs is 41.7 years (standard deviation of 9.3 years) with 44.0% aged between 30-39 years followed by 26.0% (50+), 24.0% (40-49) and a few (6.0%) aged between 20 and 29 years old. The above results present that most youths are not serving as AEAs in the study areas. Also, consistent with this study were the findings of Mustapha et al. (2022) in their ICTs service delivery in Nigeria who observed that 77.1% of the AEAs were between the ages of 31 and 50 with a mean age of 41 years.

The majority of the AEAs (86.0%) are married while 12.0% are single. Regarding their level of academic qualification, a modal qualification (48.0%) of the respondents is Diploma, whilst 28.0% have a certificate in agriculture general, 18.0% have Bachelor's degree and a few (4.0%) have a Master's degree. This suggests that all the AEAs have some form of formal education. Comparable findings were reported by Olorunfemi, Olorunfemi and Oladele (2020), who found that the majority of the AEAs (92.5%) have a National Higher Diploma (NHD) or higher level of education in their study on the development of climate-smart agriculture in Nigeria.

Additionally, the mean years of extension work experience for the AEAs are 13.8 years (S.D. =10.5). Specifically, 44.0% of the AEAs have less than 10 years, while 30.0% have between 20-29 years of extension work experience and 24% have 10-19 years of extension work experience. These findings are similar to those of Olorunfemi, Olorunfemi, and Oladele (2020), who found that AEAs in Nigeria have a comparable average work experience of 9.35 years. However, other findings have shown much higher work experience of AEAs, as the case in DIY, Indonesia where 25 years was recorded (Wulandari, 2015). The assumption is that as AEAs gain more field experience, they will be able to use a variety of extension training methods to serve the farmers. The results further show that while 26.0% of the sampled AEAs have participated in post-qualification training only once, 24.0% and 18.0% of them have participated in training 2 and 4 times while 6.0% have not attended any capacity building training after obtaining their post-university qualification. Even though extension training is generally expensive, AEAs admitted that MAFS together with other NGOs organises training for them (AEAs) in diverse agricultural activities including the rice value chain. From the results, the majority of the respondents (86.0%), attend special agricultural training courses to get the most reliable post-harvest harvest and marketing information. Few of them (4%) interact with friends, agricultural institutions and media documents for postharvest and marketing information.

These results are dissimilar to those of Oyegbami (2018) in Nigeria who discovered that the key sources of agricultural information are from AEAs themselves (79.1%), followed by mass media (37.5%), friends and neighbours (53%). The results on the distance covered by AEAs to their clientele show that the mean distance to the operational areas is (Mean=20.9km; S.D. =7.33). Nearly half of the respondents (48.0%) cover a distance between 20-29km, 28.0% and 16.0% cover 10-19km and 30 or more kilometres to provide extension services to the farmers. This finding confirms the inadequacy of the AEAs as they are sparsely placed to cover the huge number of farmers in their operational areas.

Table 10: Characteristics of the Agricultural Extension Agents

Socio-demographic variables	Frequency	Percentage
District		
Bo	19	38.0
Bonthe	15	30.0
Moyamba	10	20.0
Pujehun	6	12.0
Sex		
Male	42	84.0
Female	8	16.0
Age (completed years)	**Mean=41.72, S.D.=9.33**	
20-29	3	6.0
30-39	22	44.0
40-49	12	24.0
50+	13	26.0
Marital status		
Single	6	12.0
Married	43	86.0
Widowed	1	2.0
Qualification		
Certificate	14	28.0
Diploma	24	48.0
BSc/BA/B.Ed.	9	18.0
Postgraduate Diploma	1	2.0
MSc/MA/M.Ed.	2	4.0
Years of experience	**Mean=13.80, S.D.=10.53**	
<10	22	44.0
10-19	12	24.0
20-29	15	30.0
30-39	1	2.0
Number of post-qualification capacity training	**Mean=2, S.D.=1.74**	
None	3	6.0
1	13	26.0
2	12	24.0
3	5	10.0
4	9	18.0
5+	8	16.0

Table 10: Characteristics of the Agricultural Extension Agents (Continued)

Socio-demographic variables District	Frequency (f)	Percentage (%)
A most reliable source of post-harvest and marketing information		
Attending a special agricultural training course	43	86.0
Reading agricultural bulletins and books	1	2.0
Dialogue with knowledgeable agricultural colleagues	2	4.0
Agricultural universities/colleges research institutes	2	4.0
Media document in CD format	2	4.0
Farthest distance to the operational area (km)	**Mean=20.94, S.D.=7.33**	
<10	4	8.0
10-19	14	28.0
20-29	24	48.0
30+	8	16.0

Source: Field Data, Kamanda (2021)

Context of rice post-harvest value addition

This section discusses the results of rice post-harvest value addition in the following order: resourcing, value addition, marketing, extension services, the profitability of operations and the livelihood of smallholder farmers in rice post-harvest value addition.

Resources for rice post-harvest value addition by farming actors

Table 11 shows the rice post-harvest value addition resources used by smallholder farmers. The results reveal that all the smallholder farmers have harvesting knives (100.0%) with all of the farmers using them, whereas handheld sickles are available to 53.0% of the farmers, 52.9% of them can assess the handheld sickles, while 49.0% can afford and are using them. Compared to the harvesting knife, the handheld sickle is used by a little over half of the farmers. This is because some farmers are not very familiar and comfortable with its operation during rice harvesting.

Also, human labour to transport paddy from the field is available to 97.0% of the farmers of whom almost all the farmers (99.0%) use it. This is because most farmers use family labour including hired labour in their rice post-harvest value addition activities as earlier observed in Table 11. Other resources which farmers are extensively using because they are available, accessible and affordable include mat to dry paddy (99.3%), a tarpaulin to dry paddy (87.8%), concrete/drying floor (76.3%), mortar and pestle (95.0%), round/oval shape-weaved bamboo-strip manual winnower (97.3%), empty rice bag for rice storage (92.3%), wooden racks to stack rice 20cm above floor level (68.5%), transport to market (70.0%) and AEAs (70.5%). Studies have shown that farmers use value addition resources such as milling machines, tarpaulin, and sieves in rice value addition activities (Achandi et al. 2018). For example, the use of the mat to dry paddy by smallholder farmers has been reported in Nigeria (Adisa et al., 2020).

Some major value addition resources except moisture content meters are only utilised by less than one-fourth of the farmers. These include animal labour (oxen) (1.0%), power tiller (11.0%) to transport paddy, threshing machine (14.2%), moisture content meter (12.8%), de-stoner (6.0%), specialised parboiling container (4.8%), dehusking or dehulling machine (2.5%), oscillating sieves and aspirators (mechanical winnower) (1.3%) among others. The results show that these resources are not available, accessible and affordable to smallholder farmers in the study area. The results support the findings of Achandi et al. (2018) which suggest that there are resource constraints issues in agricultural development in Africa. They reported that in Tanzania and Madagascar, post-harvest resources such as milling machines are not available. However, it is not the case in all instances, for example, Amponsah et al. (2018) in Ghana, found that a combine harvester was the most common technology (51.0%) used by farmers to thresh paddy, followed by beating (11.0%) of the panicle straws and usage of a mechanical thresher by farmers (2.0%) in analysing the knowledge and perception of harvest and post-harvest losses among rice farmers.

The findings, therefore, reveal that the majority of the value addition resources are not available to the farmers and they hardly use these technologies in their farming activities, which denies them the ability to add value to their rice at post-harvest stages. The farmers are found to have been using more of their locally available resources (e.g. human labour, mortar and pestle, mat, tarpaulin and concrete drying floor to dry paddy) which might not effectively add value to their locally produced rice as compared to the improved technologies (e.g. threshing, de-husking and dehulling machines, de-stoners, packaging and labelling materials). The possible reason is that the low value addition resources are more affordable to the smallholder farmers.

The above findings contradict those of Adisa, Famakinwa and Adeloye (2020) who showed a high adoption level of eight out of eleven improved rice processing resources disseminated to farmers. A study by Adisa et al. (2020) shows that the use of milling machines (Mean=4.54) ranked the highest, followed by the use of a mat or tarpaulin to thresh paddy (Mean=4.44), sieve used to separate floating immature grains, residual dirt and stones (Mean=4.32). In another study that supports the lack of resources by farmers, Farooq et al. (2011), generally outlined a lack of resources (24.0%) as a limiting factor that limits their operations in Singapore.

Table 11: Adequacy rating of Post-harvest value addition resources among smallholder farmers

Type of resource	Availability		Accessibility		Affordability		Usage	
	F	%	F	%	F	%	F	%
Harvesting knife	400	100.0	392	98.0	400	100.0	400	100.0
Handheld sickle	212	53.0	211	52.9	199	49.8	196	49.0
Human labour to transport paddy from the field to the processing centre	388	97.0	388	970.	383	95.8	396	99.0
Animal labour (oxen) to transport paddy from the field to the processing centre	4	1.0	4	1.0	4	1.0	4	1.0
Power tiller to transport paddy from the field to the processing centre	67	16.8	51	12.8	67	16.8	44	11.0
Threshing machine	75	18.8	48	12.8	63	15.8	57	14.2
Moisture content meter	80	20.0	67	16.8	55	13.8	51	12.8
De-stoner	53	13.3	24	6.0	24	6.0	24	6.0
Mat for drying	306	76.5	330	82.5	396	98.5	397	99.3
Tarpaulin for drying	365	91.5	356	89.0	347	86.8	351	87.8
Concrete/drying floor	307	76.8	302	75.5	303	55.8	305	76.3
Big parboiling pot	231	57.8	231	57.8	231	57.8	231	57.8
Specialised parboiling container	19	4.8	19	4.8	19	4.8	19	4.8
Mortar and pestle	388	97.0	371	92.8	374	93.5	381	95.0

Table 11: Adequacy rating of Post-harvest value addition resources among smallholder farmers (Continued)

	Availability		Accessibility		Affordability		Usage	
Type of resource	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**
Dehusking or dehulling machine	26	6.5	10	2.5	10	2.5	10	2.5
Milling machine	189	47.3	296	74.0	143	35.8	114	28.5
Round/oval shape-weaved bamboo-strip manual winnower	366	91.5	383	95.8	391	97.8	389	97.3
Oscillating sieves and aspirators (mechanical winnower)	15	3.8	8	2.0	7	1.8	5	1.3
Grading/sorting of rice grains machine	10	2.5	8	2.0	4	1.0	4	1.0
Platform type of rice weighing scale	15	3.8	15	3.8	6	1.5	6	1.5
Hanging type of rice weighing scale	73	18.3	65	16.3	65	16.3	73	18.3
Packaging and labelling materials	10	2.5	16	4.0	10	2.5	7	1.8
Empty rice bag for rice storage	348	87.0	365	91.3	368	92.0	369	92.3
Baskets to store rice	305	76.0	305	76.0	305	76.0	115	28.7
Wooden boxes to store rice	149	37.3	128	32.0	88	22.0	91	22.8
Wooden racks to stack rice 20cm above floor level	177	443	175	43.8	175	43.8	274	68.5
Transport to markets	274	68.5	265	66.3	278	69.5	280	70.0
Financial support	37	9.3	16	4.0	16	4.0	16	4.0
Post-harvest value addition input suppliers	32	8.0	23	5.8	8	2.0	16	4.0
Agricultural Extension Agents	302	75.5	282	70.0	283	70.8	282	70.5

Source: Field Data, Kamanda (2021), n=400

Post-Harvest Value Addition Resources Available to AEAs

Rice post-harvest value addition resources available to AEAs were investigated and the results are presented in Table 12. The results reveal that rice post-harvest value addition resources were woefully inadequate for AEAs. Most of the major rice post-harvest value addition resources were unavailable and those that were available were inadequate. Besides, the rice post-harvest value addition subject matter specialists (Mean=2), post-harvest value addition input suppliers (Mean=1.66), post-harvest value addition service providers (Mean=1.60), monetary/financial resources (Mean=1.52), mobility for use by AEAs (Mean=1.84), and processing and storage facilities (Mean=1.78) that were less adequate, all the other value addition resources were also inadequate (Mean=≤1.45). Specifically, the majority of the AEAs (80.0%) cited inadequate subject matter specialists for rice postharvest value addition. Only 10.0% of the AEAs described the rice post-harvest value addition resources as adequate. Also, 62.0% noted that post-harvest value addition input suppliers are inadequate.

While monetary/financial resources are not available to 54.0% of the respondents, only 6.0% found the existing monetary/financial resources to be adequate. The majority of the AEAs (60.0%) describe mobility, processing, and storage facilities (66.0%) and venues for meetings/workshops (56.0%) as inadequate. Again, most of the AEAs reported that computers and accessories (84.0%), projectors (72.0%), office spaces (64.0%), audio-visual aids (76.0%) and print and non-print materials (74.0%) are unavailable. These findings are consistent with those of IFAD (2020) which observed limited value addition resources for the AEAs such as mobility, fuel, computers and accessories stifle their operations in Sierra Leone. It is obvious that most AEAs use their personal resources where no compensation or maintenance is done on those resources.

Table 12: Adequacy Rating of Post-harvest value addition resources among AEAs

Type of resource	Unavailable		Inadequate		Adequate		Mean	S.D.
	F	%	F	%	F	%		
Human Resource								
Value addition subject matter specialists	5	10.0	40	80.0	5	10.0	2.00	0.452
Post-harvest value addition input suppliers	18	36.0	31	62.0	1	2.0	1.66	0.519
Post-harvest value addition service providers	22	44.4	26	52.0	2	4.4	1.60	0.571
Materials/Equipment for value addition								
Monetary/financial resources	27	54.0	20	40.0	3	6.0	1.52	0.614
Mobility for use by AEAs	14	28.0	30	60.0	6	12.0	1.84	0.618
Processing and storage facilities	14	28.0	33	66.0	3	6.0	1.78	0.545
Computers and accessories	42	84.0	5	10.0	3	6.0	1.22	0.545
Photocopier	40	80.0	8	16.0	2	4.0	1.24	0.517
Stationery	3	6.0	20	40.0	3	6.0	1.52	0.614
Projector	36	72.0	14	28.0	0	0.0	1.28	0.453
Services/Structures								
Venue for meetings/workshops	18	36.0	28	56.0	4	8.0	1.72	0.607
Office spaces	32	64.0	14	28.0	4	8.0	1.44	0.643
Audio-visual aids	38	76.0	9	18.0	3	6.0	1.30	0.580
Print and non-print materials	37	74.0	11	22.0	2	4.0	1.30	0.543

Source: Field Data, Kamanda (2021), n=50. 1=Inadequate, 2=Less adequate, 3=Moderately adequate, 4=Adequate, 5=Highly adequate
Scale (Mean): **1**=(≤1.45), **2**=(1.46-2.45), **3**=(2.46-3.45), 4=(3.46-4.45), **5**=(≥4.46)

Key challenges to rice post-harvest value addition provided by the Key Informants

From the key informants (KIs) interviews, it was evident that many challenges hinder effective agricultural extension activities toward improving rice post-harvest value addition among smallholder farmers. The qualitative data produced five themes on challenges namely; logistical, human resource, financial, infrastructural and contextual factors (as shown in Table 13).

Table 13: Thematic table on challenges to rice post-harvest value addition

Challenges	Details
Logistical	• Unavailability of transportation for AEAs' activities • Inadequate equipment for work • Delay in disbursement of inputs to farmers
Human resources	• Inadequately trained staff • Inadequate training/knowledge • Low motivation/remuneration
Funding	• Limited funds for AEAs' activities • Delays in releasing funds
Infrastructural	• Poor road networks • Inadequate/spoiled value addition infrastructure • Lack of residential facilities for AEAs
Contextual	• Limited/poor knowledge of farmers on value addition skills • Low acceptance/adoption of post-harvest technologies leading to the use of crude/traditional implements

Source: Field Data, Kamanda (2021)

Logistical challenges

The senior MAFS officers/key informants (KIs) explained that the activities of AEAs are hindered by inadequate or sometimes unavailable logistics such as means of transportation, equipment to work, and delays in the distribution of farming inputs to farmers. They further noted that without motorbikes and their accompanying fuel, AEAs are unable to travel to various communities to render extension services to the farmers.

"*AEAs are under-resourced in terms of logistics and lack full support to perform effectively. Consequently, they are unable to do follow-up visits on implemented programmes*" (KI 2)

The above narrations provide credibility to the assertion that AEAs are resource constraints and the results reflect the suggestion of (Farooq et al., 2011) that a large group of the AEAs (46.0%) required mobility for delivery of resources, funds, staff/human resources, equipment and office spaces for their operations. From the narration, key informants, noted AEAs do not have adequate equipment such as computers and accessories to carry out their daily activities and planning in the study areas. There were also delays in the disbursement of farming inputs to farmers, which is negatively impacting their provision of extension services including their inability to demonstrate to farmers how farming activities should be carried out since inputs are not readily available to farmers during service visits.

"*Even in some offices, computers, accessories and other facilities needed for our day-to-day running are lacking*" (KI 4).

"*Another issue is the untimely disbursement of funds/inputs/resources to implement farming activities*" (KI 4).

The results are similar to that of Achandi et al. (2018) who reported that extension information does not reach farmers on time especially, in Tanzania due to constraints in extension delivery.

Human resource challenges

Concerning human resource challenges, three themes emerged, namely; inadequately trained AEAs, inadequate/poor training and knowledge of AEAs, and low incentives and remuneration. On inadequately trained AEAs, the KIs indicated that there are few AEAs against a high number of farmers. They noted that the agent-farmer ratio was too high in all the settings. As a result of this limited staff, extension activities are slowed down and sometimes less effective.

"*The agricultural extension agent to farmer ratio is unsatisfactorily high because the number of AEAs is far less than the farmers they serve*" (KI 7).

This finding is similar to that reported by Ibrahim et al. (2021), which showed an imbalance of the agricultural extension agent to farmer ratio in Sierra Leone which stands at 1:2,100, as against the UN FAO recommended ratio of 1:800. This is in line with the report of Dolinska and d'Aquino (2016) in Nigeria, where farmers claimed that no one was visiting them, no one invited them anywhere and no one was providing them with information. The probable reason was that there was a limited number of extension agents to cover a large number of farmers. Inadequate training and knowledge of AEAs were also cited as another human resource challenge to effective extension service for rice post-harvest value addition. From (KIs 5 and 6), some AEAs have inadequate knowledge and competency in post-harvest value addition due to inadequate training. As such, this has limited the role of AEAs in supporting farmers to effectively add value to their produce.

"Many of the AEAs have a low capacity in value addition in rice processing." "Regular refresher/in-service training of AEAs is required to move them along within the modern trends" (KI 9).

This finding supports the survey results which show that half of the

AEAs had only one or two post-qualification training (Table 10). The finding has implications for extension, as farmers continuously need the training to raise output per unit area because agricultural machines and technologies are continuously evolving and farmers must stay up to date with innovations (Mariano, Villano & 2012).

On the issue of incentives and remuneration for AEAs, it came out that there are little or no incentives for most AEAs which affects service delivery components including follow-ups and feedback, which makes them demotivated to risk getting into hard-to-reach areas to render their services. "*In most instances, there are inadequate follow-up visits, monitoring, and supervision of farmers by AEAs due to poor incentives*" (KI 11).

The findings support the report by Bitzer (2016) that public extension services in developing countries have incentives and reward systems, which make AEAs carry out routine extension assignments that are defined by senior-level managers.

Funding challenges

Another challenge of the AEAs for effective extension activities in rice post-harvest value addition is the delay in the disbursement of funds for the extension activities. Besides funds allocated to extension programmes were also inadequate.

"*Usually, we experience delays (bureaucracy) in the release of funds from the central government through district councils to implement extension activities*" (KI 8).

For the study area, such delays in to release of funding for extension services by the central government through the local government are met by lots of bureaucratic bottlenecks.

Infrastructural challenges

More often than not, infrastructural constraints such as poor road networks, lack of staff accommodation facilities and inadequate value addition infrastructure like rice processing units limit the provision and effectiveness of extension service for rice post-harvest value addition. The study participants indicated that the road networks to the farms are very bad making it difficult to access farmlands and provide extension services.

"AEAs have difficulty in accessing some farming communities, especially during the rainy season due to poor road networks. It is not easy for AEAs to ply the routes in very rough terrains" (KI 1). In addition, *there is limited mobility for AEAs to allow access to clients' farms by outreach as FEWs do not have motorbikes and even those who have them are usually not in roadworthy conditions."* (KI 1)

The result suggests the need to improve the road network to increase AEAs' access to farming communities.

A recent study on the state of extension by Bachewe, Berhane, Minten, and Taffesse (2018) in Ethiopia had similar findings, particularly with respect to poor transport infrastructure, which affected the ability of AEAs to contact the expected number of farmers.

Staying very far away from one's catchment area comes with mobility difficulties" (KI 3).

There was also a lack of adequate residential facilities for AEAs to facilitate extension services in general in the study area. It was noted that most of the AEAs have difficulty finding accommodation within the district headquarters towns and therefore reside in hard-to-reach remote communities which affects their work.

A major infrastructural concern identified by the respondents is the inadequate value addition infrastructure such as processing and storage facilities. As such, the farmers tend back to the use of their traditional methods and equipment such as mortar and pestle which affect rice grain size and uniformity, thereby affecting the quality. Thus, effective extension service is hindered by a lack of adequate facilities to support value addition processes.

"Processing infrastructures like threshing, parboiling, drying, milling and storage facilities are limited in these areas making our interventions less effective" (K I 2).

Processing infrastructure such as Agricultural Business Centres (ABCs) is provided in selected communities in the study area. These centres are equipped with rice processing equipment including drying floors and stores. Some of these facilities are not available, or affordable to the majority of the smallholder farmer population. However, only a few master farmers in the urban areas have some of these facilities, unlike the smallholder farmers.

Contextual challenges

There are contextual barriers to effective extension services for rice post-harvest value addition among the participants. These contextual barriers include poor knowledge of farmers in value addition and low adoption of modern post-harvest value addition technologies. Poor knowledge of farmers in post-harvest value addition is identified as a barrier to extension programmes; in that, some farmers do not know or understand the rice post-harvest value addition technologies due to a lack of training from extension agents, whom themselves need training. Thus, farmers either fail or decide not to apply the new technologies.

"There is a lack of training and knowledge on the part of the farmers and the AEAs on the use of the improved equipment at some ABCs" (KI 10).

Comparable findings were reported in Indonesia by Cahyono and Agunga (2016) where nearly all the AEAs (95.2%, n=120) who implemented the participatory extension approach needed annual in-service training to enhance their job.

Another key contextual barrier is the low adoption of new technologies and approaches among the farmers. It came out that some farmers do not accept the new post-harvest value addition technologies but preferred using their traditional ways to the extent of rejecting new varieties of rice and mechanised innovations.

...Another challenge we face is the poor adoption level of new technologies by farmers as the farmers seek to continue with their old practices by using crude implements" (KI 2).

The result is not surprising as the major rice value addition technologies are not available to farmers. Those that are available are not affordable making the farmers use old practices. The results corroborate those of Achandi et al. (2018), who also found that rice post-harvest value addition resources such as milling machines are not accessible in Tanzania and Madagascar.

The extent of Value addition practices by smallholder farmers

Table 14 shows the results of rice post-harvest value addition practices among smallholder farmers. The results show that generally rice post-harvest value addition practices are practised by smallholder farmers to a small extent (Composite Mean=1.45). This suggests that farmers seldom undertake rice value addition at post-harvest stages. The results further show that activities that are traditionally known to farmers, such as harvesting paddy with a knife, sun drying are practised to a great extent compared to innovations such as the use of moisture meter, harvesters, de-stoning, sorting and grading machines or tools.

The results specifically show that almost all of the farmers (99.5%, Mean=3.34) practised timely harvesting of paddy to a moderate extent. This means that farmers have fair knowledge to identify signs of ripe grain to harvest paddy. Moreover, the use of a planting calendar is an added advantage for some farmers. Also, farmers harvest paddy by panicle selection with a knife (92.3%, Mean=3.82) and sun drying of paddy on tarpaulin (90.8%, Mean=3.63) to a great extent. The results are not surprising as these are locally available resources for the farmers in processing rice. In addition, milling/processing paddy (88.0%, Mean=3.17), parboiling paddy (78.0%, Mean=2.55) and sun drying of paddy on the cemented floor (69.0%, Mean=2.83) were practised to a moderate extent.

Due to unavailability and the high cost to procure these technologies, farmers are usually not effectively involved in their use to add value to rice.

The rest of the other rice post-harvest technologies starting with the use of a moisture meter to determine moisture content in the paddy, the use of de-stoner, sorting and grading of processed rice, threshing paddy with a mechanical thresher, use of ventilated and insect-free storage facility, packaging and labelling processed rice, harvesting paddy with a combine harvester were all practiced by smallholder farmers to a very small extent, with mean values ranging between (0.75-0.05). The above results are also not surprising, because, most of the smallholder farmers as discussed earlier are challenged and therefore cannot afford these high rice value addition technologies. This is consistent with the literature (Achandi et al., 2018) that because the farmers are resource-poor and practice subsistent farming, their ability to undertake such rice post-harvest value addition activities is a big challenge.

The above findings are in contrast with those of Amponsah et al. (2018) in Ghana who showed that 50.0% of the respondent farmers used handheld sickles as compared to 92.3% in the study area who used harvesting knives to a very great extent. Amponsah et al. (2018) further revealed that a combine harvester was the major technology (51.0%) used by farmers to thresh paddy followed by beating (11.0%) of the panicle straws and the use of a mechanical thresher (2.0%) by the farmers.

Table 14: Rice Post-Harvest Value Addition Practices among Smallholder Farmers

Value Addition activity	Practicing Farmers		Mean practice (Extent)	S.D. practice
	Frequency	Percentage		
Timely harvesting of paddy	398	99.5	3.34	1.12
Harvesting paddy by panicle selection with knife	369	92.3	3.82	1.31
Sun drying of paddy on tarpaulin/plastic sheet	363	90.8	3.63	1.39
Milling/processing paddy	352	88.0	3.17	1.43
Parboiling paddy	313	78.3	2.55	1.71
Sun drying of paddy on the cemented floor	276	69.0	2.83	2.09
Sun drying of paddy on a raised platform	85	21.3	0.75	1.50
Moisture meter to determine moisture content in the paddy	57	14.3	0.40	1.09
De-stoning paddy	53	13.3	0.36	1.01
Sorting and grading processed rice	51	12.8	0.27	0.86
Threshing paddy with mechanical thresher	24	6.0	0.24	0.95
Use of ventilated and insect free storage facility	24	6.0	0.14	0.62
Packaging and labelling of processed rice	13	3.3	0.07	0.45
Harvesting paddy with a combine harvester	9	2.3	0.10	0.63
Weighing processed rice for packaging	5	1.3	0.05	0.44
Composite Mean			**1.45**	**1.04**

Source: Field Data, Kamanda (2021). n=400. Means were calculated on a scale of 1-5
Scale: 1=To a small extent, 2=To some extent, 3=To a moderate extent, 4=To a great extent, 5=To a very great extent
Note: 1=(≤1.45), **2**=(1.46-2.45), **3**=(2.46-3.45), **4**=(3.46-4.45), **5**=(≥4.46)

Marketing process of post-harvest value added rice by smallholder farmers

Regarding the marketing of post-harvest value added rice by farmers, the results show that farmers in the study area have an unstable market, characterised by the sale of paddy rice (mainly) and poor quality milled rice at low prices offered by retailers/buyers/consumers in the local market. The results in Table 15 show that the majority of the respondents (81.5%) immediately sell a portion of their rice after harvest of which 61.0% sell in both paddy and milled forms, (31.9%) sell in the form of paddy and 7.1% in milled form. Of those who sell their harvested rice, 89.3% have a ready market and more than half (64.1%) do not get good prices for their rice. In Sierra Leone, smallholder rice farmers have an available market for their rice at all times. They sell a portion of their rice immediately after harvest at the weekly periodic markets called "Lummur". Aside from that retailers visit farmers in their homes and farms to buy rice during harvest. Smallholder farmers sell their rice as farming is their major source of income.

The above findings which show that 81.5% of the farmers sell their rice after harvest is an indication that farming is a business for most farmers even though not a profitable one. This implies that farming is a source of livelihood for most of the smallholder farmers in the region. They often sell their rice to purchase domestic items, pay for services (medication and education for their children/wards), and sometimes enable them to undertake infrastructural development. The sale of paddy or rice is an act that sets other farming operations in motion because the selling of produce brings income to the farmer (Hulke, & Diez, 2022). These results are in line with that of Nwet, Lantican, Aragon, and Sumalde (2017) in Myanmar, which found the majority of farmers (71%) either store all their harvested rice or sell (29%) a portion immediately after harvest and store the rest.

The shortest distance to the nearest market for more than half of the farmers (57.4%) is less than 10km. Nearly one-fourth of the farmers (24.8%) mentioned full-grained parboiled rice; as their customers prefer quality milled rice, followed by polished/brown rice (23.8%) and polished/parboiled/brown (22.5%). More than half of the farmers (62.6%) disclosed that customers pay a lower price for the quality of rice they prefer. Also, the majority of the farmers (81.9%) do not package their rice for sale while another 92.3% of the farmers admitted to receiving complaints from customers regarding their rice. Frequent complaints reported by respondents (smallholder farmers) from buyers include too much chaff and/or stones (56.0%), less profit when milled after the sale of rice by farmers (36.0%), poor packaging by farmers (4.0%) and rice not being well-polished by farmers (4.0%). These concerns are not surprising as smallholder farmers lack basic rice value addition resources and knowledge (see Table 12).

Challenges encountered in the sale of harvest were an unstable market (21.1%) condition, cost of transporting goods (12.5%), inadequate storage facilities, poor pricing (10.2%) for each, low patronage (9.4%, high competition (8.6%), seasonal nature of the market (7.0%), advertisement costs (3.1%) and others which include low literacy level, age of farmer, among others. (1.6%).

Similar findings on challenges were reported by Nkwabi et al. (2021) in Lake Zone, Tanzania such as the low price for rice (38.95%), price fluctuations (17.90%), inappropriate measuring scale (14.90%), the dominance of middlemen (51.79%), absence of a big market (12.58%) for rice farmers.

Table 15: Marketing of value added rice by smallholder farmers

Value addition marketing	Frequency	Percentage
Sell rice after harvest	326	81.5
Form rice is sold (n=326)		
Both	199	61.0
Paddy	104	31.9
Milled	23	7.1
Have a ready market for rice (n=326)	291	89.3
Level of the market (n=291)		
Local/periodic market	150	51.5
Farmgate	88	30.2
Barter system	28	9.6
Big towns/cities	25	8.6
Get good prices for rice (n=326)	117	35.9
Shortest distance to the nearest market (km) (n=326)		
<10	187	57.4
10-19	82	25.2
20-29	46	14.0
30+	11	3.4
Quality of milled rice customers prefer		
Parboiled full grain	99	24.8
Polished/Brown	95	23.8
Polished/Parboiled/Brown	90	22.5
Polished	30	7.6
Parboiled/Polished	8	2.0
Other (aroma, brown only)	4	1.0
Customers pay a higher price for the quality of rice they want (n=326)		
Yes	122	37.4
Farmers Packaging rice for sales (n=326)	59	18.1
Some rice buyers have complaints (n=326)		
Yes	25	7.7
Buyer complaints (n=25)		

Table 15: Marketing of value added rice by smallholder farmers (Continued)

Value addition marketing	Frequency	Percentage
Too much chaff and/or stones	14	56.0
Less profit when milled after sale	9	36.0
Poor packaging	1	4.0
Rice not well-polished	1	4.0
Challenges faced with the marketing of your rice (n=256)		
Unstable market	54	21.1
Cost of transportation of goods	32	12.5
Inadequate storage facilities	26	10.2
Poor pricing	26	10.2
Low patronage	24	9.4
High competition	22	8.6
Seasonal nature of the market	18	7.0
Poor road networks	15	5.9
Advertisement challenges	8	3.1
Others (low literacy level, age of farmer, etc.)	4	1.6

Source: Field Data, Kamanda (2021)

Extension Services for Smallholder Rice Post-Harvest Value Addition

Extension services in rice post-harvest value addition among smallholder farmers were assessed and the results are presented in Table 16. The results show that smallholder farmers have limited access to extension services on rice post-harvest value addition, even though extension services, in general, are available and accessible to farmers. The results specifically show that even though most of the farmers (78.8%) have access to extension services in rice production, less than half receive post-harvest extension information. Out of this percentage, 34.9% have monthly access, 34.0% have bi-monthly access, and 23.8% and 5.3% have quarterly and half-yearly contacts with extension services respectively. Among the farmers who have access to extension services, more than half (52.5%) do not receive extension information on rice at post-harvest stages.

Areas, where a considerable number of farmers have received extension services/training are timely harvesting (41.0%), drying paddy on the cemented floor (38.3%), use of sickle for harvesting (34.3), use of moisture meter (17.3%), drying paddy on a raised platform (16.8%) and use of an improved parboiling container of rice (16.0%), harvesting non-weed infested rice straws/panicles (14.8%) and de-stoning paddy (14.0%) among others.

Given the high agricultural extension agent-to-farmer ratio (1:2,100) in Sierra Leone (Ibrahim et al., 2021), it is surprising that the majority of the farmers (78.8%) are receiving extension services in the region. What is however worrying is the majority of farmers (52.5%) do not receive extension information on rice post-harvest value addition in the region. It will be interesting to know the nature, quality and efficiency of the extension services farmers are receiving in the study area. The findings from this study are not similar to those of Conteh et al. (2015) in Sierra Leone who discovered that only 26.0% of farmers have access to extension services. Nonetheless, the findings are similar to what has been reported in Ghana where nearly 73.0% of the farmers have access to RPHVA extension services in rural areas in Brong-Ahafo, Ashanti, Eastern, Western, and the Volta regions (Rock, 2019).

Table 16: Rice post-harvest value addition extension services among farmers

Rice post-harvest value addition extension	Frequency	Percentage
Have access to extension service in rice production		
Yes	315	78.8
No	85	21.3
Frequency of extension service access (n=315)		
Monthly	110	34.9
Bi-monthly	107	34.0
Quarterly	75	23.8
Half-yearly	17	5.3
Rarely	6	1.9
Receive extension information on rice at post-harvest stages		
No	210	52.5
Yes	190	47.5
Had training in the following activities		
Timely harvesting of paddy	164	41.0
Drying paddy on a cemented floor	153	38.3
Harvesting paddy with sickle	137	34.3
Use of moisture meter to determine moisture content in the paddy	69	17.3
Drying paddy on a raised platform	67	16.8
Use of improved parboiling container of paddy	64	16.0
Harvesting non-weed-infested rice straws or panicles	59	14.8
De-stoning paddy	56	14.0
Dehulling and milling paddy by use of a machine	33	8.3
Weighing processed rice for packaging	32	8.0
Threshing paddy with mechanical thresher	30	7.5
Packaging and labelling rice for marketing	15	3.8
Harvesting paddy with a combine harvester	14	3.5
Sorting and grading processed rice by use of a machine	13	3.3
Meeting the quality and traceability standards of rice	7	1.8
Transportation of paddy using animal labour (oxen)	2	0.5

Source: Field Data, Kamanda (2021)

Extension Services by AEAs in Rice Production

To verify the claim of access to extension services and the frequencies of visits by AEAs to smallholder farmers, the researcher sought the opinion of the AEAs on the extension services they generally provide in the production of rice. The majority of the AEAs (86.0%) claimed to be providing extension services to farmers in rice production and more than half (56.0%) do so, monthly. Also, 88.0% use group methods to reach out to farmers. The predominant extension service delivery method (88.0%) used by the AEAs is group training (Table 17). The group method appealed to most farmers as farmers learn more from each other in the study areas.

Also consistent with this study was the finding of Igene, Sedibe, Van der Westhuizen and Solomon (2018) in Nigeria on Raw Material Research Development Council (RMRDC) that the primary extension teaching method for disseminating advanced processing technology was demonstration (M=4.8) as a group method. The method considers the preference of the individual farmers to accommodate the pressures and feelings of other group members in which they participate and to listen to their views before they collectively reach a decision stage on changes in their farming operations (Van der Ploeg et a. 2000). The group method enables wider extension coverage and as a result, seems to be very cost effective. The extension agent can reach more farmers by using this method, and so make contact with many more farmers who have never been exposed to extension services before.

Table 17: Extension Services by AEAs in Rice Production

Extension services in Rice post-harvest value addition	Frequency	Percentage
Provide regular extension service in rice Production		
Yes	43	86.0
No	7	14.0
Frequency of extension service access (n=315)		
Monthly	28	56.0
Bi-monthly	10	20.0
Quarterly	8	16.0
Half-yearly	4	8.0
Methods used in providing extension service		
Group	44	88.0
Individual	4	8.0
Both	2	4.0

Source: Field Data, Kamanda (2021)

Availability of new technologies to AEAs in rice post-harvest value addition

The number of new technologies available to AEAs determines their level of effectiveness in delivering quality extension services to smallholder farmers at rice post-harvest value addition stages. Table 18 shows that the majority of the technologies are unavailable to more than half of the AEAs in the study areas. These include a combine harvester (76.0%), use of animal labour to transport paddy from the field after harvest (92.0%), use of a power tiller to transport paddy from the field after harvest (74.0%), de-stoner (80.0%), use of specialised parboiling container (88.9%), use of the dehusking machine (72.0%), grading/sorting of rice grains machine (84.0%) and packaging and labelling materials (72.0%). As earlier discussed, the extension organization in Africa is faced with resource constraints, with limited milling machines as a typical example (Achandi, Mujawamariya, Agboh-Noameshie, Gebremariam, Rahalivavololona, & Rodenburg 2018).

Table 18: New technologies used by AEAs to provide extension services

New Technologies	Unavailable		Inadequate		Adequate		Mean	S.D.
	F	%	F	%	F	%		
Use of combine harvester	38	76.0	11	22.0	1	2.0	1.26	0.486
Use of animal labour (oxen) to transport paddy from the field after harvest	46	92.0	3	6.0	1	2.0	1.10	0.364
Use of power tiller to transport paddy from the field after harvest	32	64.0	18	36.0	0	0.0	1.36	0.484
Threshing machine	21	42.0	27	54.0	2	4.0	1.62	0.567
Moisture content meter	22	44.0	22	44.0	6	12.0	1.68	0.683
De-stoner	40	80.0	9	18.0	1	2.0	1.22	0.464
Specialised parboiling container	44	88.0	6	12.0	0	0.0	1.12	0.328
Dehusking or dehulling machine	36	72.0	11	22.0	3	6.0	1.34	0.592
Milling machine	19	38.0	29	58.0	2	4.0	1.66	0.557
Oscillating sieves and aspirators (mechanical winnower)	40	40.0	7	14.0	3	6.0	1.26	0.564
Grading/sorting of rice grains machine	42	84.0	7	14.0	1	2.0	1.18	0.437
Weighing scale	19	38.0	27	54.0	4	8.0	1.70	0.614
Packaging and labelling materials	36	72.0	12	24.0	2	4.0	1.32	0.551

Source: Field Data, Kamanda (2021)

Agricultural Extension Agents' Professional Capability

The professional capability of the AEAs was assessed with the results presented in Table 19. The findings show that the AEAs in the study areas have the ability in all of the professional capability assessment dimensions (Mean range = 3.46 - 4.45). These include professional knowledge, personal skills and qualities and public speaking.

Table 19: Professional Capability of the AEAs

Capability	Mean	Std. Deviation
Professional Knowledge		
Knowledge of the rural life	4.34	0.823
Ability to conduct adult education	4.14	0.833
Technical knowhow to perform his/her task	4.10	0.931
Awareness about the existing extension policy	4.00	1.01
Group facilitation	3.86	1.010
Negotiation in rice marketing	3.74	1.046
Personal skills		
Capable to communicate extension ideas	4.30	0.814
Leadership qualities	4.22	0.789
Initiative skills and style	4.06	0.890
Ability to organise and plan programmes	4.02	0.891
Ability to analyse and diagnose problems	3.98	0.936
Personal qualities		
Confidence in his/her own ability to achieve	4.34	0.688
Commitment to work	4.32	0.793
Humility to work and with farmers	4.16	0.710
Reliability in his/her work and to farmers	4.02	0.820
Public speaking ability		
Entertain questions, answers and discussions	4.24	0.743
Ability to write a report	4.20	0.857
Ability to prepare beforehand	4.20	0.670
Preparation of content to be spoken about	4.16	0.841
Has a perfect method to deliver content	4.08	0.804

Source: Field Data, Kamanda (2021)
Scale: 1=incapable, 2=less capable, 3=moderately capable, 4=capable, 5=highly capable. **1**=(≤1.45), **2**=(1.46-2.45), **3**=(2.46-3.45), **4**=(3.46-4.45), **5**=(≥4.46)

Also consistent with this study were the findings of Reynolds (1993) who placed very high importance on the professional competencies of AEA in the United States. These competencies include continuing to be professional (Mean=4.65, S.D.=.52), creating and adhering to an organisational concept (Mean=4.39, S.D.=.72), identifying areas where one can improve as a professional (Mean=4.35, S.D.=.63), creating a professional growth strategy (Mean=4.24, S.D.=.71) and engagement in activities and professional organisations (Mean=4.12, S.D.=.92).

Profitability of operations in smallholder rice post-harvest value addition

Generally, the finding from the analysis of profits shows that the majority of the farmers who sell their rice after harvest do not make a profit. Taking into account the effects of production costs (land, seed rice, tools and farm labour), the results show that some farmers do not make any profit in their rice post-harvest value addition.

The categorisation of the estimated different parameters, including the area of farmland, annual yield and profits made by farmers per hectare per year was based on the varying minimum, maximum, mean and standard deviation values for each parameter as shown in Table 20 below.

The results show that the estimated land area in hectares with (Mean=0.41) and (S.D.=2.03) for the four successive years was found to be uniform. For paddy yield in kilogram, there was a varying degree of mean and standard deviation. The lowest (Mean=189.0) and the highest (S.D.=4995.0) were both identified in the 2018 cropping season. For profit (Leones) in rice post-harvest value addition, the lowest (Mean=3545104.0000) and (S.D.=3118960.64910) were identified in the 2017 cropping season whilst the highest (Mean=5173081.2500) and (S.D.=4402335.06837) were realised in 2020 cropping season. Lastly, the lowest (Mean=3545104.0000) and (S.D.=3118960.64910) of profit/hectare/year was realised in 2017 and the highest (Mean=17610000.00) and (S.D.= 4402335.06837) was in 2020 cropping seasons.

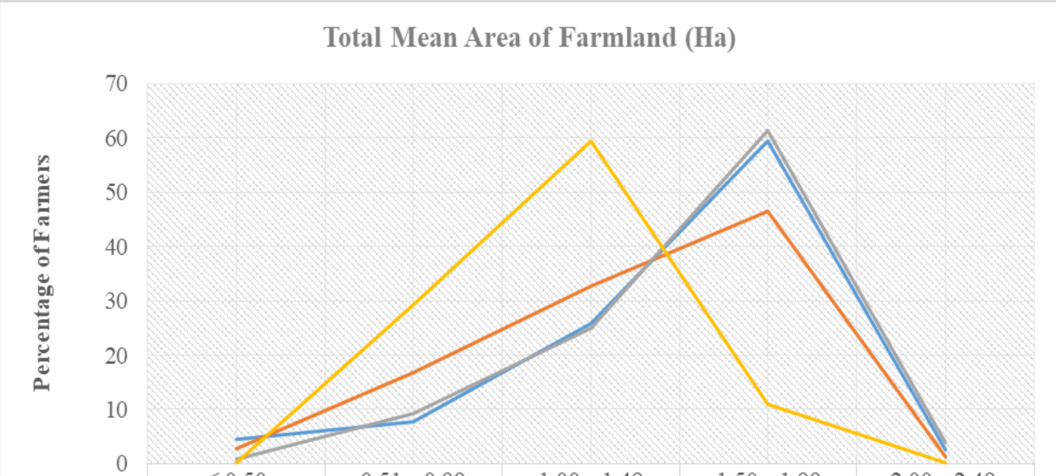
Table 20: Categorisation of variables based on their Minimum, Maximum, Mean and Standard Deviation values

Parameter	2017	2018	2019	2020
Area (Ha)				
Minimum	0.34516	0.34431	0.30035	0.30087
Maximum	1.4084	1.3233	1.4499	1.4570
Mean	0.41	0.41	0.41	0.41
S.D.	2.03	2.03	2.03	2.03
Yield (Kg)				
Minimum	1489.6250	1730.8325	1652.2650	1605.8250
Maximum	1076.28450	1229.88042	1081.08790	1141.87365
Mean	250.00	189.00	351.00	216.00
S.D.	4500.00	4995.00	4725.00	4617.00
Profit (Leones) attained by smallholder farmers/year				
Minimum	-640000.00	-630000.00	-220000.00	-590000.00
Maximum	13320000.00	15930000.00	16090000.00	17610000.00
Mean	3545104.0000	4538842.5000	4794797.2750	5173081.2500
Standard deviation	3118960.64910	3798595.30530	3711204.32225	4402335.06837
Profit (Leones) of farmer/hectare/year				
Minimum	-640000.00	-630000.00	-220000.00	-590000.00
Maximum	13320000.00	15930000.00	16090000.00	17610000.00
Mean	3545104.0000	4538842.5000	4794797.2750	5173081.2500
Standard deviation	3118960.64910	3798595.30530	3711204.32225	4402335.06837

Source: Field Data, Kamanda (2021)

Note: 1 Sierra Leone Leone (SLL) = US.D.0.000096 = GH¢0.00058

Figure 4 presents the analysis of farmland area used by smallholder farmers in rice post-harvest value addition operations. The mean categories of the cultivated farmlands by farmers in hectares for the given years were calculated. The results show that 59.5%, 46.5%, and 61.3% of the farmers cultivated a mean farmland area ranging between 1.50-1.99ha in 2017, 2019 and 2020 respectively. By 2018, more than half of the farmers (57.5%) cultivated between 1.00-1.49 farmland. These results show that the majority of the smallholder farmers in the study area have now exceeded the estimated national mean area of farmland (1.63ha) in Sierra Leone (Fileding et al., 2015). This might be attributed to an increase in population growth which corresponds to an increase in the family source of labour that is required to increase the cultivation of farmland by smallholder farmers.



	≤ 0.50	0.51 – 0.99	1.00 – 1.49	1.50 – 1.99	2.00 – 2.49
2017	4.5	7.8	25.8	59.5	2.5
2018	2.8	16.8	32.8	46.5	1.3
2019	0.8	9.3	25	61.3	3.8
2020	0.3	29.3	59.5	11	0.3

Figure 4: Total farmland cultivated by smallholder farmers (Ha)

Source: Field Data, Kamanda (2021).

Figure 5 presents the percentages of the total mean yields of farmers in the study areas. For the year 2017, nearly half of the farmers (47.5%) harvested less than 1,000kg of paddy rice. About one-fourth of the farmers (26.8% and 27.3%) harvested 1.001 – 2.000tonnes/ha of paddy in 2017 and 2018 respectively. The trend increased in 2019 by 35.0% and further rose to 40.3% in 2020. The results are surprising as much has changed since 2017. This implies that more than half of the farmers are obtaining higher paddy yields in Sierra Leone. Related findings are reported by (Saito et al. 2020) who discovered that yield of paddy rice in Sierra Leone was 17,369 kg per ha (1.737 tonnes/ha).

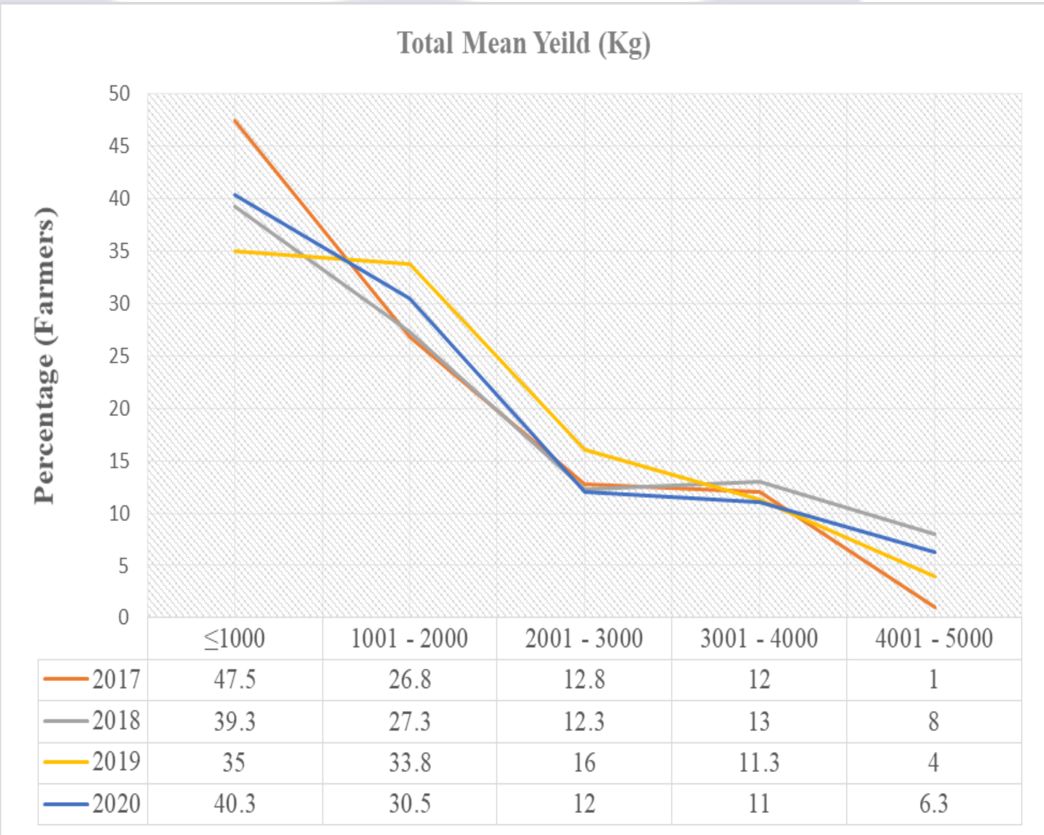


Figure 5: Total mean yields (kg)

Source: Field Data, Kamanda (2021)

Figure 6 presents the profits accrued from the sale of rice/paddy by farmers in rice post-harvest value addition over the given number of years which might have a direct effect on their income levels. Profit (P) was therefore calculated by subtracting the total production costs (PC) from the total revenue (TR) from the sale of the harvested rice yield. Therefore, profit (P) = TR - PC. The total production costs include all estimated costs of production factors (land, labour and capital). Considering the effects of production costs (land, seed rice, tools and farm labour), the finding shows that some farmers practically accrued serious loss in their farming activities with a profit margin of less than Le1, approximately US.D. 0.000096. This includes 0.3% of the farmers in 2017, 2.5% in 2018, 0.5% in 2019, and 1.9% in 2020. The majority of the farmers made a profit of around Le3000000 or less which shows that smallholder farmers are not making any significant profit in rice farming. Overall, the highest profit mean realised by smallholder farmers (Le5173081) (Figure 6) was in 2020, followed by Le4794797 in 2019 and the least was Le3545104 in 2017.

The above results affirm that the majority of the smallholder farmers are not making profits or not even achieving a break-even point (BEP) in their farming activities. This is more serious with landless and other resource-poor farmers who have to pay for almost all of the required production inputs. These findings, ceteris paribus, are consistent with those of Hussaini, Oladimeji, Sanni and Abdulrahman, (2021) who discovered in Nigeria that approximately 70.0% of rice farmers mentioned lack of improved rice processing methods ranked highly as one of the factors that impeded investment in rice value addition activities. This shows that farmers still rely on their traditional rice processing methods in the study area.

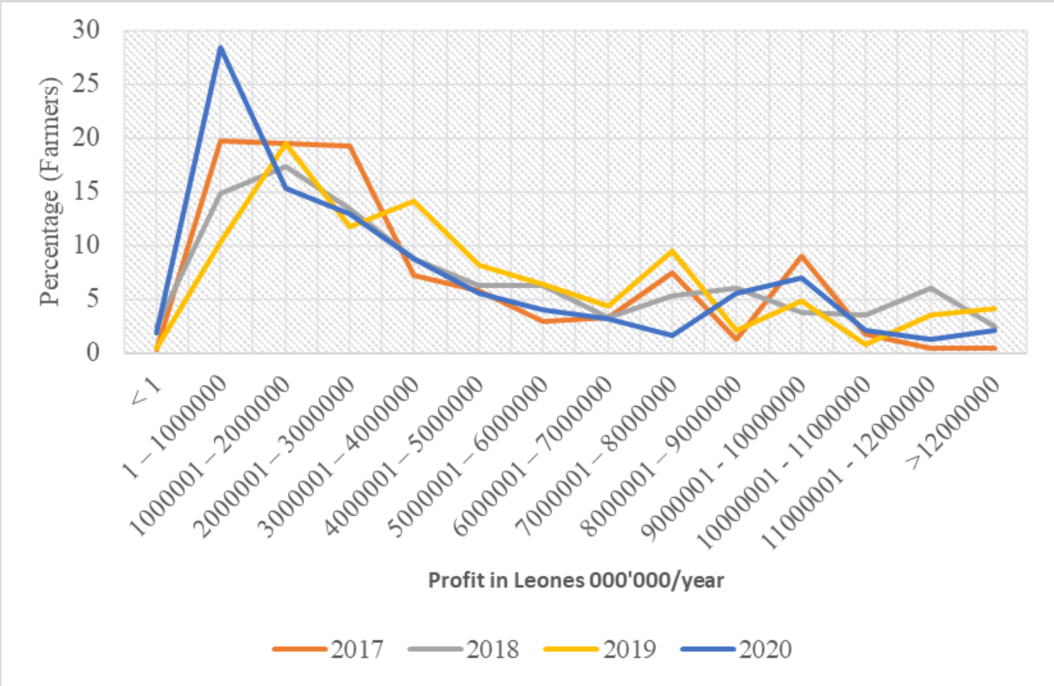


Figure 6: Total rice production profit attained by smallholder farmers for the given period of years.

Note: 1 Sierra Leone Leone (SLL/Le) = US.D.0.000096 = GH¢0.00058

Source: Field Data, Kamanda (2021)

The figure below describes the profit accrued by farmers per hectare. The total production costs include all estimated costs of production factors (land, labour and capital) and revenue was the cost of yield harvested yields. Considering the overall effects of the estimated production costs (land, seed rice, tools and farm labour) by smallholder farmers, the study revealed that 0.3% of the farmers in 2017, 2.5% in 2018, 0.5% in 2019 and 1.9% in 2020 practically accrued no profit from the sales of rice which is a serious loss in their rice processing activities. Their profit margin was less than Le1, equivalent to US.D.0.000096 per year. Overall, the highest mean profit realised by farmers was Le5173081 in 2020, followed by Le4794797 in 2019 and the least was Le3545104 in 2017 (See Table 20).

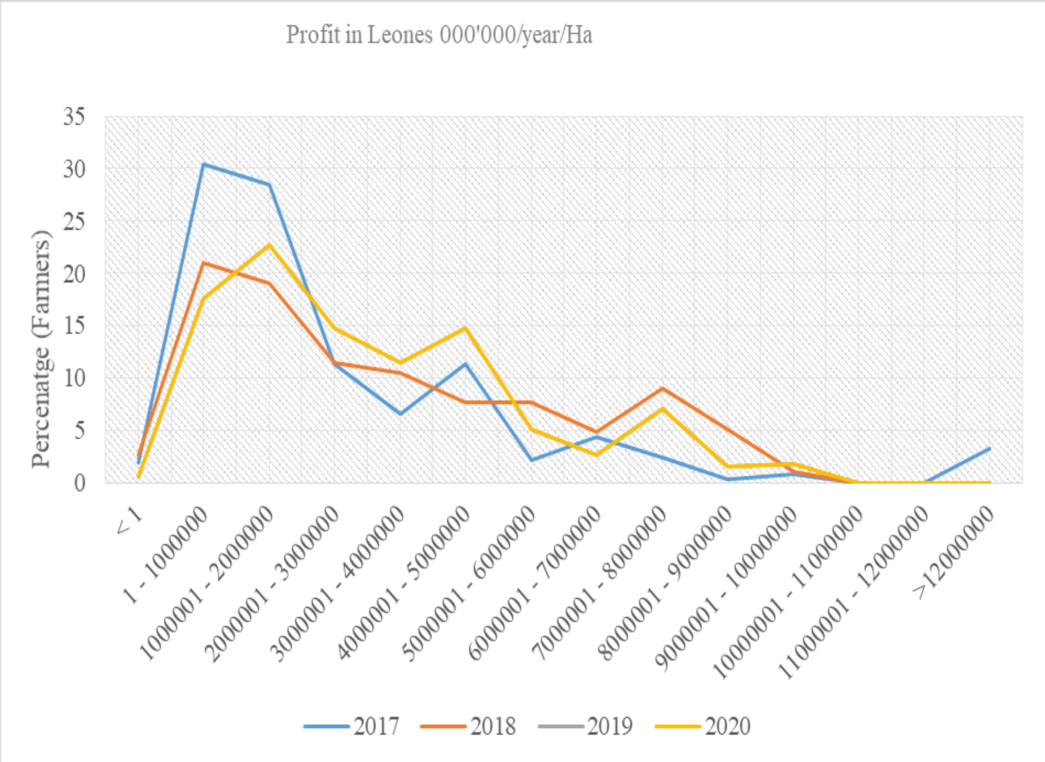


Figure 7: Profit per hectare in rice production by smallholder farmers for the given period of years

Note: 1 Sierra Leone Leone (SLL/Le) = US.D.0.000096 = GH¢0.00058

Source: Field Data, Kamanda (2021)

The highest profit accrued by 11.3% of the farmers per hectare ranged between Le4000001-5000000 in 2017 and Le3000001-4000001 by 10.5% of the farmers in 2018.

The findings for 2019 and 2020 remain to range between Le4000001-5000000 for 14.8% of farmers each year. These suggest that only a small percentage of farmers attained a higher profit margin over the given number of years.

The evidence from the above findings shows that smallholder farmers do not engage in gainful farming practices either because they are resource-constrained or they lack the value addition knowledge to their rice. Contrary to the study are the findings of Kulyakwave, et al. (2020) which concluded that rice farming is a profitable venture in Tanzania as farmers obtained revenue of TZS 1484175.3 equivalent to US.D.162.54 per hectare.

Contribution of value addition to the livelihood of smallholder farmers

The findings in Table 20 reveal that the overall livelihood status of the farmers is fairly low. The findings further show that the majority of the farmers fairly agree with the contributions of natural, human and financial capital for value addition (Mean=2.46-3.45), whilst they disagree with the contributions of the physical capital (Mean=1.46-2.45).

The results specifically indicate that farmers fairly agree that natural capital such as increased yield per unit area (Mean=3.20, S.D.=0.91), income from rice harvest (Mean=3.15, S.D.=0.96), improved land fertility (Mean=2.73, S.D.=1.16) and access to livestock (Mean=2.84, S.D.=1.10) have contributed to the improvement in their livelihood.

For physical capital, farmers strongly disagree that their value addition practices will not enable them to educate their children (Mean=1.26, S.D.=0.58), ability to pay for medical services (Mean=1.24, S.D.=0.54), ability to build or renovate a dwelling home (Mean=1.29, S.D.=0.72), ability to buy or hire a vehicle for use (Mean=1.21, S.D.=0.53), owning a power tiller (Mean=1.24, S.D.=0.55), owning a de-stoner (Mean=1.90, S.D.=0.90) and owning a thresher (Mean=1.93, S.D.=1.08). For the rest of the other physical capital items, farmers fairly agree with their contributions to improving farmers' livelihood.

For the human capital livelihood items, all of the farmers fairly agree to access to non-technical staff (Mean=2.50, S.D.=1.27), access to AEAs (Mean=3.08, S.D.=1.11), access to other sources of information (Mean=3.06, S.D.=1.12), access to technical staff (Mean=3.19, S.D.=0.89) and competence in the use of farm machines (Mean=2.96, S.D.=1.12) for the improvement of their livelihood.

Lastly, farmers fairly agree that financial capital in rice post-harvest value addition had reduced their loans (Mean=2.57, S.D.=0.83) and high level of income (Mean=2.49, S.D.=0.75). In addition, farmers disagree that financial capital has not led to a high level of savings (Mean=1.82, S.D.=0.90) and access to credit facilities (Mean=2.06, S.D.=1.03) in rice post-harvest value addition.

The implication is that the livelihood status of the farmers remains very low and has not been positively influenced by rice post-harvest value addition activities. The results are not surprising as similar findings have been reported by Kuang, Jin, He, Ning and Wan, (2020) who noted that natural risks were reported by almost 76.0% of the farmers, whilst more than 63.0% reported exposure to market risks as hindrances to their livelihood improvement.

Table 21: Perceived improvements in farmers' livelihood from Rice post-harvest value addition

Livelihood item	Strongly Disagree		Disagree		Fairly Agree		Agree		Strongly Agree		X	S.D.
	F	%	F	%	F	%	F	%	F	%		
Natural capital												
Has increased yield per unit area	15	3.8	84	21.0	110	27.5	188	47.0	3	0.8	3.20	0.91
Has increased income from the harvest	12	3.0	108	27.0	106	26.5	158	39.5	16	4.0	3.15	0.96
Has improved the fertility of my farmland	48	12.0	97	24.3	129	32.3	125	31.3	1	0.3	2.73	1.16
Has increased access to extended farmlands	84	21.0	83	20.0	96	24.0	132	33.0	5	1.3	2.20	1.22
Has increased access to livestock	170	42.5	76	19.0	63	15.8	88	22.0	3	0.8	2.84	1.01
	Composite Mean										***2.82***	***1.05***
Physical capital												
Capable of educating my children	17	4.3	60	15.0	124	31.0	180	45.0	19	4.8	1.26	0.58
Capable to pay for medical services	15	3.8	75	18.8	137	34.3	163	40.8	10	2.5	1.24	0.54
Access to market to sell my processed rice	53	13.3	85	21.3	898	22.3	166	41.5	7	1.8	3.31	0.93
Ability to build or renovate a dwelling home	54	13.5	76	19.0	123	30.8	137	34.3	10	2.5	1.29	0.72
Use bore-hole water well	92	23.0	138	34.5	106	26.5	64	16.0	-	-	3.20	0.90
Access to good roads	106	26.5	143	35.8	135	33.8	15	3.8	1	0.3	2.16	1.27
Own a storage facility for my harvested rice	190	47.5	55	13.8	64	16.0	84	21.0	-	-	2.97	1.11

Table 22: Perceived improvements in farmers' livelihood from Rice post-harvest value addition (Continued)

Ability to buy or hire a vehicle for use	164	41.0	139	34.8	75	18.8	22	5.5	-	-	1.21	0.53
Own a rice miller	323	80.8	51	12.8	19	4.8	7	1.8	-	-	1.24	0.55
Own a rice harvesting machine	322	80.5	59	14.8	14	3.5	5	1.3	-	-	2.36	1.01
Own a power tiller to transport harvested rice	324	81.0	56	14.0	19	4.8	1	0.3	-	-	2.16	0.87
Own a de-stoner	325	81.3	55	13.8	18	4.5	2	0.5	-	-	1.90	0.90
Own a rice thresher	336	84.0	44	11.0	19	4.8	1	0,3	-	-	1.93	1.08
	Composite Mean										***1.92***	***0.85***
Human capital												
Access to non-technical staff	37	9.3	72	18.0	121	30.3	164	41.0	6	1.5	2.50	1.27
Access to AEAs	51	12.8	77	19.3	77	19.3	187	46.8	8	2.0	3.08	1.11
Access to other sources of information	27	6.8	99	24.8	143	35.8	126	31.5	5	1.3	3.06	1.12
Access to technical staff	73	18.3	134	33.5	115	28.7	76	19.0	2	0.5	3.19	0.89
Competence in the use of farm machines	180	45.0	140	35.0	54	13.5	26	6.5	-	-	2.96	1.12
	Composite Mean										***2.68***	***1.10***
Financial capital												
Reduction in level of debt	13	3.3	77	19.3	140	35.0	160	40.0	10	2.5	2.57	0.83
Table 23 (Continued)												
High level of income	42	10.5	133	33.3	185	46.3	37	9.3	3	0.8	2.49	0.75
High level of savings	36	9.0	158	39.5	181	45.3	24	6.0	1	0.3	1.82	0.90
Access to credit facilities	140	35.0	142	35.5	85	21.3	19	4.8	14	3.5	2.06	1.03
	Composite Mean										***2.58***	***0.88***

Source: Field Data, Kamanda (2021)
n=400. Means were calculated on a scale of 1-5
Scale: (1=Strongly Disagree, 2=Disagree, 3=Fairly Agree, 4=Agree, 5=Strongly Agree).
Note: 1=0.45-1.45; 2=1.46-2.45; 3=2.46-3.45; 4=3.46-4.45; 5=4.46-5.00

Summary of the Chapter

The chapter presents the findings on objective one, starting with the socio-demographic characteristics of smallholder farmers and AEAs who were involved in rice post-harvest value addition. The findings show that a great majority of the farmers are males and are married with slightly more than a quarter not having formal education. These farmers have varying forms of disability ranging from deafness and dumbness to physical disability, eye defects and mental disorders. Most of the AEAs are also males in the mid-career level with approximately half of them having at least, Diploma certificates.

Findings on the rice post-harvest value addition context issues further show that limited resources are available to both farmers and the AEAs and value addition is practised to a small extent by farmers. Marketing of rice on the other hand, by the smallholder farmers, usually occurs in an unstable market condition with fluctuating prices for rice because of the poor quality of rice. As for the services provided by the AEAs, smallholder farmers asserted not to be receiving extension services at the rice post-harvest value addition stages in particular whilst the former claimed to have been providing services by preferably using group methods. In addition, AEAs admitted to being equipped in their professional capabilities. Due to the above reasons militating against the smallholder farmers, it is evident that the majority of them do not make a profit in their rice post-harvest value addition stages, hence, the likelihood of their low livelihood status.

CHAPTER FIVE

COMPETENCIES OF SMALLHOLDER RICE FARMERS AND AEAs IN RICE POST-HARVEST VALUE ADDITION

Introduction

The focus of this chapter is on the second and third study objectives. These include evaluating the competencies of smallholder farmers and AEAs in rice post-harvest value addition and determining the influence of the socio-demographic characteristics of the smallholder farmers and the AEAs on their competence in rice post-harvest value addition in the Southern Region of Sierra Leone. The chapter specifically presents the findings and discussions on (i) Rice post-harvest value addition competencies of smallholder farmers, (ii) Rice post-harvest value addition competencies of AEAs, **(**iii) Influences of the socio-demographic characteristics of smallholder farmers and AEAs on their competence in rice post-harvest value addition and (iv) Testing of the study hypotheses.

Rice post-harvest value addition competencies of smallholder farmers

The results from Table 22 show that the smallholder farmers generally have moderate competence in the entire rice post-harvest value addition technologies (Overall Mean=2.60, S.D.=1.16) in the study area. This generally means that the farmers are moderately capable of undertaking rice post-harvest value addition technologies. However, there are varying degrees of capabilities of the farmers concerning the various categories and specific activities of the post-harvest value addition competency areas, with milling (Mean=1.52, S.D.=0.94) and packaging and marketing (Mean=1.78, S.D.=0.98) recording the lowest levels of competencies. These results are slightly different from that of Adisa, Famakinwa and Adeloye, (2020) where smallholder rice farmers in Osun State, Nigeria rated themselves more competent in rice post-harvest value addition technologies than in this study.

The results show that the farmers generally are less capable of using the harvesting technologies in rice post-harvest value addition (Mean=2.41; S.D.=1.01). This is particularly so with technologies including using planting calendars, moisture metre and combine harvesters. They were, however, moderately capable of using handheld sickles and cutting panicles at the recommended length and capable of using a local knife in harvesting. These technologies are common to farmers. As a result, farmers do not require special skills or knowledge in their use as in the case of cropping calendar, moisture meter, combine harvester, thresher, among others. In the study area, locally available technologies such as handheld sickles and knives are the ones farmers have competencies in their use as compared to those technologies which are largely unavailable to farmers.

In the area of heaping, farmers have a moderate capability of heaping paddy (Mean=3.10, S.D.=1.19). Yet, they have the capability of heaping paddy on a tarpaulin. For the transportation of paddy, farmers also have a moderate capability (Mean=3.09, S.D.=1.52) in the transportation of paddy from the field after harvest to the threshing site. Even though farmers are incapable to use a power tiller to transport paddy, they seem to have high capability in the use of baskets and bags to transport paddy. This is not surprising because the use of baskets and bags to transport paddy does not require any special skills as compared to power tillers. Power tillers may be expensive and require skills to operate them. Hence, only those farmers who are closer to the agricultural business centers (ABCs) and have been using power tillers have the ability to effectively operate them in the study area.

The results show that farmers in general, demonstrate moderate capability (Mean=3.08, S.D. =1.28) in threshing technologies. In detail, farmers are highly incapable with the use of threshing machines. They, however, have a moderate capability in all of the other specific threshing technologies except for whipping paddy straws on the floor with sticks to remove grains where farmers have the capability. As indicated by GoPNG (2015), paddy rice can be threshed by hand, foot, or by swinging, beating, and whipping on a framed object. These results are expected because the latter is the traditional practice of threshing paddy by farmers in the study area, as compared to the use of threshing machines, which is costly to hire and requires training. However, the traditional methods of whipping paddy break the grains, destroy grain quality and reduce the market value of rice.

Farmers also have a moderate capability in winnowing paddy (Mean=2.83, S.D.=0.88). The detailed results show that even though farmers are capable of using round/oval shape-weaved bamboo-strip manual winnowers, they are incapable to use oscillating sieves and aspirators (mechanical winnowers). Although locally made winnower is available for farmers, they demonstrated moderate competence in its use. This suggests that farmers need training in winnowing as most farmers cannot operate the mechanical winnower. Parboiling as a key value addition technology is where farmers also have a moderate capability (Mean=2.66, S.D.=1.14). With the use of specialised parboiling containers and rice separator/nets to sieve broken grains from paddy, farmers have less capability in their use. Specialised parboiling containers are not only expensive to farmers but also require training in their use. Similarly, farmers do not use rice separators because rice grading is not a common practice among farmers, which results in the sale of ununiformed sizes of grain. Thus, farmers do not effectively sort long grains from shorter ones, and training in the use of these technologies is necessary for farmers in the study area.

Farmers also have a moderate capability in drying paddy (Mean=2.61, S.D.=1.29). They are however less capable of the use of a mechanical dryer, and moisture meter to test for moisture content in the paddy. Paddy drying technologies such as mechanical dryers and moisture meters are not available and affordable to farmers in the study area. Also, farmers require training to be capable of their use.

Table 24: Rice post-harvest value addition competencies of smallholder farmers

Competency item	Mean	S.D.
Harvesting technologies		
Harvesting paddy with a knife to select panicle	3.95	1.04
Harvesting paddy with handheld sickles	2.69	1.27
Cutting straws 4-5cm above ground level	2.56	1.20
Planting calendar to determine the harvesting date	2.23	0.98
Moisture meter to determine moisture content	1.61	0.85
Harvesting paddy with a combine harvester	1.41	0.73
Composite Mean	***2.41***	***1.01***
Heaping technologies		
Heaping paddy on tarpaulin	3.49	1.20
Use of coned heap style to pack paddy	2.95	1.18
Heaping harvested paddy for not more than a day	2.85	1.20
Composite Mean	***3.10***	***1.19***
Transporting technologies		
Use of baskets to transport paddy by humans	4.13	0.85
Use of bags to transport paddy by humans	3.85	0.59

Table 22: Rice post-harvest value addition competencies of smallholder farmers (Continued)

Competency item	Mean	S.D.
Use of a power tiller to transport paddy by humans	1.29	3.12
Composite Mean	***3.09***	***1.52***
Threshing technologies		
Whipping paddy straws on the floor with sticks	3.90	1.01
Threshing paddy with feet on a mud floor	3.33	1.79
Threshing paddy with feet on tarpaulin	3.33	1.09
Threshing paddy the very day it is harvested	3.20	1.34
Beating paddy straws in bags to remove grains	3.13	1.27
Threshing with feet on concrete or drying floor	3.05	1.02
Drying wet paddy before it is threshed	3.04	1.32
Use of threshing machine	1.67	1.43
Composite Mean	**3.08**	**1.28**
Winnowing technologies		
Round/oval shape-weaved manual winnower	4.21	0.91
Oscillating sieves (mechanical winnower)	1.44	0.85
Composite Mean	**2.83**	**0.88**
Parboiling technologies		
Removal of chaffs on paddy before soaking it	3.78	1.08
Steaming paddy for about 30-40 minutes	3.41	1.35
Removal of unfilled/empty grains	3.27	1.31
Jute bags to cover container during steaming	2.84	1.54
Washing paddy twice with clean water	2.54	1.20
Soaking paddy for about 18 hours in warm water	2.49	1.18
Use of specialised parboiling container	1.61	0.79
Use of rice separator/net to sieve broken grains	1.35	0.65
Composite Mean	**2.66**	**1.14**
Drying technologies		
Use of tarpaulin/plastic sheet to dry the paddy	4.04	1.10
Use concrete/drying floor to dry paddy	3.63	1.45
Use of shed with a fire underneath to dry paddy	2.79	1.27
Solar energy to dry paddy by occasionally stirring it	3.89	1.37
Use of moisture meter to test for moisture content	1.68	1.22

Table 22: Rice post-harvest value addition competencies of smallholder farmers (Continued)

Competency item	Mean	S.D.
Use of mechanical dryer to dry paddy	1.62	1.30
Composite Mean	**2.61**	**1.29**
Milling technologies		
Use of mechanical miller to mill rice	1.98	1.16
Use of de-stoner to remove stones/pebbles from rice	1.45	0.84
Use of dehusking or dehulling machine to paddy	1.43	0.83
Use of a machine to remove unfilled grains	1.37	1.24
Use of rice separator to grade broken rice	1.35	0.65
Composite Mean	**1.52**	**0.94**
Storage technologies		
Use of sacks/jute bags to store rice	3.59	1.21
Use of containers (wooden boxes, drums/kegs, etc.)	3.32	1.40
Use of ice barns	3.00	1.40
Stack bags of rice 20cm above on wooden racks	2.95	1.29
Cleaning storehouse three weeks before the arrival of fresh harvest	2.75	1.27
Keep moisture content of grains at or below 14.0%w.b	2.35	1.24
Checking moisture content of store by using a moisture meter	2.13	1.52
Composite Mean	**2.87**	**1.33**
Packaging & marketing technologies		
Use of phone to facilitate marketing negotiations	2.45	1.10
Use groups to market rice.	2.22	1.18
Packing rice at 8-13% moisture content	2.01	1.03
Weighing rice on a weighing scale	1.68	1.21
Weighing paddy on weighing scale	1.58	1.22
Use labels/tags for traceability/identification of rice types and quality	1.34	0.63
Use of laminated and zipped bags to package rice	1.17	0.47
Composite Mean	**1.78**	**0.98**
Overall Mean	**2.60**	**1.16**

Source: Field Data, Kamanda (2021) n=400. Means were calculated on a scale of 1-5
Note: Competence scale: 1=incapable, 2=less capable, 3=moderately capable, 4=capable, 5=highly capable.
Where: **1**=(≤1.45), **2**=(1.46-2.45), **3**=(2.46-3.45), 4=(3.46-4.45), **5**=(≥4.46)

Rice post-harvest value addition competencies of AEAs

The results from Table 23 also show that the AEAs generally have a moderate competence in rice post-harvest value addition technologies (Overall Mean=3.07, S.D.=0.66) in the study area. This generally means that the AEAs also are moderately capable of undertaking rice post-harvest value addition technologies. However, there are also varying degrees of capabilities of the AEAs concerning the various categories and specific activities of the postharvest value addition competency areas, with packaging and marketing (Mean=2.55, S.D.=0.65) and parboiling (Mean=2.95, S.D.=0.51), recording the lowest levels of competencies.

Limited literature exists on the rice post-harvest value addition competencies of AEAs studies. Several studies, however, have discovered diverse competencies of AEAs in the entire production circle of crops. For example, Chikaire et al. (2018) outlined teaching skills, agricultural marketing and conducting group sessions as competencies of AEAs whilst Bahua (2018) noted an ability to design and implement the extension programme and the ability to manage the available extension information, as competencies of AEAs in Kabila and Tilongkabila sub-districts in Gorontalo, Indonesia. These findings, nonetheless, are similar to that of Haleem (2018) who found post-harvest technologies as the highly ranked training needs of the AEAs in Iraq.

The results show that the AEAs are generally moderately capable of using the harvesting technologies in rice post-harvest value addition (Mean=3.09; S.D.=0.62). This is with technologies including using of planting calendar to determine planting date, harvesting paddy with handheld use of sickles, combine harvesters and moisture metre. They are however capable of using local knives to select paddy for harvesting. Technologies such as combine harvesters are not available as compared to local knives. Also, rice post-harvest specialists are inadequate but some of AEAs have some capability in some post-harvest technologies.

In the area of heaping, AEAs are capable of heaping paddy on tarpaulin (Mean=3.70, S.D.=0.81) and use of coned heap style to heap paddy (Mean=3.54, S.D.=0.65). The AEAs have an overall moderate competence (M=3.07, S.D.=0.66) in all of the post-harvest value addition technologies. More specifically, AEAs have the moderate capability of heaping paddy harvested paddy for not more than a day. Their knowledge in heaping rice for not more than a day is moderate but they have adequate knowledge and skills in heaping paddy on a tarpaulin. For the transportation of paddy, AEAs also have the capability (Mean=3.78, S.D.=0.74) in the transportation of paddy with the use of baskets and bags to transport paddy by humans. The results also show that AEAs are less capable to use a power tiller to transport paddy. As compared with the farmers, AEAs have limited capability in the use of improved technology such as power tiller due to unavailability. But, AEAs have the capability in the use of baskets and bags to transport paddy after harvest.

For threshing, AEAs are capable of threshing paddy with the use of feet on tarpaulin (Mean=3.96, S.D.=0.73) and use of the threshing machine (Mean=3.88, S.D.=0.82). They are however less capable in all other specific threshing technologies such as threshing paddy with feet on a mud floor and beating paddy straws in bags to remove grains.

In the drying of paddy, AEAs are capable to dry paddy using a shed with a fire underneath it, use tarpaulin, solar energy to dry paddy by occasionally stirring it to dry and concrete floors to dry paddy. AEAs, however, have less capability, especially in the use of mechanical dryers and moisture meter to test for moisture content in the paddy. Nonetheless, these improved value addition technologies are not readily available for all AEAs to utilise. Rice post-harvest specialists, therefore, may take the lead to provide and teach other AEAs but these specialists themselves are few. This constraint is worsened by the limited budgetary allocation by the central government to extension services through MAFS.

Table 25: Rice post-harvest value addition competencies of AEAs

Competency item	Mean	S.D.
Technologies used to harvest paddy		
Harvesting paddy with a knife to select panicle	3.96	0.40
Use of planting calendar to determine the harvesting date	3.20	0.93
Harvesting paddy with handheld sickles	3.10	0.64
Harvesting paddy with a combine harvester	2.98	0.71
Use of moisture meter to determine moisture content in the paddy	2.70	0.46
Harvesting paddy by cutting straws 4-5cm above the ground level	2.62	0.60
Composite Mean	**3.09**	**0.62**
Technologies used by farmers to heap paddy		
Heaping paddy on tarpaulin	3.70	0.81
Use of coned heap style to pack paddy	3.54	0.65
Heaping harvested paddy for not more than a day	3.28	1.01
Composite Mean	**3.50**	**0.82**
Technologies used by farmers to transport		
Use of baskets to transport paddy by humans	3.78	0.74
Use of bags to transport paddy by humans	3.52	0.79
Use of power tiller to transport paddy	1.55	0.67
Composite Mean	**2.96**	**0.73**
Technologies used by farmers to thresh paddy		
Threshing paddy with feet on tarpaulin	3.96	0.73

Table 23: Rice post-harvest value addition competencies of AEAs (Continued)

Competency item	*Mean*	*S.D*
Use of threshing machine	3.88	0.82
Threshing paddy with feet on concrete/dying floor	3.38	0.95
Whipping paddy straws with sticks to remove grains	3.88	0.85
Threshing paddy the very day it is harvested	3.56	0.64
Drying wet paddy before it is threshed	3.36	0.64
Threshing paddy with feet on a mud floor	2.12	0.69
Beating paddy straws in bags to remove grains from panicles	2.12	0.69
Composite Mean	***3.35***	***0.75***
Technologies used by farmers to parboil paddy		
Removal of unfilled/empty grains	3.74	0.63
Steaming paddy for about 30-40 minutes	3.72	0.78
Removal of chaffs on paddy before soaking it	3.64	0.63
Use of jute bags to cover the container during steaming	3.62	0.57
Washing paddy twice with clean water	2.74	0.49
Soaking paddy for about 18 hours in warm water	2.72	0.45
Use of specialised parboiling container	1.93	0.59
Use of rice separator/net to sieve broken grains from paddy	1.60	0.49
Composite Mean	***2.95***	***0.51***
Technologies used by farmers to dry paddy		
Use of shed with a fire underneath to dry paddy	4.02	0.94
Use of tarpaulin/plastic sheet to dry the paddy	3.82	0.48
Use of solar energy to dry the paddy by occasionally stirring it to dry	3.80	0.07
Use of concrete/drying floor to dry paddy	3.72	0.61
Use of mechanical dryer to dry the paddy	1.82	0.69
Use of moisture meter to test for moisture content in the paddy	1.54	0.73
Composite Mean	**3.12**	**0.58**
Technologies used by farmers to mill paddy		
Use of dehusking/dehulling machine to dehusk paddy	3.80	0.67
Use of rice separator to grade broken rice	3.44	0.50
Use of mechanical miller to mill paddy	2.18	0.66
Use of de-stoner to remove stones/pebbles from rice	1.64	0.72
Composite Mean	**2.58**	**0.64**
Technologies used by farmers in rice storage		
Use of sacks or jute bags to store rice	3.90	0.46
Stack bags of rice 20cm above the floor on wooden racks	3.64	0.59
Use of rice barns	3.54	0.65

Table 23: Rice post-harvest value addition competencies of AEAs (Continued)

Competency item	*Mean*	*S.D*
Use of containers (wooden boxes, drums/kegs, etc.)	3.52	0.58
Checking moisture content of store by using a moisture meter	3.50	0.71
Keep moisture content of grains at or below 14.0%.w.b	3.36	0.94
Cleaning storehouse three weeks before the arrival of fresh harvest	3.10	0.86
Composite Mean	**3.51**	**0.68**
Technologies used by farmers to package and market rice		
Use of groups to market rice	3.54	0.58
Use of phone to facilitate marketing negotiations	3.50	0.74
Packing rice at 8-13 percent moisture content	3.18	0.80
Weighing rice on a weighing scale to determine selling weight	2.34	0.69
Weighing paddy on a weighing scale to determine selling weight	2.32	0.55
Use of laminated and zipped bags to package rice	1.58	0.70
Use labels/tags for traceability/identification of rice types and quality	1.42	0.49
Composite Mean	**2.55**	**0.65**
Overall Mean	**3.07**	**0.66**

Source: Field Data, Kamanda (2021)
n=50. Means were calculated on a scale of 1-5
Note: **Competence scale**: 1=incapable, 2=less capable, 3=moderately capable, 4=capable, 5=highly capable.
Scale: **1**=(≤1.45); **2**=(1.46-2.45); **3**=(2.46-3.45); 4=(3.46-4.45); **5**=(≥4.46)

Influences of the socio-demographic characteristics of smallholder farmers and AEAs on their competence in rice post-harvest value addition

This section presents the results and discussions of objective three of the study which sought to determine the relationship between the competencies of smallholder farmers in rice post-harvest value addition and their socio-demographic characteristics. Furthermore, the section presents the relationship between the competencies of AEAs in rice post-harvest value addition and their socio-demographic characteristics. Relationship between the competencies of the smallholder farmers in rice post-harvest value addition and their socio-demographic characteristics.

Competencies of smallholder farmers in rice post-harvest value addition as the dependent variable whilst their socio-demographic characteristics as the independent variables were analysed using the Ordinary Least Squares (OLS) multiple linear regression to determine the relationship in rice post-harvest value addition. The aim is to determine the socio-demographic characteristics that influence the competence of smallholder farmers and AEAs in rice post-harvest value addition. The independent variables used in the regression model are the Age of the farmer (X_1), Level of Education (X_2), Main source of labour (X_3), Type of education (X_4), Sex (X_5), Variety (X_6), Key source of information (X_7), Main source of income (X_8), Alternative livelihood (X_9), Type of ecology (X_{10}), Type of land ownership (X_{11}), Access to credit (X_{12}), Main occupation (X_{13}), Years of farming (X_{14}) and Member of FBO (X_{15}).

OLS Multiple Linear Regression on socio-demographic characteristics of smallholder farmers and their competencies in rice post-harvest value addition

Table 24 presents the results of the Ordinary Least Squares (OLS) multiple regression on socio-demographic characteristics of smallholder farmers and their competencies in rice post-harvest value addition. The model specification is: $Y = a + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 3X4 + ...\beta nX...$ Where 'β' was the beta coefficient, 'a' was the Y-intercept (constant), 'X' was the independent variables (socio-demographic characteristics of farmers) and Y was the competency of the farmers in rice post-harvest value addition technologies.

The choice of the use of Linear regression was based on the following assumptions that were met by the data collected: These include a) linear relationship, b) multivariate normality, c) no multicollinearity, d) no auto-correlation, and e) homoscedasticity of the independent variables. The model's residuals have a normally distributed distribution. From the results, the OLS model predicted 12.5% (R-square value, r = 0.125) of variance in smallholder farmers' competencies in rice postharvest value addition. Four independent variables namely, the main source of labour, alternative livelihood, the key source of information and the main source of income are the best predictors of the post-harvest value addition competencies of smallholder rice farmers. See Appendix F for the other socio-demographic predictors that explained the majority of the farmers' competencies.

Specifically, the main source of labour was a significantly positive predictor (P=0.00) of smallholder farmers' competence in rice post-harvest value addition. The beta coefficient (β = 0.336) suggests that smallholder farmers who have a family as their main source of labour are 0.336 times more likely to increase their competence in rice post-harvest value addition by controlling all the other variables. Household heads have greater control of family labour as compared to hired and rotatory sources of labour in the study area. As a result, family labour is deeply anchored in territorial networks and local traditions and they spend their earnings mostly in local markets, generating a large number of agricultural and non-agricultural jobs and promoting environmental sustainability. The results on the sources of farm labour support the findings of Rasheed et al. (2020) who stated that the use of family labour is the most readily available source of labour for most families because household members are not directly paid to work. On the other hand, if family labour is used to perform most farming tasks, the farmers may not have enough time to attend training in rice post-harvest value addition to increase their competencies.

Alternative livelihood was also a significantly positive predictor (P=0.004) of smallholder farmers' competence in rice post-harvest value addition. The beta coefficient ($\beta = 0.302$) suggests that an increase in the alternative livelihood of smallholder farmers will result in a 0.30 times increase in their competence in rice post-harvest value addition controlling all the other variables. This implies that farmers who have an alternative livelihood are more capable to acquire training in rice post-harvest value addition that will increase their competencies for increased productivity.

The source of information was another significantly positive predictor (P=0.002) of farmers' competencies in rice post-harvest value addition. Furthermore, the result revealed that farmers who receive information from AEAs are more likely to increase their competencies in rice post-harvest value addition. That is, for every unit increase in smallholder farmers' sources of information, their competencies in rice post-harvest value addition will increase by 0.174 holding all the other variables constant. There are different sources of information available to farmers. For the reliability and technological effectiveness of rice post-harvest value addition source information, it is obvious that AEAs are the right medium to provide such relevant information for farmers.

The main source of income was a significantly negative predictor (P= -0.089) of smallholder farmers' competencies in rice value addition. Also, the beta coefficient suggests that for every unit increase in the source of income, there is a -0.89 decrease in the competencies of smallholder farmers in rice post-harvest value addition. The negative influence of the income variable implies that, in some cases, the more sources of income farmers have, the lesser their competencies in rice post-harvest value addition. This is because as farmers engage in various activities that provide them with multiple sources of income, the time available to attend training to improve their competencies will be reduced due to their engagement in other activities for income.

Table 26: Multiple linear regression of the socio-demographic variables of smallholders that influence competencies

Variables	Beta	Std. Error	R^2	Adj. R^2	S.E.E	F Ratio	P. value
(Constant)	2.357	.074	.125	.116	.53099	4.877	.000
Main source of labour	.336	.055					.000
Alternative livelihood	.302	.105					.004
Key source of information	.174	.055					.002
Main source of Income	-.089	.040					.028

Source: Field Data, Kamanda (2021) n=400, p<0.05

A multi-collinearity diagnostic test was done to determine the relationship and predictors of AEAs competencies in rice postharvest value addition and their demographic characteristics. It was realised that all of the other socio-economic (independent) including a few other demographic variables used to explain the majority of the farmers' competencies were insignificant (See Appendix F). These include (Sex of respondents, marital status, age at last birthday, age groups, highest educational level, years of working experience, number of post-university training, reliable source of post-harvest and marketing information, and farthest distance to the operational area (Km). The result is different from the findings of Siriwardana et al. (2015) who found that AEAs' experience has a significant correlation coefficient of 0.209 on knowledge sharing with AEAs in Sri Lanka.

Tests of hypotheses

Hypothesis 1 $(H_0)_1$: There is no significant relationship between the competencies of smallholder farmers and their socio-demographic characteristics (Main source of labour, alternative livelihood, key source of information and main source of income). The analysis shows that there is a significant relationship between the competencies of smallholder farmers and their socio-demographic characteristics. Therefore, H_0 was rejected and H_1 was accepted.

Unlike the variables used in this study, other studies have, however, shown similar positive relationships between the demographic characteristics of farmers as independent variables and their dependent variables. However, in this study, the socio-demographic characteristics did not influence farmers' competencies in rice postharvest value addition but rather their economic characteristics did. The findings, therefore, contradict those of Martey et al. (2013) who found socio-demographic characteristics like level of education, marital status and access to income, among others to have a significant influence on farmers' level of participation or competencies in rice farming in general.

Table 27: Relationship between the competencies of smallholder farmers and their socio-demographic characteristics

Sum of Squares	Df	Mean Square	F	Sig.	Sum of Squares
Regression	15.930	4	3.982	.000	14.125
Residual	111.372	395	.282		
Total	127.302	399			

Source: Field Data, Kamanda (2021) P>0.05

Hypothesis 2 (H_0)$_2$: The null hypothesis states that there is no significant relationship between the competencies of AEAs in rice post-harvest value addition and their socio-demographic characteristics. The findings of the analysis of this hypothesis did not observe any significant relationship between the competencies of AEAs in rice post-harvest value addition and their socio-demographic characteristics as independent variables (sex, marital status, age at last birthday, highest educational level, working experience, number of post-university capacity building training, reliable source of post-harvest and marketing information). Hence, H_0 was accepted and H_1 was rejected (See appendix G).

Like the Null hypothesis two above, none of the independent variables used in the regression analysis have any relationship with the competence of the AEAs. Nonetheless, other studies not on rice post-harvest value addition have shown a relationship between the socio-demographic characteristics of AEAs and their competencies. A study by Akpotosu et al. (2017) on the competencies of AEAs in the use of the internet shows the adjusted R-squared value of 0.563 as predictor variables which explain 56.3% of the variation by the independent variables like training, location, duration of use of the internet, age and the educational level of the AEAs.

Hypothesis 3 (H_0)3: The null hypothesis states that there is no significant difference between the competencies of smallholder farmers and the AEAs in rice post-harvest value addition. Table 25 presents the relationship that exists in the level of competencies between smallholder farmers and AEAs in rice post-harvest value addition. The mean and standard deviations indicated that the smallholder farmers (Mean=2.54, S.D.=0.56) had moderate competence whilst the AEAs (Mean=3.15, S.D.=0.31) too depicted a moderate competence in rice post-harvest value addition technologies. The independent t-test result reveals that there is a statistically significant (p=0.001) difference between the competencies of smallholder farmers and AEAs in rice post-harvest value addition. Therefore, the study fails to accept the null hypothesis that there is no statistically significant difference between the competencies of smallholder farmers and AEAs in rice post-harvest value addition. The alternate hypothesis is thus accepted.

Table 28: Independent sample t-test of rice post-harvest value addition competencies between farmers and AEAs

Group	N	Mean	S.D.	Mean difference	T	P-Value
Farmers	400	2.54	.56	0.61	1.77	.001
AEAs	50	3.15	.31			

Source: Field Data, Kamanda (2021) P> 0.05.

Means were calculated on a scale of 1-5
Note: **Competence scale**: 1=incapable, 2=less capable, 3=moderately capable, 4=capable, 5=highly capable.
Scale: **1**=(≤1.45); **2**=(1.46-2.45); **3**=(2.46-3.45); 4=(3.46-4.45); **5**=(≥4.46)

Summary of the Chapter

This chapter presented the results of objectives two and three. Objective two sought to assess the competencies of smallholder farmers and

AEAs in rice post-harvest value addition in the Southern Region of Sierra Leone. Objective three also sought to determine the relationship between the socio-demographic characteristics and competence of the farming factors. The tests of the hypothesis show that only the socioeconomic characteristics (independent variables) among the socio-demographic characteristics influence the competencies (dependent variable) of the smallholder farmers. None of these independent variables influences the competencies of the AEAs in rice post-harvest value addition. The independent t-test showed a statistically significant relationship that exists between the competencies of smallholder farmers and that of the AEAs in rice post-harvest value addition in the study areas.

CHAPTER SIX

TRAINING NEEDS OF SMALLHOLDER FARMERS AND AEAs IN RICE POST-HARVEST VALUE ADDITION

Introduction

Chapter six presents the findings and discussion for the study objective, determining the training needs appropriate for smallholder rice post-harvest value addition (RPHVA) in the Southern Region, Sierra Leone. The major headings under this chapter include the training needs of smallholder rice farmers and the training needs of AEAs. These needs were assessed through the use of the Borich needs assessment model and presented in ascending order.

Training needs of smallholder rice farmers

With the results in Table 27, it can be seen that whereas the farmers find the rice post-harvest technology as “moderately important” to “important” (Means=2.83 - 4.04) to their post-harvest value addition activities, they were less capable to moderately capable (Mean=1.52 - 3.10) in using the technologies.

The most important post-harvest value addition technologies to the farmers include those of keeping the moisture content of grains at or below 14.0% (Mean=4.04), transporting paddy (Mean=4.03), and drying paddy (Mean=3.74). The technology the farmers rated least important has to do with the winnowing of paddy (Mean=2.83).

From the results and as described earlier in Chapter Five, Table 22, the post-harvest technologies where the farmers have the least competency include milling (Mean=1.52) and packaging and marketing (Mean=1.78).

Using the Borich needs assessment model, the researcher found that the mean weighted discrepancy score (MWDS) presents the prioritised competency areas in rice post-harvest technologies needed by the farmers. The results show that the following technologies are the key areas that require prior attention in rice post-harvest value addition as shown by the MWDS. They include packaging and marketing (MWDS=5.3997) followed by milling (MWDS=5.1889), drying (MWDS=5.1297) and winnowing (MDWS=4.6865).

For the individual technologies, the use of a combine harvester to harvest paddy (MWDS=9.9457) was ranked the highest harvesting training need to be expressed by smallholder farmers. The least expressed training need was harvesting paddy by selecting a panicle with a knife (MWDS=0.5941). For heaping technologies, heaping paddy for not more than a day was ranked first (MWDS=2.4549) and the least was the use of coned heap style to pack paddy (MWDS=0.2850). For the transportation of paddy, the use of a power tiller ranked first (MWDS=10.4801), and the use of a threshing machine to thresh paddy (MWDS=8.2674) came first among the threshing technologies. For winnowing, the use of oscillating sieves and aspirators (mechanical winnower) (MWDS=5.0000) ranked first among the winnowing technologies, the use of specialized parboiling container to parboil paddy (MWDS=5.1055), the use of moisture meter to test for moisture content in drying paddy (MWDS=8.1597), use of rice separator to grade broken rice (MWDS=8.9051), keeping moisture content of grains at or below 14.0%.w.b in storage (MWDS=8.9801) and use of labels/tags for traceability of rice type and quality (MWDS=8.9801) in packaging and marketing paddy/rice.

To reprioritise the training needs of smallholder farmers in rice post-harvest value addition, packaging and marketing technologies (MWDS=5.3997) ranked the highest post-harvest value-addition training needs of farmers. These were followed by paddy milling technologies (MWDS=5.1889), drying technologies (MWDS=5.1297), winnowing technologies (MWDS=4.6865), paddy harvesting technologies (MWDS=4.6316), transportation technologies (MWDS=3.7125), storage technologies (MWDS=3.5129), parboiling technologies (MWDS=2.4845), threshing technologies (MWDS=1.9421) and paddy drying technologies (MWDS=1.6842) as the least. The results are consistent with that of Alarima et al. (2014) who revealed that power tiller management and operation (93.20%) were among the important areas where training was needed for Sawah farmers. To winnow paddy, farmers required training in the use of oscillating sieves and aspirators (mechanical winnowers) and the use of specialised parboiling containers to parboil paddy. For drying, the use of a moisture meter to test for moisture content in the paddy and the use of a rice separator to grade broken rice were the training needs of farmers.

Keeping moisture content of grains at or below 14.0%w.b. in storage and use of labels/tags for traceability were identified as the key training needs of farmers in rice post-harvest value addition technologies. These findings suggest that smallholder farmers expressed a great need for packaging and marketing technologies for the rice they produce. This emphasises that after processing, there is the need for the provision of adequate rice packaging and marketing facilities if farmers are to maintain adding value to rice.

Notwithstanding the numerous importance attached to rice post-harvest value addition technologies, Mossie, Adem and Aynalem (2019) discovered in Ethiopia that smallholder farmers soon sell their paddies after harvest and end up buying them again at a higher cost simply because of a lack of improved storage facilities for their paddy. Against value addition, Danbaba et al. (2019) observed in Nigeria that massive grain loss occurrence was recorded totalling 11.39% at different paddy post-harvest stages beginning from the harvesting stage (4.43%), threshing and cleaning (4.97%), transportation of paddy from the field to store (0.34%), drying and storage of paddy (1.53%) and transportation of paddy to local markets for sale (0.12%).

Table 29: MWDS for Level of Importance and Competency of Smallholder Farmers in RPHVA Technologies

Post-harvest value addition competence	Importance		Competence		MWDS	Rank
	Mean	S.D.	Mean	S.D.		
1. Technologies used by farmers to package and market rice	**3.35**	**1.14**	**1.78**	**0.98**	**5.3997**	**1**
a. Use labels/tags for identification of rice types and quality	3.32	0.97	1.34	0.63	8.9801	1
b. Weighing paddy on a scale to determine selling weight	3.89	1.01	1.58	1.22	7.0973	2
c. Packing rice at 8-13 percent moisture content	3.30	1.36	2.01	1.03	7.0319	3
d. Use of laminated and zipped bags to package rice	2.99	0.97	1.17	0.47	6.5471	4
e. Use of phone to facilitate marketing negotiations	3.06	1.17	2.45	1.10	3.3342	5
f. Weighing rice on a scale to determine selling weight	3.64	1.32	1.68	1.21	2.9328	6
g. Use groups to market rice	3.25	1.18	2.22	1.18	1.8743	7
2. Technologies used by farmers to mill paddy	**2.89**	**1.18**	**1.52**	**0.79**	**5.1889**	**2**
a. Use of rice separator to grade broken rice	2.30	1.57	1.35	0.65	8.9051	1
b. Use of a machine to remove unfilled grains	3.62	1.06	1.37	1.24	8.3429	2
c. Use of dehusking or dehulling machine to dehusk rice	3.69	0.99	1.43	0.83	7.8457	3
d. Use of mechanical miller to mill rice	3.96	1.16	1.98	1.16	4.2454	4
e. Use of de-stoner to remove stones/pebbles from rice	3.80	2.30	1.45	0.84	1.7944	5
3. Technologies used by farmers to dry paddy	**3.74**	**1.41**	**2.61**	**1.29**	**5.1297**	**3**
a. Use of moisture meter to test for moisture content	3.55	0.10	1.68	1.22	8.1597	1
b. Use of concrete/drying floor to dry paddy	4.22	0.94	3.63	1.45	7.1329	2

Table 27: MWDS for Level of Importance and Competency of Smallholder Farmers in RPHVA Technologies (Continued)

Post-harvest value addition competence	Importance		Competence			
	Mean	S.D.	Mean	S.D.	MWDS	Rank
c. Solar energy to dry paddy by occasionally stirring it to dry	3.49	1.37	1.89	1.37	6.6474	3
d. Use of shed with fire underneath to dry paddy	3.19	1.99	2.79	1.27	5.9299	4
e. Use of tarpaulin/plastic sheet to dry paddy	4.32	2.25	4.04	1.10	2.5033	5
f. Use of mechanical dryer to dry paddy	3.68	1.78	1.62	1.30	0.4050	6
4. Technologies used by farmers to winnow paddy	**2.83**	**0.88**	**2.83**	**0.88**	**4.6865**	**4**
a. Use of oscillating sieves and aspirators (mechanical winnower)	4.21	0.91	4.21	0.91	5.0000	1
b. Use of round shape-weaved bamboo-strip manual winnower	1.44	0.85	1.44	0.85	4.3731	2
5. Technologies used to harvest paddy	**3.68**	**1.09**	**2.41**	**1.02**	**4.6316**	**5**
a. Harvesting paddy with a combine harvester	3.95	1.21	1.41	0.73	9.9457	1
b. Use of moisture meter to determine moisture content in paddy	3.33	1.26	1.61	0.85	5.7190	2
c. Use of planting calendar to determine harvesting date	3.68	1.05	2.23	0.98	5.2904	3
d. Harvesting paddy with handheld sickles	3.68	1.05	2.69	1.27	3.6082	4
e. Harvesting paddy by cutting straws 4-5cm above the ground level	3.34	1.02	2.56	1.20	2.6322	5
f. Harvesting paddy with a knife to select panicle	4.10	0.96	3.95	1.04	0.5941	6
6. Technologies used by farmers to transport paddy	**4.03**	**1.07**	**3.09**	**0.82**	**3.7125**	**6**
a. Use of power tiller to transport paddy	3.94	1.30	1.29	0.59	10.4801	1
b. Use of baskets to transport paddy by humans	3.94	1.02	3.85	1.03	0.3743	2

Table 27: MWDS for Level of Importance and Competency of Smallholder Farmers in RPHVA Technologies (Continued)

Post-harvest value addition competence	Importance		Competence		MWDS	Rank
	Mean	S.D.	Mean	S.D.		
c. Use of bags to transport paddy by humans	4.20	0.89	4.13	0.85	0.2833	3
7. Technologies used by farmers to store paddy/rice	**4.04**	**1.58**	**2.87**	**1.56**	**3.5129**	**7**
a. Keep moisture content of grains at or below 14%.w.b	3.01	1.32	2.35	1.24	8.9801	1
b. Use of sacks or jute bags to store rice	3.91	1.14	3.59	1.21	3.2352	2
c. Cleaning storehouse three weeks before the arrival of fresh harvest	3.64	1.79	2.75	1.27	2.4758	3
d. Use of containers	3.49	1.33	3.32	1.40	1.9924	4
e. Use of rice barns	3.72	1.24	3.00	1.40	1.6827	5
f. Checking moisture content of store by using a moisture meter	2.97	1.46	2.13	1.52	1.5076	6
g. Stack bags of rice 20cm above the floor on wooden racks	3.47	1.19	2.95	1.29	1.2308	7
8. Technologies used by farmers to parboil paddy	**3.52**	**1.20**	**2.66**	**1.16**	**2.4845**	**8**
a. Use of specialised parboiling container	3.10	1.48	1.61	0.97	5.1055	1
b. Removal of unfilled/empty grains	4.07	1.09	3.27	1.31	4.2769	2
c. Washing paddy twice with clean water	3.70	1.13	2.54	1.20	3.9110	3
d. Soaking paddy for about 18 hours in warm water	3.58	1.18	2.49	1.18	2.4780	4
e. Use of rice separator/net to sieve broken grains from paddy	3.03	1.45	1.35	0.65	2.1859	5
f. Use of jute bags to cover container during steaming	3.54	1.14	2.84	1.54	1.8678	6
g. Removal of chaffs on paddy before soaking it	3.84	1.08	3.78	1.08	1.1803	7

Table 27: MWDS for Level of Importance and Competency of Smallholder Farmers in RPHVA Technologies (Continued)

Post-harvest value addition competence	Importance		Competence		MWDS	Rank
	Mean	S.D.	Mean	S.D.		
h. Steaming paddy for about 30-40 minutes	3.95	1.01	3.41	1.35	0.7376	8
9. Technologies used by farmers to thresh paddy	**3.65**	**1.32**	**3.08**	**1.28**	**1.9421**	**9**
a. Use of threshing machine	3.93	2.28	1.67	1.43	8.2674	1
b. Threshing paddy the very day it is harvested	3.75	1.11	3.20	1.34	4.7121	2
c. Threshing paddy with feet on tarpaulin	4.17	0.89	3.33	1.09	3.1421	3
d. Beating paddy straws in bags to remove grains from panicles	3.36	1.19	3.13	1.27	0.7722	4
e. Threshing paddy with feet on a mud floor	3.03	1.05	3.33	1.79	0.7487	5
f. Whipping paddy straws on the floor with sticks to remove grains	3.88	1.74	3.90	1.01	0.1073	6
g. Threshing paddy with feet on concrete/dying floor	3.99	0.97	3.05	1.02	-0.488	7
h. Drying wet paddy before it is threshed	3.07	1.36	3.04	1.32	-1.725	8
10. Technologies used by farmers to heap paddy	**3.62**	**1.02**	**3.10**	**1.19**	**1.6842**	**10**
a. Heaping harvested paddy for not more than a day	3.55	1.08	2.85	1.20	2.4549	1
b. Heaping paddy on tarpaulin	4.06	0.91	3.49	1.20	2.3128	2
c. Use of coned heap style to pack paddy	3.24	1.07	2.95	1.18	0.2850	3

Source: Field Data, Kamanda (2021)
n=400. Means were calculated on a scale of 1-5
Note: **Importance scale**: 1=unimportant, 2=less important, 3=moderately important, 4=important, 5=very important.
Competence scale: 1=incapable, 2=less capable, 3=moderately capable, 4=capable, 5=highly capable.
Scale: 1=(≤1.45), 2=(1.46-2.45), 3=(2.46-3.45), 4=(3.46-4.45), 5=(≥4.46) MWDS = Mean Weighted Discrepancy Score.

The training needs of Agricultural Extension Agents

The training needs of AEAs in rice post-harvest value addition were assessed using Borich needs assessment model with the results presented in Table 28. From the results, it is evident that AEAs find the rice post-harvest technology as "moderately important" to "important" (Means=3.91-4.27) to their post-harvest activities. As for their competencies, they were "moderately capable" to "capable" (Mean=2.55-3.50) in using the technologies.

The most important post-harvest technologies for the AEAs include harvesting paddy with a combine harvester (Mean=4.64), drying paddy before it is threshed (Mean=4.90), use of barns and sacks/jute bags (Mean=4.44) and use of moisture meter to test for moisture content (Mean=4.38). The technology the AEAs rated as the least important is beating paddy straws with sticks in bags to remove grains (Mean=3.33).

From the results, as described in Table 23, the post-harvest technologies where the AEAs have the least competence include the use of a power tiller to transport paddy after (Mean=1.54), the use of a rice separator/net to sieve broken grains from the paddy (Mean=1.60) and use of specialised containers (Mean=1.94).

In assessing the training needs of the AEAs with the Borich needs assessment model, the researcher identified that the mean weighted discrepancy score (MWDS) presents the prioritised competencies areas of the rice post-harvest technologies needed. The results show the key areas AEAs require prior attention in rice post-harvest value addition as shown by the MWDS. Generally, the trend of the training needs discovered for the AEAs in rice post-harvest value addition technologies differs from one value addition technology to another which emphasises the importance of the technologies. For example, the composite mean score for milling technologies is (MWDS=7.2769) which is ranked first as important followed by packaging and marketing technologies (MWDS=6.8672). The least desired training need of AEAs is the threshing of paddy (MWDS=1.7487). As per the individual milling technologies, the use of a de-stoner to remove stones/pebbles from paddy ranked the highest (MWDS=12.001) and the least was the use of dehusking/dehulling machine to dehusk paddy (MWDS=1.3184).

For packaging and marketing technologies, the use of laminated and zipped bags (MWDS=12.0984) ranked the highest and the use of a phone (MWDS=2.6496) to facilitate marketing negotiations was their least training need. These are followed by the use of a rice separator/net to sieve broken grains to parboil paddy (MWDS=11.8916), the use of a combine harvester to harvest paddy (MWDS=7.7024), the use of a power tiller (MWDS=11.448) and use of mechanical dryer to dry paddy (MWDS=10.936), use of moisture meter to test for moisture content in the paddy (MW7DS=6.8728). For heaping technologies, the use of coned heap style to pack paddy ranked first (MWDS=2.9680) and the least is heaping harvested paddy for not more than a day (MWDS=0.9968). Keeping moisture content of grains at or below 14.0%.w.b (MWDS=3.9376) ranked highest among the storage technologies and the use of a threshing machine (MWDS=4.0748) ranked as the highest training need among the threshing technologies.

To reprioritise the training needs of AEAs in rice post-harvest value addition, milling of paddy technologies (MWDS=7.2769) ranked the highest rice post-harvest value-addition training needs of AEAs. These were followed by paddy packaging and marketing technologies (MWDS=6.8672), parboiling technologies (MWDS=4.9634), paddy harvesting technologies (MWDS=4.4945), transportation technologies (MWDS=3.9594), drying technologies (MWDS=3.8105), storage technologies (MWDS=2.8880), heaping technologies (MWDS=2.0530) and paddy threshing technologies (MWDS=1.7487).

The results are in line with those of Saleh and Man (2017) who showed that rice post-harvest technologies are the most required training needs of AEAs in Iraq. On the contrary, these findings are broadly inconsistent with the existing study of Cahyono and Agunga (2016) who discovered in Indonesia that almost all of the farmers (95.2%) preferred yearly in-service training as a requirement for their competencies.

It is, therefore, prudent enough to note that both farmers and AEAs prioritised four technologies as their priorities under different technology areas. These technologies include harvesting paddy with a combine harvester, use of a power tiller to transport paddy, using a threshing machine to thresh paddy and keeping the moisture content of grains at or below 14.0% (w.b.).

Table 30: MWDS for Level of Importance and Competencies of AEAs in RPHVA Technologies

Post-harvest value addition competencies	Importance		Competence		MWDS	Rank
	Mean	S.D.	Mean	S.D.		
1. Technologies used by farmers to mill paddy	**4.27**	**0.55**	**2.58**	**0.63**	**7.2769**	**1**
a. Use of de-stoner to remove stones/pebbles from paddy	4.38	0.53	1.64	0.72	12.001	1
b. Use of a machine to remove unfilled grains	4.28	0.57	1.82	0.59	10.528	2
c. Use of mechanical miller to mill paddy	4.24	0.72	2.18	0.66	8.7344	3
d. Use of rice separator to grade broken rice	4.32	0.62	3.44	0.50	3.8016	4
e. Use of dehusking/dehulling machine to dehusk paddy	4.12	0.33	3.80	0.67	1.3184	5
2. Technologies used by farmers to package and market rice	**4.19**	**0.62**	**2.55**	**0.65**	**6.8672**	**2**
a. Use of laminated and zipped bags to package rice	4.26	0.59	3.54	0.58	12.098	1
b. Use labels/tags for traceability/identification of rice types and quality	4.26	0.53	1.42	0.49	11.416	2
c. Weighing paddy on a weighing scale to determine selling weight	4.20	0.69	2.32	0.55	7.8960	3
d. Weighing rice on a weighing scale to determine selling weight	4.04	0.81	2.34	0.69	6.8680	4
e. Packing rice at 8-13 percent moisture content	4.14	0.64	3.18	0.80	3.9744	5
f. Use of groups to market rice	4.28	0.45	1.58	0.70	3.1672	6

Table 28: MWDS for Level of Importance and Competencies of AEAs in RPHVA Technologies (Continued)

Post-harvest value addition competencies	Importance		Competence		MWDS	Rank
	Mean	S.D.	Mean	S.D.		
g. Use of phone to facilitate marketing negotiations	4.14	0.61	3.50	0.74	2.6496	7
3. Technologies used by farmers to parboil paddy	**4.15**	**0.66**	**2.96**	**0.58**	**4.9634**	**3**
a. Use of rice separator/net to sieve broken grains from paddy	4.34	0.62	1.60	0.49	11.891	1
b. Use of specialised parboiling container	4.26	0.69	1.94	0.59	9.8832	2
c. Soaking paddy for about 18 hours in warm water	4.10	0.65	2.72	0.45	5.6580	3
d. Removal of chaffs on paddy before soaking it	4.34	0.55	3.64	0.63	3.0380	4
e. Washing paddy twice with clean water	3.58	0.78	2.74	0.49	3.0072	5
f. Removal of unfilled/empty grains	4.36	0.63	3.74	0.63	2.7032	6
g. Use of jute bags to cover container during steaming	4.10	0.61	3.62	0.57	1.9680	7
h. Steaming paddy for about 30-40 minutes	4.10	0.71	3.72	0.78	1.5580	8
4. Technologies used to harvest paddy	**4.14**	**0.65**	**3.09**	**0.62**	**4.4945**	**4**
a. Harvesting paddy with a combine harvester	4.64	0.48	2.98	0.71	7.7024	1
b. Use of moisture meter to determine moisture content in paddy	4.36	0.48	2.70	0.46	7.2376	2

Table 28: MWDS for Level of Importance and Competencies of AEAs in RPHVA Technologies (Continued)

Post-harvest value addition competencies	Importance		Competence		MWDS	Rank
	Mean	S.D.	Mean	S.D.		
c. Use of planting calendar to determine harvesting date	4.42	0.49	3.20	0.93	5.3924	3
d. Harvesting paddy by cutting straws 4-5cm above the ground level	3.66	0.87	2.62	0.60	3.8064	4
e. Harvesting paddy with handheld sickles	3.92	0.72	3.10	0.64	3.2144	5
f. Harvesting paddy with a knife to select panicle	3.86	0.88	3.96	0.40	-0.3860	6
g. Heaping harvested paddy for not more than a day	3.56	0.73	3.28	1.01	0.9968	3
5. Technologies used by farmers to transport	**4.19**	**0.69**	**2.95**	**0.73**	**3.9594**	**5**
a. Use of power tiller to transport paddy	4.24	0.62	1.54	0.67	11.448	1
b. Use of bags to transport paddy by humans	4.28	0.70	3.52	0.79	3.2528	2
c. Use of baskets to transport paddy by humans	4.06	0.77	3.78	0.74	1.1368	3
6. Technologies used by farmers to dry paddy	**4.21**	**064**	**3.12**	**0.59**	**3.8105**	**6**
a. Use of mechanical dryer to dry paddy	4.34	0.59	1.82	0.69	10.936	1
b. Use of moisture meter to test for moisture content in the paddy	4.38	0.49	1.54	0.73	6.8728	2
c. Use of concrete/drying floor to dry paddy	4.18	0.72	3.72	0.61	1.9228	3
d. Use of solar energy to dry paddy by occasionally stirring it to dry	4.22	0.78	3.80	0.07	1.7724	4

Table 28: MWDS for Level of Importance and Competencies of AEAs in RPHVA Technologies (Continued)

Post-harvest value addition competencies	Importance		Competence		MWDS	Rank
	Mean	S.D.	Mean	S.D.		
e. Use of tarpaulin/plastic sheet to dry paddy	4.20	0.67	3.82	0.48	1.5960	5
f. Use of shed with fire underneath to dry paddy	3.96	0.60	4.02	0.94	-0.2376	6
7. Technologies used by farmers to heap paddy	**4.01**	**0.63**	**3.50**	**0.82**	**2.0530**	**7**
a. Use of coned heap style to pack paddy	4.24	0.52	3.54	0.65	2.9680	1
b. Heaping paddy on tarpaulin	4.22	0.65	3.70	0.81	2.1944	2
8. Technologies used by farmers in rice storage	**4.20**	**0.74**	**3.51**	**0.68**	**2.8880**	**8**
a. Keep moisture content of grains at or below 14.0%.w.b	4.28	0.64	3.36	0.94	3.9376	1
b. Use of rice barns	4.44	0.57	3.54	0.65	3.7840	2
c. Cleaning storehouse three weeks before the arrival of fresh harvest	4.02	0.91	3.10	0.86	3.6984	3
d. Checking moisture content of store by using a moisture meter	4.14	0.73	3.50	0.71	2.6496	4
e. Use of sacks or jute bags to store rice	4.44	0.73	3.90	0.46	2.3976	5
f. Stack bags of rice 20cm above the floor on wooden racks	4.20	0.63	3.64	0.59	2.3520	6
g. Use of containers (wooden boxes, drums/kegs, etc.)	3.88	0.98	3.52	0.58	1.3968	7
9. Technologies used by farmers to thresh paddy	**3.91**	**0.74**	**3.35**	**0.75**	**1.7487**	**9**

Table 28: MWDS for Level of Importance and Competencies of AEAs in RPHVA Technologies (Continued)

Post-harvest value addition competencies	Importance		Competence		MWDS	Rank
	Mean	S.D.	Mean	S.D.		
a. Use of threshing machine	4.00	0.69	3.88	0.82	4.0748	1
b. Threshing paddy with feet on concrete/dying floor	4.12	0.59	3.38	0.95	3.0488	2
c. Threshing paddy the very day it is harvested	3.58	0.73	3.56	0.64	2.9376	3
d. Whipping paddy straws with sticks to remove grains	3.88	0.69	3.88	0.85	1.2434	4
e. Drying wet paddy before it is threshed	4.90	0.80	3.36	0.64	1.0000	5
f. Threshing paddy with feet on tarpaulin	4.14	0.57	3.96	0.73	0.7452	6
g. Threshing paddy with feet on a mud floor	3.34	0.92	2.12	0.69	0.4800	7
h. Beating paddy straws in bags to remove grains from panicles	3.33	0.92	2.12	0.69	0.4600	8

Source: Field Data, Kamanda (2021)

n=50. Means were calculated on a scale of 1-5
Note: **Importance scale**: 1=unimportant, 2=less important, 3=moderately important, 4=important, 5=very important.
Competence scale: 1=incapable, 2=less capable, 3=moderately capable, 4=capable, 5=highly capable.
Scale: 1=(≤1.45), 2=(1.46-2.45), 3=(2.46-3.45), 4=(3.46-4.45), 5=(≥4.46)
MWDS = Mean Weighted Discrepancy Score.

Summary of the Chapter

Chapter six describes the training needs of smallholder farmers and the AEAs in rice post-harvest value addition in the Southern Region of Sierra Leone. The results from this chapter show that farmers see rice post-harvest value addition as “moderately important” to “important”. In terms of their competencies, farmers are “less capable” to “moderately capable” in using the rice post-harvest value addition technologies. With the use of the Borich needs assessment model MWDS to identify the prioritised needs of the farmers, the researcher found that packaging and marketing, drying and winnowing ranked the highest training needs.

The AEAs perceive the rice post-harvest value addition technologies as “moderately important” to “important” whilst their competencies were rated as “moderately capable” to “capable”. The MWDS calculated by the use of the Borich needs assessment model identified milling, followed by packaging and marketing as the prioritized training needs of the AEAs.

CHAPTER SEVEN

EXTENSION EDUCATION METHODS APPROPRIATE FOR SMALLHOLDER RICE POST-HARVEST VALUE ADDITION

Introduction

This chapter focuses on determining the extension education methods appropriate for smallholder rice post-harvest value addition in Sierra Leone. The chapter includes the following broad headings: appropriate extension education methods for smallholder rice post-harvest value addition for farmers and the appropriate extension education methods for smallholder rice post-harvest value addition for AEAs. The preferred rice post-harvest value addition extension education methods for smallholder farmers and AEAs were determined for each post-harvest technology by the use of simple descriptive statistics involving frequencies and percentages.

Farmers preferred extension teaching method for rice post-harvest value addition

Table 29 shows the various extension teaching methods smallholder farmers prefer to rice post-harvest value addition. The results show that the farmers generally prefer group methods when training them on rice post-harvest value addition, this is followed by the individual methods, then the mass media. In Table 29, the majority of the farmers preferred the group extension training method in technologies used to harvest paddy (51.8-77%) to the individual (10.3-25.8%) and mass (0.8-26.0%) methods. Similarly, more farmers preferred group extension training methods in heaping (82.5-91%), transportation (48.5-59.5), threshing (81.0-86.5) including other rice post-harvest technologies to individual and mass methods.

From the results, there are however some key specific technologies where substantial proportions of farmers (a quarter or more) have indicated their preference for individual or mass extension training methods. For example, a little more than a quarter of the farmers (26%) preferred the mass media for training in the use of a planting calendar to determine harvesting dates; close to a quarter (24.5%) preferred individual methods for training in using a moisture meter to measure moisture content in paddy and slightly more than a third (34.3%) preferred individual methods in the use of handheld sickles to harvest paddy. The others 25.8% also preferred individual training methods to harvest paddy by cutting straws at 4-5cm above ground level and use of bags (27.5%), and baskets (25.5%) to transport paddy by humans. Nearly half of the farmers (46.3%) preferred individual methods in the use of a power tiller to transport paddy after harvest.

The results are not surprising as similar findings have emerged from a previous study by Baral et al. (2018) among farmers in Nepal who ranked the group method with a mean score of 0.78 as their most preferred extension method. A similar finding was also reported by Ayanda (2019) who discovered that 93.11% of farmers saw Management Training Plot (MTP) or method demonstration as their most preferred training method for increasing their capacities in rice farming. There are numerous advantages to adopting the group extension method over the other methods in rice post-harvest value addition in the study area. Even though the staffing and extension resources are restricted, a huge number of people will be reached in a short time with a low extension cost per unit head of the target group.

Table 31: Smallholder farmers' preferences for extension training methods in rice post-harvest value addition

Rice post-harvest value addition	Extension Training Methods					
	Group		Individual		Mass media	
Technologies used to harvest paddy	F	%	F	%	F	%
Use of planting calendar to determine harvesting date	207	51.8	89	22.2	104	26.0
Determining moisture content in paddy in the field by using a moisture meter	287	71.8	98	24.5	15	3.8
Harvesting paddy with a knife to select panicles only	274	68.5	76	19.0	50	12.6
Harvesting paddy with handheld sickles	225	56.3	137	34.3	38	9.5
Harvesting paddy with a combine harvester	308	77.0	41	10.3	51	12.8
Harvesting paddy by cutting straws 4-5cm above ground level	294	73.5	103	25.8	3	0.8
Technologies used by farmers to heap paddy						
Use of coned heap style to pack paddy	364	91.0	33	8.2	3	0.8
Heaping paddy on tarpaulin	330	82.5	56	14.0	14	3.5
Heaping harvested paddy for not more than a day	356	89.0	30	7.5	14	3.5
Technologies used by farmers to transport paddy						
Use of bags to transport paddy by humans	231	57.8	110	27.5	59	14.8
Use of baskets to transport paddy by humans	238	59.5	102	25.5	60	15.0
Use of power tiller	194	48.5	185	46.3	21	5.2
Technologies used by farmers to thresh paddy						
Use of threshing machine	324	81.0	74	18.5	2	0.5

Table 29: Smallholder farmers' preferences for extension training methods in rice post-harvest value addition (Continued)

Rice post-harvest value addition	Extension Training Methods					
	Group		Individual		Mass media	
	F	%	F	%	F	%
Technologies used by farmers to thresh paddy	328	82.0	66	16.5	6	1.5
Threshing paddy with feet on tarpaulin	346	86.5	47	11.8	7	1.8
Drying wet paddy before it is threshed	322	80.5	77	19.3	1	0.2
Technologies used by farmers to winnow paddy						
Use of oscillating sieves and aspirators (mechanical winnower)	308	77.0	91	22.8	1	0.2
Technologies used by farmers to parboil paddy						
Use of specialised parboiling container	312	78.0	67	16.8	21	5.3
Use of rice separator/net to sieve broken grains from paddy	328	82.0	69	17.3	3	0.8
Removal of chaffs on paddy before soaking it	347	86.8	41	10.3	12	3.0
Removal of unfilled/empty grains	350	87.5	37	9.3	13	3.3
Washing paddy twice with clean water	351	62.8	72	18.0	77	19.3
Soaking paddy for about 18 hours in warm water	295	73.8	56	14.0	49	12.3
Use of jute bags to cover container during steaming	304	76.0	69	17.3	27	6.8
Steaming paddy for about 30-40 minutes	305	76.3	69	17.3	26	6.5
Technologies used by farmers to dry paddy						
Use of tarpaulin/plastic sheet to dry paddy	262	65.5	120	30.0	18	4.5

Table 29: Smallholder farmers' preferences for extension training methods in rice post-harvest value addition (Continued)

Rice post-harvest value addition	Extension Training Methods					
	Group		Individual		Mass media	
Technologies used by farmers to dry paddy	F	%	F	%	F	%
Use of concrete/drying floor to dry paddy	265	66.3	115	28.8	20	5.0
Use of mechanical dryer to dry paddy	278	69.5	120	30.0	2	0.5
Use of shed with fire underneath to dry paddy	290	72.5	91	22.8	19	4.8
Mechanical dryer	330	82.5	69	17.3	1	0.2
Solar energy to dry paddy by occasionally stirring it to dry	373	93.3	25	6.3	2	0.4
Use of moisture meter to test for moisture content in the paddy	358	89.5	42	10.5	0	0.0
Technologies used by farmers to mill paddy						
Use of a machine to remove unfilled grains	354	88.5	42	10.5	4	1.0
Use of dehusking or dehulling machine to dehusk rice	332	83.0	55	13.8	13	3.3
Use of mechanical miller to mill rice	306	76.5	94	23.5	0	0.0
Use of rice separator to grade broken rice	364	91.0	36	9.0	0	0.0
Use of de-stoner to remove stones/pebbles from rice	366	91.5	33	8.3	1	0.2
Technologies used by farmers in rice storage						
Stack bags of rice 20cm above the floor on wooden racks	305	76.3	54	13.5	41	10.3
Keep moisture content of grains at or below 14.0%w.b.	347	86.8	25	6.3	28	7.0
Cleaning storehouse three weeks before the arrival of fresh harvest	291	72.8	70	17.5	39	9.8

Table 29: Smallholder farmers' preferences for extension training methods in rice post-harvest value addition (Continued)

Rice post-harvest value addition	Extension Training Methods					
Technologies used by farmers in rice storage	**Group**		**Individual**		**Mass media**	
	F	**%**	**F**	**%**	**F**	**%**
Checking moisture content of store by using a moisture meter	33	83.3	62	15.5	5	1.3
Use of sacks/jute bags to store rice	342	85.5	28	7.0	30	7.5
Use of rice barns	340	85.0	34	8.5	26	6.5
Use of containers (wooden boxes, drums/kegs, etc.)	329	82.3	22	5.5	49	12.3
Technologies used by farmers to package and market rice						
Weighing paddy on weighing scale to determine selling weight	339	84.8	57	14.3	4	1.0
Weighing rice on a weighing scale to determine selling weight	307	76.8	79	19.8	14	3.5
Packing rice at 8.0-13.0% moisture content	308	77.0	61	15.3	31	7.8
Use of laminated and zipped bags to package rice	305	76.3	87	21.8	8	2.0
Use labels/tags for traceability/identification of rice types and quality	317	79.3	58	14.5	25	6.3
Use of phone to facilitate marketing negotiations	274	68.5	106	26.5	20	5.0
Use groups to market rice	354	88.5	26	6.5	20	5.0

Source: Field Data, Kamanda (2021)

Agricultural Extension Agents' preferred extension teaching method for rice post-harvest value addition

The findings in Table 30 show the various preferred extension teaching methods for rice post-harvest value addition by AEAs. Like the farmers, the general trend with the AEAs also shows that group teaching methods dominate the other rice post-harvest value addition training methods. These are followed by individual methods and mass media methods for all the rice post-harvest value addition technologies ranging from harvesting to packaging and marketing of rice.

From Table 30, like with smallholder farmers, the majority of the AEAs preferred group extension training methods in technologies used to harvest paddy (86.0-90.0%) compared to individual (4.0-10.0%) and mass methods (4.0-10.0%). Similarly, more AEAs preferred group extension training methods in heaping (86-92%), transportation (86.0-92%), threshing (86.0-92.0%) including other rice post-harvest technologies to both individual and mass methods.

From these results also, there are however some key specific technologies where reasonable proportions of AEAs (more than one-tenth) have indicated their preference for individual extension training methods. For example: in milling paddy, 12.0% of the AEAs preferred the individual methods in the use of rice separator to grade broken grains, use of de-stoner, and use of the machine to remove unfilled grains.

In specific terms, the findings show that group teaching methods are majorly preferred by the AEAs in the use of all paddy harvesting-related technologies such as the use of a planting calendar to determine the harvesting date (86.0%), the use of a moisture meter to determine moisture content in paddy (90.0%) and harvesting paddy with combine harvester for harvesting paddy (90.0%). Also, the majority of the AEAs chose group teaching methods for all the training on the use of coned heaping technologies (88.0%) and heaping paddy on tarpaulin (94.0%). Again, group teaching methods dominated training on paddy transportation technologies which include the use of bags (86.0%) and baskets (88.0%) to transport paddy. Additionally, regarding training on the use of technologies to thresh paddy, most of the AEAs chose group teaching methods in the use of the threshing machine (90.0%) and threshing paddy with feet on concrete/drying floor (86.0%) and tarpaulin (90.0%).

Similarly, preferred teaching methods on the use of specialised parboiling containers (94.0%), rice separator/net to sieve broken grains from paddy (92.0%) and jute bags to cover container during steaming (96.0%) were group teaching methods. Almost all of the AEAs chose group teaching methods for training on the use of tarpaulin (92.0%), concreted drying floor (90.0%), mechanical dryer (92.0%) and solar energy (84.0%) to dry paddy. For the use of mechanical huller to mill paddy (90.0%), rice separator to grade broken rice (88.0%), de-stoner to remove stones/pebbles from rice (88.0%) and mortar and pestle to mill rice (90.0%), a majority of the AEAs chose group teaching methods. Group teaching methods in training on the use of technologies for packaging and marketing rice such as the use of laminated and zipped bags to package rice, the use of labels/tags for identification of rice types and quality and the use of a phone to facilitate marketing negotiations are preferred by almost all (90.0%) of the AEAs.

Different from these findings are those of Ahmed and Adisa (2017) who concluded that the individual method ranked first with a grand mean of 2.45, seconded by the group method (2.39) and mass media (2.37) on the perceived effectiveness of agricultural extension methods used to disseminate improved technologies to rice farmers in Nigeria. This finding suggests that in the study area, the group and individual teaching methods for farmers are the most preferred methods and are therefore the more successful ones than the mass media methods. The reason for this could be that the first two methods appeal to farmers' active participation in teaching and learning processes by permitting information sharing among AEAs and the farmers.

Table 32: AEAs' preferences for extension training methods in rice post-harvest value addition

Value addition item	Extension Training Methods					
Technologies used by farmers to harvest paddy	**Group**		**Individual**		**Mass media**	
	F	**%**	**F**	**%**	**F**	**%**
Use of planting calendar to determine harvesting date	43	86.0	2	4.0	5	10.0
Determining moisture content in paddy by using a moisture meter	45	90.0	5	10.0	0	0.0
Harvesting paddy with a knife to select panicle	44	88.0	3	6.0	3	6.0
Harvesting paddy with handheld sickles	43	86.0	4	8.0	3	6.0
Harvesting paddy with a combine harvester	45	90.0	4	8.0	1	2.0
Harvesting paddy by cutting straws 4-5cm above ground level	43	86.0	5	10.0	2	4.0
Technologies used by farmers to heap paddy						
Use of coned heap style to pack paddy	44	88.0	4	8.0	2	4.0
Heaping paddy on tarpaulin	47	94.0	3	6.0	0	0.0
Heaping harvested paddy for not more than a day	44	88.0	5	10.0	1	2.0
Technologies used by farmers to transport paddy						
Use of bags to transport paddy	43	86.0	4	8.0	3	6.0
Use of baskets to transport paddy	44	88.0	3	6.0	3	6.0
Use a power tiller to transport paddy	46	92.0	4	8.0	0	0.0
Technologies used by farmers to thresh paddy						

Table 30: AEAs' preferences for extension training methods in rice post-harvest value addition (Continued)

Value addition item	Extension Training Methods					
Technologies used by farmers to thresh paddy	**Group**		**Individual**		**Mass media**	
	F	**%**	**F**	**%**	**F**	**%**
Use a threshing machine to thresh paddy	45	90.0	5	10.0	0	0.0
Threshing paddy with feet on concrete/drying floor	43	86.0	5	10.0	2	4.0
Threshing paddy with feet on tarpaulin	45	90.0	3	6.0	2	4.0
Drying wet paddy before it is threshed	46	92.0	3	6.0	1	2.0
Technologies used by farmers to parboil paddy						
Use of specialised parboiling container	47	94.0	3	6.0	0	0.0
Use of rice separator/net to sieve broken grains from paddy	46	92.0	3	6.0	1	2.0
Removal of chaffs on paddy before soaking it	45	90.0	3	6.0	2	4.0
Removal of unfilled/empty grains	45	90.0	3	6.0	2	4.0
Washing paddy twice with clean water	45	90.0	2	4.0	3	6.0
Soaking paddy for about 18 hours in warm water	48	96.0	1	2.0	1	2.0
Use of jute bags to cover container during steaming	48	96.0	1	2.0	1	2.0
Steaming paddy for about 30-40 minutes	49	98.0	0	0.0	1	2.0
Technologies used by farmers to dry paddy						
Use of tarpaulin to dry paddy	46	92.0	1	2.0	4	8.0

Table 30: AEAs' preferences for extension training methods in rice post-harvest value addition (Continued)

Value addition item	Extension Training Methods					
Technologies used by farmers to dry paddy	**Group**		**Individual**		**Mass media**	
	F	**%**	**F**	**%**	**F**	**%**
Use of concreted drying floor to dry paddy	45	90.0	1	2.0	4	8.0
Use of mechanical dryer to dry paddy	46	92.0	4	8.0	0	0.0
Use of shed with fire underneath to dry paddy	46	92.0	3	6.0	1	2.0
Solar energy to dry paddy by occasionally stirring it to dry	42	84.0	5	10.0	3	6.0
Use of moisture meter to test for moisture content in the paddy	44	88.0	6	12.0	0	0.0
Technologies used by farmers to mill paddy						
Use of mechanical huller to mill paddy	45	90.0	5	10.0	0	0.0
Use of rice separator to grade broken rice	44	88.0	6	12.0	0	0.0
Use of de-stoner to remove stones/pebbles from rice	44	88.0	6	12.0	0	0.0
Use of a machine to remove unfilled grains	44	88.0	6	12.0	0	0.0
Use of mortar and pestle to mill rice	45	90.0	4	8.0	1	2.0
Technologies used by farmers in rice storage						
Stack bags of rice 20cm above the floor on wooden racks	49	98.0	0	0.0	1	2.0
Keep moisture content of grains at or below 14%w.b	46	92.0	4	8.0	0	0.0
Cleaning storehouse three weeks before the arrival of fresh harvest	45	90.0	1	2.0	4	8.0

Table 30: AEAs' preferences for extension training methods in rice post-harvest value addition (Continued)

Value addition item	Extension Training Methods					
Technologies used by farmers in rice storage	**Group**		**Individual**		**Mass media**	
	F	**%**	**F**	**%**	**F**	**%**
Checking moisture content of store by using a moisture meter	43	86.0	4	8.0	3	6.0
Use of sacks/jute bags to store rice	47	94.0	1	2.0	2	4.0
Use of rice barns	46	92.0	1	2.0	3	6.0
Use of containers (wooden boxes, drums/kegs, etc.)	47	94.0	1	2.0	2	4.0
Technologies used by farmers to package and market rice						
Weighing paddy on weighing scale to determine selling weight	49	98.0	0	0.0	1	2.0
Weighing rice on a weighing scale to determine selling weight	47	94.0	2	4.0	1	2.0
Packing rice at 8-13% moisture content	48	96.0	1	2.0	1	2.0
Use of laminated and zipped bags to package rice	45	90.0	4	8.0	1	2.0
Use labels/tags for identification of rice types and quality	45	90.0	5	10.0	0	0.0
Use of phone to facilitate marketing negotiations	45	90.0	4	8.0	1	2.0
Use groups to market rice	46	92.0	3	6.0	1	2.0

Source: Field Data, Kamanda (2021)

Summary of the Chapter

The chapter focused on the appropriate extension education methods for smallholder farmers and AEAs in rice post-harvest value addition. The key findings of this chapter reveal that the majority of the smallholder farmers generally prefer group training methods in rice post-harvest value addition. These results, however, show that substantial proportions of farmers, about a quarter or more also preferred individual or mass methods in some specific value addition technologies such as the use of moisture meter, planting calendar, handheld sickles and cutting straws 4-5cm above ground level.

The vast majority of the AEAs too preferred group extension teaching methods in rice post-harvest value addition even though slightly more than one-tenth preferred individual training methods in some specific technologies like milling, use of rice separator, de-stoner and machine to remove unfilled grains.

CHAPTER EIGHT

EXTENSION TRAINING MODEL FOR RICE POST-HARVEST VALUE ADDITION CAPACITY BUILDING IN SIERRA LEONE

Introduction

This chapter draws from the previous chapters to develop an appropriate extension training model for rice post-harvest value addition for building the capacity of smallholder farmers and AEAs in Sierra Leone. The model intends to provide a practical guide for extension training in rice post-harvest value addition for capacity building of farming actors in Sierra Leone. As such, it is not meant to be prescriptive but to foster an understanding of the very complex nature of delivering effective and efficient rice post-harvest value addition knowledge and skills to smallholder farmers and extension agents in Sierra Leone.

In this context, the extension training model shows how the rice post-harvest value addition training contents and methods are assessed, structured and organized to meet the local training needs of farmers. To do this, the researcher put the chapter into two sections. The first section presents the context specific training model for rice post-harvest value addition which is currently relevant for smallholder rice farmers in Southern Sierra Leone; whereas the second section presents a dynamic extension training model for improving rice post-harvest value addition in Sierra Leone.

Extension Training Model for Smallholder Rice Post-harvest Value Addition

From the previous chapters, it is evident that the development of an appropriate context specific training model is dependent on proper training needs assessment and the provision of training support (See Figure 8). These are discussed in the following sections.

Training Needs Assessment

From Chapter 6, it is clear that effective training needs assessment requires an understanding of the context of the target group and the knowledge gap that should be filled. This understanding is important because the context of farmers can influence their adoption of technologies and thus, their level of knowledge or skills in a particular technology (Bukchin & Kerret, 2020).

The context here includes the low level of resources available to the smallholder farmers and the agents, the low level of rice post-harvest value addition undertaken by farmers, the imperfect market situation, the high extension agent-to-farmer ratio, low profit margin realised by farmers in farming, low livelihood status of smallholder farmers and AEAs, peasantry nature of the smallholder farmers and demotivated AEAs (Figure 8).

From the results, key rice post-harvest value addition resources are not available to smallholder rice farmers (see Table 11). These include animal labour, specialised parboiling container, dehusking machine, grading machine, monetary resources and packaging and labelling materials. Where they are available, the majority of the farmers are unable to access or afford them. The extent of value addition by smallholder farmers is also low (see Table 14).

In the area of the low level of rice post-harvest value addition (Table 14), smallholder farmers generally scored a (composite mean=1.45) indicative of adding value to a small extent. For some technologies, smallholder farmers practise value addition to a moderate extent by undertaking timely harvesting, sun drying of paddy on tarpaulin/plastic sheets or concrete floors, milling and parboiling of paddy. For the rest of the other value addition activities such as the use of moisture meter in determining moisture content in the paddy, the use of a de-stoner and the use of a threshing machine to thresh paddy, farmers carried them to a very small extent.

The study further reveals that though the majority of the smallholder farmer sell their rice after harvest, only a very small proportion sell in milled form. Because of the different rice quality preferred by customers, these qualities are hardly met by farmers at both local and periodic markets "Lummur". This, therefore, confirms the imperfect nature of the market conditions as farmers do not meet the required value addition standard of buyers. As a result of this market imperfection, poor or low prices are usually offered by buyers for rice. This situation is even worse due to several challenges such as unstable market conditions, transportation, low yield, limited storage facilities and poor pricing farmers encountered in marketing their rice.

The findings further show that farmers have limited access to extension information during the rice post-harvest value addition stages. This cannot be unconnected to the high extension agent-to-farmer ratio which prevents farmers from adequately tapping into and adopting the rice post-harvest value addition technologies in the study areas.

With the low level of value addition coupled with the total production costs for all of the production factors (land, labour and capital), little or no profit is realised by the majority of the farmers. As a result of the above challenges confronting smallholder farmers, their livelihood status is found to be very low.

From the overall findings, smallholder farmers can be best described as peasant farmers since the majority of them are poor with low social status in their communities. Some of the distinguishing peasant characteristics of the farmers are the family ownership right to farmland. This is because the land is majorly owned by the family, their varying production patterns, subordination to other social sectors in and outside their communities, and their level of integration into the market system.

For very effective training of the farming actors as evidenced by the research findings, the conceptual framework below can be used.

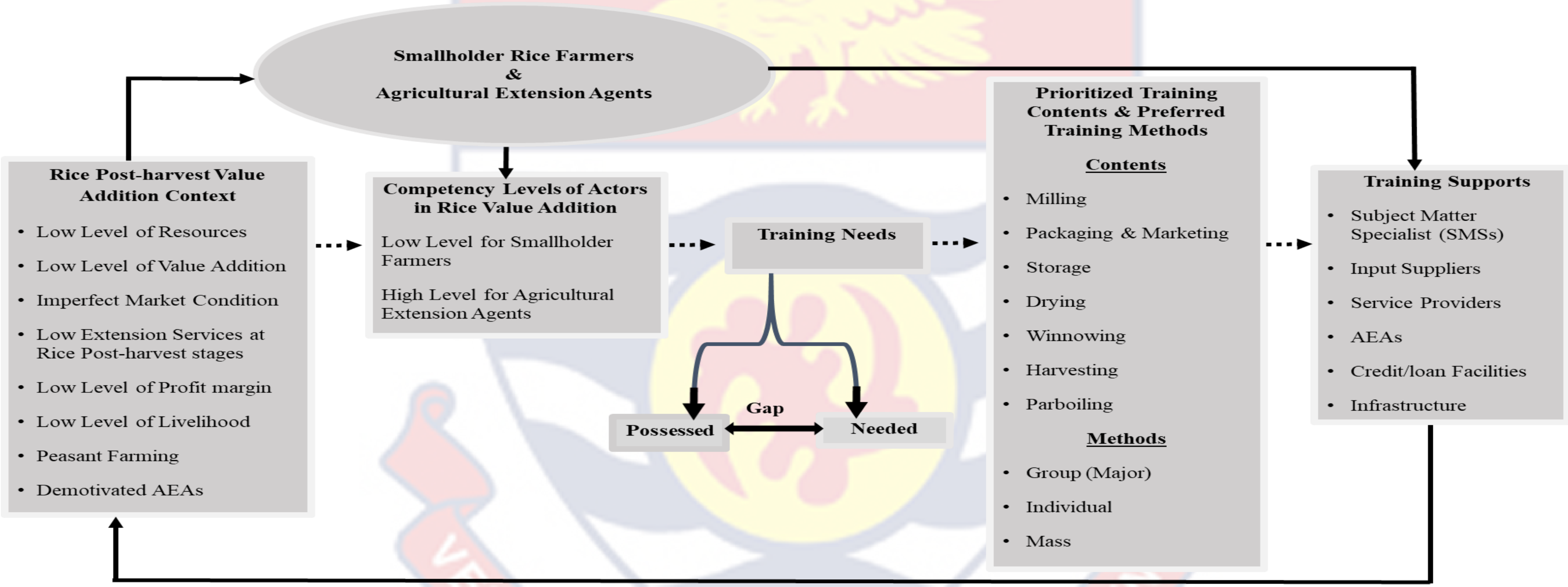


Figure 8: Proposed Extension Training Model for Rice Post-harvest Value Addition in Southern Region, Sierra Leone

Source: Author's construct, Kamanda (2021

The rice post-harvest value addition resources for AEAs show that most of the resources were inadequate (Table 12). These resources include human resources, materials/equipment for value addition and services/structures. The main human resources were value addition, subject matter specialists, post-harvest value addition input suppliers, and post-harvest value addition service providers. The material resources also include monetary/financial resources, mobility for AEAs, processing and storage facilities, computers and accessories, and infrastructures such as venues, office spaces, audio-visual aids, and print and non-print materials.

The majority of the AEAs admitted to providing extension services for smallholder farmers during the entire rice production cycle. Slightly more than half of the agents provide extension services every month and most of them use the group method.

Owing to the lack of the above basic extension resources, AEAs are characterized by demotivation which usually prevents them from effectively and efficiently carrying out their extension tasks. Low financial remuneration and a low level of self morale ascribed to the public extension agents are conspicuous indicators of their demotivation in the study areas.

The findings from Tables 22 and 23 show that both smallholder farmers and AEAs have moderate competencies in rice post-harvest value addition. For the farmers, except for harvesting paddy with a knife by selecting a panicle, heaping paddy on tarpaulin and using baskets to transport paddy by humans, where they have high competencies. They (farmers), however, have low competencies in the use of a moisture meter to determine moisture content in the paddy, harvesting paddy with a combine harvester, using power tiller to transport paddy by humans, and using threshing machine and a host of others as seen in Table 22.

The reasons for these findings could be linked to context issues. For example, lack of resources including credit facilities will limit farmers from learning and adopting new technologies. Also, low prices offered for rice by buyers will to a great extent, prevent farmers from fully adopting value addition practices. Additionally, less effective extension services especially at rice post-harvest stages coupled with the low profit margin, often realised by the majority of farmers, will altogether lessen their keenness to adopt these post-harvest value addition technologies. For effective extension services, failures that hinder adequate information transfer from scientists or experimental stations to farmers according to Jewitt and Raman (2017) are the focus of an increasing number of recent studies.

In the entire process of technological dissemination and adoption, public extension workers have always played a key role with high profits in farming and are more likely to adopt technology than smallholder farmers. For farm profit maximisation, a study by Dhraief et al. (2018) in Tunisia revealed that larger farmers who obtain high profits from farming activities are more likely to adopt technology than small farmers. However, actively training all individual farmers to raise their awareness and understanding of new technologies and hence promoting technology adoption and wider dissemination, may be prohibitively expensive. This is especially true in many low-income nations, where small-scale farms in geographically dispersed locations represent the predominant manner of agricultural production. The quality of infrastructure in these areas is frequently poor and it increases the expense of transmitting information to them. Lastly, the low livelihood status of the farmers will have the likelihood to prevent them from acquiring value addition processing equipment that qualifies their involvement in peasant farming.

The findings from Table 23 show that AEAs have the same moderate competencies as compared to the farmers. Areas where the AEAs have a high level of competence include harvesting paddy with a knife to select panicle, heaping paddy on tarpaulin, use of coned heap style to pack paddy and several other technologies as indicated in Table 23. Nonetheless, AEAs also have low competence levels in the following areas which include the use of a power tiller to transport paddy, drying wet paddy before it is threshed, use of a specialized parboiling container, and several others as shown in Table 23.

The reasons for the findings could be influenced by the context issues. Comparatively, even though AEAs have limited resources, subject matter specialists, input suppliers, and poor infrastructure, their competence level remains high in rice post-harvest technologies. This is certainly because AEAs have at least a reliable source of post-harvest market information as a result of their professional training. This training is manifested in their regular extension service delivery to farmers during the general agronomic stages in rice farming as seen in this study. This, therefore, increases the competence levels of the AEAs. Yet, the low livelihood status of the AEAs is a result of their level of demotivation due to low remuneration packages which will eventually have the predisposition to hinder their competencies to effectively assist farmers to achieve value addition.

Training Contents and Preferred Methods

Having gained a good understanding of the training needs and the context around the smallholder farmers and AEAs, the researcher's next step was to identify the training contents and methods that enhance farmer learning and the adoption of new practices. Drawing from Chapter 6, Tables 27 and 28, key training areas in rice post-harvest value addition that require prior attention based on the Borich Needs Assessment Model (Umar, Man, Nawi, Latif, & Samah, 2017) can be identified for farmers and extension agents in Tables 31 and 32 respectively. The corresponding preferred training methods for both farmers and the AEAs can also be identified.

From Table 31, the prioritised (ranked) technologies that should be considered in designing training for smallholder rice post-harvest value addition farmers are packaging and marketing, milling, drying, winnowing, harvesting, transporting, storage, parboiling, threshing and heaping. Interestingly, in all areas of the technologies, a majority of the farmers preferred the use of group methods for their training.

Packaging and marketing technologies involve a lot of specific activities (Table 31), but the three most important areas of training needs are labelling for the identification of rice types and quality, weighing paddy on a scale to determine selling weight and packing rice at 8.0-13.0% moisture content. For these areas, most of the farmers preferred the use of group methods for the training sessions. For milling, the outstanding areas that require training are the use of machines in grading broken and unbroken rice (separator), removing unfilled grains and dehusking or dehulling rice.

The key training content for drying paddy for smallholder farmers should include the use of a moisture meter to test for moisture content, a mechanical dryer for paddy, oscillators and aspirators for mechanical winnowing. Harvesting paddy was another training need of smallholder farmers. Specifically, preferred key training contents for smallholder farmers include the use of a combine harvester, moisture meter and planting calendar to determine the harvesting date of paddy. For the transportation of paddy after harvesting from the field, smallholder farmers prefer training in the use of a power tiller, basket and sack to transport paddy.

For storage, the key training areas smallholder farmers prefer training include keeping the moisture content of grains at or below 14.0%.w.b., storing paddy in sacks or jute bags and cleaning of storehouse three weeks before the arrival of freshly harvested paddy. Even though threshing of paddy was one of the least prioritized training needs of the smallholder farmers, they, however, prefer the use of a threshing machine and threshing paddy with feet on tarpaulin as their key training contents. Lastly, the smallholder farmers require training in heaping paddy on tarpaulin and use of coned heap style to pack their paddy after harvest.

Table 33: Smallholder farmer's training contents and preferred training methods

Rank	Technology	Priority Areas	Method (%)		
			Group	Individual	Mass
1	Packaging & Marketing	Labels/tags for identification of rice types and quality	79.3	14.5	6.2
		Weighing paddy on a scale to determine selling weight	84.8	14.2	1.0
		Packing rice at 8.0-13.0% moisture content, etc.	77.0	15.3	7.7
2	Milling	Rice separator to grade broken rice	91.0	9.0	0.0
		Machine to remove unfilled grains	88.5	10.5	1.0
		Dehusking or dehulling machine to dehusk rice, etc.	83.0	13.8	3.2
3	Drying	Moisture meter to test for moisture content	89.5	9.5	1.0
		Use of mechanical dryer to dry paddy	69.5	30.0	0.5
4	Winnowing	Use of oscillating sieves and aspirators (mechanical winnower)	78.0	21.8	0.2
5	Harvesting	Harvesting paddy with a combine harvester	77.0	10.2	12.8
		Use of moisture meter to determine moisture content in paddy	71.8	24.4	3.8
		Use of planting calendar to determine harvesting date	51.8	22.2	26.0
6	Transporting	Use of power tiller to transport paddy	48.5	46.3	5.2
		Use of baskets to transport paddy by humans	59.5	25.5	15.0
		Use of bags to transport paddy by humans	57.8	27.5	14.7
7	Storage	Keeping moisture content of grains at or below 14.0%.w.b.	86.8	6.2	7.0
		Sacks or jute bags to store rice	85.5	8.0	6.5
		Cleaning storehouse three weeks before the arrival of fresh harvest etc.	72.8	17.5	9.7
8	Parboiling	Use of a specialized parboiling container	78.0	16.8	5.2
		Removal of unfilled/empty grains	86.8	10.2	3.0
		Use of rice separator/net to sieve broken grains from paddy	82.0	17.3	0.7
9	Threshing	Use of threshing machine	81.0	18.5	0.5
		Threshing paddy with feet on tarpaulin	82.0	16.5	1.5
10	Heaping	Heaping paddy on tarpaulin	82.5	14.0	3.5
		Use of coned heap style to pack paddy	91.0	8.2	0.8

Source: Field Data, Kamanda (2021)

Table 32 also presents the prioritised rice post-harvest value addition technologies where AEAs require training. The technologies include milling, packaging and marketing, parboiling, harvesting, transporting, drying, storage, heaping and threshing in an order of importance to the AEAs. For the specific training areas otherwise known as the training contents, AEAs require the above mentioned rice post-harvest value addition technology areas that require training. For instance, in milling, AEAs require training in the use of a de-stoner to remove stones/pebbles from rice, a machine to remove unfilled grains, and a mechanical miller to mill paddy.

In the like manner, the type of extension training methods AEAs majorly prefer are group method followed by the individual method for most of the training contents in rice post-harvest value addition technologies in the region. For the majority of the specific training areas, AEAs prefer to be trained by group method, followed by a mass method. Nonetheless, there are other areas such as weighing paddy on a scale, soaking paddy for about 18 hours in the water, using of planting calendar to determine the planting date, and a few others where AEAs prefer to be trained by group methods, followed by a mass method.

From Table 32, the highly prioritised (ranked) technologies that should be considered in designing training for AEAs in rice post-harvest farmers are milling, packaging and marketing, parboiling, harvesting, transporting, drying, storage, heaping and threshing.

Milling of paddy technologies as a highly prioritised training need of AEAs in rice post-harvest value addition requires several specific activities

(Table 32), but there are three key important areas of training needs preferred by the AEAs. These include the use of a de-stoner to remove stones/pebbles from rice, the use of a machine to remove unfilled grains and the use of a mechanical miller to mill paddy. Followed by packaging and marketing, AEAs specifically require training in the use of laminated and zipped bags to package rice, labelling or tagging rice packages for tracing and identifying types of rice and quality. Also, AEAs require parboiling as their third prioritised training need. Specific practices they need training in parboiling paddy are the use of a rice separator/net to sieve broken grains, the use of specialized parboiling containers and soaking paddy in warm water before drying.

In harvesting paddy, AEAs will highly need training in the use of a combine harvester, a moisture meter to determine moisture content in the paddy and the use of a planting calendar to determine the harvesting date. They also require a mechanical dryer, a moisture meter in testing for the moisture content in the paddy, and the use of concrete or drying floors to dry the paddy. For storage, AEAs require training in keeping the moisture content of grains at or below 14.0% w.b, use of rice barns and cleaning of storehouses before the arrival of fresh harvests.

In the least prioritised training needs including heaping and threshing, the AEAs, highly need training in the use of coned heap style to pack paddy after harvest and heaping for not more than a day before threshing. Lastly, the AEAs highly need training in the use of a threshing machine and the use of feet to thresh paddy with feet on concrete or drying floors.

Table 34: Agricultural extension agents' training contents and preferred training methods

Rank	Technology	Priority Areas	Method (%)		
			Group	Individual	Mass
1	Milling	Use of de-stoner to remove stones/pebbles from rice	88.0	12.0	0.0
		Use of a machine to remove unfilled grains	88.0	12.0	0.0
		Use of mechanical miller to mill paddy	90.0	10.0	0.0
2	Packaging & Marketing	Use of laminated and zipped bags to package rice	90.0	8.0	2.0
		Use labels/tags for traceability/identification of rice types and quality	90.0	10.0	0.0
		Weighing paddy on a weighing scale to determine selling weight	98.0	0.0	2.0
3	Parboiling	Use of rice separator/net to sieve broken grains from paddy	92.0	6.0	2.0
		Use of a specialized parboiling container	94.0	6.0	0.0
		Soaking paddy for about 18 hours in warm water.	96.0	2.0	2.0
4	Harvesting	Harvesting paddy with a combine harvester	90.0	8.0	2.0
		Use of moisture meter to determine moisture content in paddy	90.0	10.0	0.0
		Use of planting calendar to determine harvesting date	86.0	4.0	10.0
5	Transporting	Use of power tiller to transport paddy	92.0	8.0	0.0
		Use of bags to transport paddy by humans	86.0	8.0	6.0
		Use of baskets to transport paddy by humans	88.0	6.0	6.0
6	Drying	Use of mechanical dryer to dry paddy	92.0	8.0	0.0
		Use of moisture meter to test for moisture content in the paddy	88.0	12.0	0.0
		Use of concrete/drying floor to dry paddy	90.0	2.0	8.0
7	Storage	Keeping moisture content of grains at or below 14.0%.w.b	92.0	8.0	0.0
		Use of rice barns	92.0	2.0	6.0
		Cleaning storehouse three weeks before the arrival of fresh harvest	90.0	2.0	8.0
8	Heaping	Use of coned heap style to pack paddy	88.0	8.0	4.0
		Heaping paddy on tarpaulin	94.0	6.0	0.0
		Heaping harvested paddy for not more than a day	88.0	10.0	2.0
9	Threshing	Use of threshing machine	90.0	10.0	0.0
		Threshing paddy with feet on concrete/dying floor	86.0	10.0	4.0

Source: Field Data, Kamanda (2021)

Training Support

Training support here refers to practical or material support available to facilitate training and its application to acquire knowledge and skills for a definite purpose (Issahaku, 2014). Once knowledge and skills are successfully acquired through training, it is expected that there should be a support system in place to facilitate the application of the acquired skill (Rodriguez & Walters, 2017). From the study, it is evident that several resources and conditions are needed for effective and efficient training for smallholder farmers and extension agents in rice post-harvest value addition in Sierra Leone.

For the smallholder farmers, the critical training support coming from the study includes the need for adequate Agricultural Extension Agents (AEAs), rice post-harvest value addition input suppliers, rice post-harvest value addition service providers, infrastructure (buildings) and credit/loan facilities for farmers (Figure 8). In training smallholder farmers in rice post-harvest value addition, AEAs are very valuable resources without whom training cannot be executed (FAO, 2020). The training contents are to be prepared and implemented by the AEAs for training the farmers based on the training needs assessment result from this study through the appropriate training methods. Currently, there is limited training support and without it, it would be impossible to provide effective training for smallholder farmers in rice post-harvest value addition technologies.

At the same time, the absence of rice post-harvest value addition input suppliers and service providers will make training impossible and unsustainable. These actors are therefore integral parts of the entire training cycle. The importance of infrastructure for example, venue for meetings/workshops and conference halls cannot be over-emphasized for organizing a successful training programme for farmers.

Very importantly, the application of support services especially credit/loans can be a very essential input to sustain the aftermath of every training effort (Rodriguez & Walters, 2017). Farmers, therefore, need financial assistance either in the form of loans (payable) or subsidies (non-payable) to be able to sustain what they are taught. Measures such as fines or collaterals for loan defaulters can be instituted by the government to promote a loan recovery scheme.

The training supports needed for the AEAs emanating from the study also include adequate subject matter specialists (SMS), rice post-harvest value addition input suppliers, rice post-harvest value addition service providers, credits and infrastructure (buildings). Similarly, all of the above training supports are key requirements that play a pivotal role in the implementation of an extension training programme for the AEAs. Without any of these, the training of AEAs cannot be very effective. In effect, every extension training programme in rice post-harvest value addition must be preceded by an effective need assessment study of the AEAs to identify their priority needs as in Table 30.

For the AEAs, the notable support service for the sustainable application of training efforts is the provision of financial resources to enable them to evaluate the training programme or replicate what they will be taught.

Dynamic Extension Training Model for Improving Rice Post-Harvest Value Addition in Sierra Leone

Agriculture in Africa is modernising and both technology, context and the needs of farmers are rapidly changing. Thus, it is important to look at the proposed extension training model as a dynamic model, which hinges on two key processes: 1) continuous generation of prioritised knowledge (technology) in rice post-harvest value addition through an interaction between extension agents and farmers, taking into consideration field context and 2) transfer of new rice post-harvest value addition technologies by extension agents to farmers, which draws on good support services and use of appropriate extension methods (Figure 9).

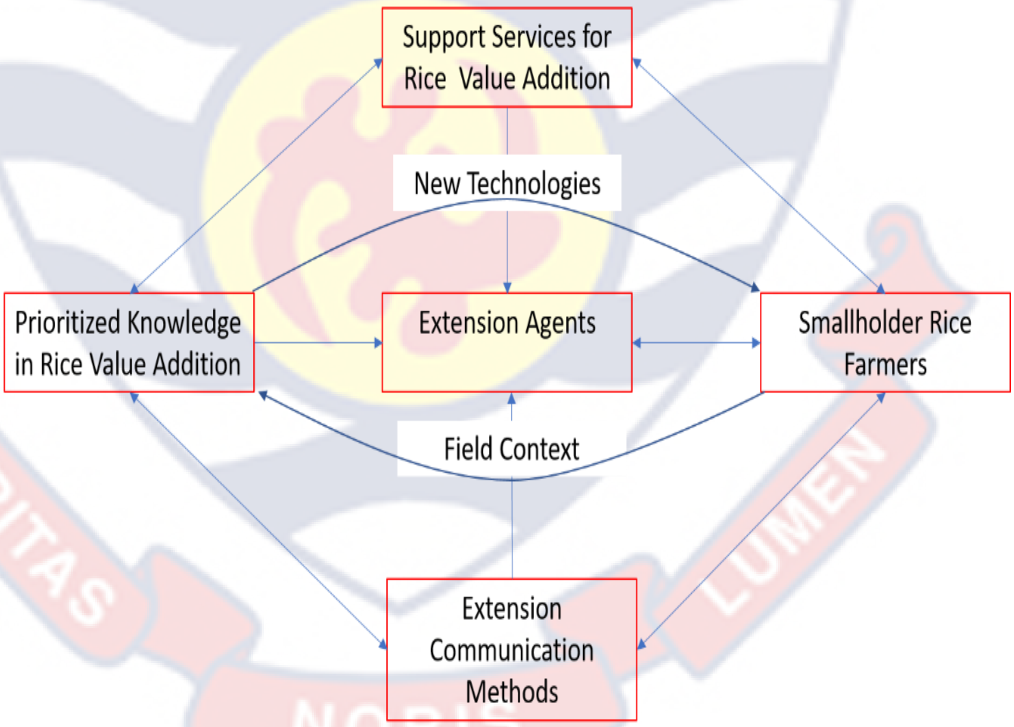


Figure 9: Dynamic extension model for improving Rice Post-harvest in Sierra Leone

Source: Author's construct, Kamanda (2021)

This proposed framework is based on regular monitoring and needs assessment of the actors and their context, as they keep changing. The framework implies that smallholder rice farmers and extension agents should constantly interact for the AEAs to understand the context and needs of farmers in rice post-harvest value addition and for the farmers to gain new knowledge to improve rice post-harvest value addition. Although the farmers generally prefer group methods of extension, the new dynamic model presents that AEAs should constantly evaluate their extension training methods with farmers to identify the most suitable methods for specific rice post-harvest technologies to ensure effectiveness.

An important aspect of the model is the training support needed to ensure that the training is effectively conducted and the knowledge is appropriately applied. The onus lies with the public extension service to mobilise the needed resources (human and material) solely or in partnership with the private sector, to ensure effective and efficient training for both AEAs and farmers. Farmers also have a role to play in mobilising the necessary resources to enable them to adopt and use the rice post-harvest value addition technologies. Farmers can, therefore, go about actualizing the adoption process of rice post-harvest addition technologies where the need for change by farmers is felt (necessity is the mother of invention). In a technologically entrepreneurial society like ours, farmers need to take a new stance on farming issues if they are to improve their livelihood situation through farming. This means that farmers are to see farming as a business and dynamic venture that requires adjustment for the expected yields and outcome. Such an awareness of the dynamic nature of farming will come about through the training of the farmers which will enhance their business orientation and willingness to form viable farmer-based organisations (FBOs) in their communities for partnership. Working in partnership can sometimes create easy access to funders thereby, substituting for the impossibility to access state funds.

Summary of the Chapter

Chapter Eight presented the extension training model for smallholder farmers and AEAs in rice post-harvest value addition in the Southern Region of Sierra Leone. The chapter has provided a context specific training model which could be adopted by the Sierra Leonean extension system to increase the capacity of extension agents and smallholder farmers in rice post-harvest value addition in Southern Sierra Leone. Finally, it presented a dynamic extension training model that could be useful in improving the capacity of extension agents and smallholder farmers in rice post-harvest value addition continuously in Sierra Leone. The next chapter presents the summary, conclusions, and recommendations of the study.

CHAPTER NINE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

This chapter presents the summary, conclusions and recommendations of the study. The chapter is divided into six main sections. Section One covers the summary of the study, Section Two presents the key findings and Section Three presents the conclusions based on the key findings of the study. The recommendations from the study are presented in Section Four, whilst section five presents the contributions of the study to knowledge and the last section presents areas for further research.

Summary

Rice is the staple food that is consumed by almost all households in Sierra Leone. The country has favourable environmental and climatic conditions suitable for rice production, yet the production of rice is not echoing with the growing population of the country. Sierra Leone is among other low rice producing countries in Africa that entirely rely on rice importation to feed their citizens. The main objective of the study was to determine an agricultural training model for improving the capacity of the farming actors in rice post-harvest value addition in the study areas. To keep the availability of rice in equilibrium with the national consumption level in the country, the government of Sierra Leone is seen to be spending more than US.D. 240 million of her scarce foreign exchange on rice importation every year. Many factors could have been associated with the shortage of locally produced rice in the country. To this end, the government of Sierra Leone has made tremendous efforts toward the rice value chain with the intent to increase rice production from its current 1.23 tons/ha to 2 tons/ha through several methods. A few of these methods are the financial donation received by the government from international donors to invest in Agribusiness and Rice Value Chain Support Project.

The study adopted the mixed methods approach to collect both quantitative and qualitative data. For the quantitative research method, a descriptive research design through the use of a questionnaire and structured interview schedule was used to collect quantitative data. A multi-stage and proportional random sampling technique was employed to select four hundred smallholder farmers, whilst a census was done to select fifty AEAs and eleven senior ministry officials. Data analysis techniques including descriptive statistics (frequencies, percentages, means and standard deviations) were used to analyse respondents' characteristics and other variables. Also, multi-collinearity diagnostic test, multiple linear OLS regression, ANOVA, Independent sample t-test, and Borich needs assessment model was used to analyse quantitative data. The diagnostic research design was used to collect qualitative data through the use of an in-depth interview guide. Thematic analysis was used to analyse qualitative data. The results were presented in line with the specific objectives/research questions of the study whilst the summary of the key findings was presented under the succeeding heading.

Against this backdrop, a training needs assessment was done to assess the competencies of the smallholder farmers and AEAs in rice post-harvest value addition stages in the Southern Region of Sierra Leone. Even though extension training is generally costly, the study noted that both farmers and AEAs needed training in rice post-harvest value addition to improve their competencies. Rice post-harvest value addition by farmers is generally low and therefore cannot enhance profit maximisation for the farmers. This limit farmers to further expand their production pattern and productivity levels thereby lowering their livelihood status. It is only through increased value added rice productivity in the country that will lower the high importation cost of rice by the government.

This study and many others have however revealed that smallholder farmers in Sierra Leone still rely on their traditional rice production practices, especially at the post-harvest stages. As a result, there is an over-reliance on the use of locally available farming resources/technologies by smallholder farmers which add little or no value to rice at post-harvest stages. This is because smallholder farmers do not have the required resources and competencies to add value to rice at post-harvest stages. The AEAs on the other hand, who are supposed to train the farmers in rice value addition at post-harvest stages, are equally challenged in these areas. In addition, the number of AEAs working with the farmers is low and only a limited number are serving a large mass of smallholder farmers including those growing other agricultural food crops.

Characteristics of the farming actors

The findings on the characteristics of the smallholder farmers show that more males (74.0%) participated in the survey than female farmers, with a mean age of forty-three (43) years. The majority of the farmers are married (83.5%). More than one-fourth (26.5%) of the farmers have informal education and 25.0% have non-formal education. The remaining farmers (47.0%) have some form of formal education ranging from primary to tertiary levels. Most of the farmers have a household size of 6-10 with a mean household size of 10 and a standard deviation of four members. The alternative livelihood activity for the majority of the farmers is micro-business (74.0%). Forty-one percent of the farmers have 10-19 years of farming experience with a mean of fourteen years and a standard deviation of eight years. Nearly half of the respondents (49.0%) have their families as their main source of labour. AEAs (60.3%) are the main source of information in rice post-harvest value addition and marketing, followed by colleague farmers (33.0%). More than four-fifths (80.5%) have not received any type of farm credit. The percentage of farmers with different forms of disability is 7.3% with a majority having physical disability (3.3%) followed by eye defects at (3.0%). The study discovered that there are more male AEAs (84.0%) than female AEAs in the study area. The majority (44.0%) of AEAs are aged between 30 and 39 years with a mean age of forty-one years. About half of the AEAs (48.0%) have a diploma certificate as their qualification, with a mean working experience of nearly fourteen years, whilst 44.0% have less than ten years of working experience.

Key Findings

The key findings of the study are as stated under the following subheadings:

Context of smallholder rice post-harvest value addition in rice post-harvest value addition

This section presents the findings on the rice post-harvest value addition context issues. The value addition resources extensively used by farmers include harvesting knives (100.0%), human labour and mortar and pestle (97.0%) and tarpaulin for drying (91.5%) among others. Other value addition resources not widely used by farmers include animal labour (oxen) (1.0%), power tiller to transport paddy (11.0%), threshing machine (14.2%), moisture content meter (12.8%), de-stoner (6.0%), specialised parboiling container (4.8%), dehusking or dehulling machine (2.5%) among others.

As for the resources by the AEAs, subject matter specialists (80.0%), value addition input suppliers (62.0%), value addition service providers (52%), mobility used by AEAs (60%), processing and storage facilities (66%) and meeting venues (56%) were inadequately available for the AEAs in the study areas. Some challenges AEAs are faced with include logistic, human, infrastructural, financial and contextual challenges such as limited knowledge of farmers on value addition skills and the very low use of post-harvest technologies by farmers in the study area.

Concerning value addition, farmers practise it to a very small extent. They undertake their traditional practices to a very great extent. The value addition practices which involve the use of moisture meter, de-stoner, sorting and grading machine, mechanical thresher, improved storage facility, packaging and combine harvester are all practised by smallholder farmers to a very small extent (Mean ≤1.45). The extent to which farmers practice value addition was investigated in rice post-harvest value addition. The findings show that 99.5% of the farmers practice timely harvesting of paddy to a moderate extent, 92.3% practice panicle selection with a knife and sun drying of paddy (90.8%) to a great extent. Very few farmers use a combine harvester (2.3%), mechanical thresher (6.0%), moisture meter to test moisture content (14.3%), destoning paddy (13.3%), sorting and grading processed rice (12.8%), weighing processed rice for packaging (3.3%) and use of ventilated and insect free storage facility (6.0%) to a very small extent. Specifically, at rice post-harvest value addition stages, more than half of the farmers (52.5%) do not receive any extension information.

With marketing, the majority of the farmers (81.5%) sell their rice after harvest in paddy and milled form and most of them (89.3%) generally have access to a ready market for their rice. More than 60% of the farmers do not receive good prices for their rice. This is certainly because 81.9% of the farmers do not package rice for sale and more than half (56%) reported that too many chaff and stones were found in their rice. These are the key complaints made by the buyers as reported by farmers.

More than three-fourths of the farmers (78.8%) generally reported access to extension services in rice production and nearly 70% receive extension services on either a monthly or bi-monthly basis. Less than half of the farmers (47.5%) affirmed receiving extension information on rice post-harvest technologies.

As for profit-making in rice post-harvest value addition by farmers, only 0.5% make more than Le12,000,000 in 2017, 2.5% in 2018, 4,1% in 2019 and 2.1% in 2020. Most of the farmers profited around Le3000000 or less which shows that smallholder farmers are not making a profit in rice farming when costs are placed on their rice production resources.

For the livelihood issues of the farmers, the majority of the respondents state a mean value of (1,2,3) which indicates that farmers strongly disagree, disagree, or moderately agree with the statement that rice post-harvest value addition has improved their livelihood status.

Competencies of smallholder rice farmers and AEAs in rice post-harvest value addition

The overall level of competence for the smallholder farmers was found to be moderately rated on the scale of (Mean=2.59, S.D=1.16) on a 5-point Likert scale. Even though farmers have moderate competencies in the entire value addition technologies, milling, packaging and marketing of rice are areas farmers have the least competencies. The findings also revealed that the AEAs have an overall moderate mean level (Mean=3.07, S.D.=0.66) in rice post-harvest value addition technologies. The AEAs also demonstrated their lowest competencies in the areas of packaging and marketing and parboiling of rice.

The independent variables show a significant relationship in the rice post-harvest value addition competencies of smallholder farmers by (R^2= 12.50%). The variables include labour, alternative livelihood, source of information and source of income. In the test of the hypothesis, a significant relationship exists between the competencies of smallholder farmers and their socio-demographic characteristics exists (p=0.000). As for the AEAs, the multiple linear regression shows that all the socio-economic (independent) variables among the socio-demographic characteristics used in the model were insignificant. A significant relationship exists between the competency of smallholder farmers and those of the AEAs in rice post-harvest value addition ($p<0.001$). Appreciable beta coefficients of 33.6% and 30.2% were observed for sources of labour and alternative livelihood respectively.

Training needs of smallholder farmers and AEAs in rice pos-harvest value addition

The prioritised and grouped training needs of the farmers include packaging and marketing of rice (MWDS=5.3997), milling (MWDS=5.1889), drying (MWDS=5.1297), winnowing (MWDS=4.6865) and harvesting (MWDS=4.6316). Rice post-harvest addition technologies where farmers expressed their least training needs are in threshing (MWDS=1.9421) and heaping of paddy after harvest (MWDS=1.6842). As compared with the farmers, the training needs of the AEAs include milling (MWDS=7.2769), packaging and marketing (MWDS=6.8672), parboiling (MWDS=4.9634), harvesting (MWDS=4.4945) and transporting paddy after harvest to the processing site (MWDS= 3.9594). Finally, rice post-harvest value addition technologies where AEAs required the least training are in the storage of rice (MWDS=2.8880) and threshing paddy (MWDS=1.7487).

Preferred extension training methods for smallholder farmers and AEAs in rice post-harvest value addition

Most of the farmers (48.0 - 93.3%) prefer group training methods followed by individual and mass methods in rice post-harvest value addition technologies. A substantial percentage of farmers, however, prefer either individual or group methods. The majority of the AEAs prefer group methods even though one-tenth prefer either individual or group methods.

Training model for smallholder rice-postharvest value addition

A proposed training model for training smallholder farmers and AEAs in Sierra Leone was developed. The need assessment study of the farming actors informed the development of the training model. The model was developed considering the rice post-harvest value addition context issues, competencies of the farming actors, training needs, prioritised training contents, the preferred training methods and training support in mind. The developed model is characteristic of the Sierra Leone situation for the farming actors in rice post-harvest value addition. The model presents the technology priority training areas and the required training methods for both smallholder farmers and the AEAs as revealed by the study.

Conclusions

The following conclusions are drawn from the key findings of the study:

Smallholder rice post-harvest value addition in the Southern Region of Sierra Leone can be characterised as male dominated with most of the farmers married and in their active working age bracket. They are largely illiterate, but have considerable work experience, generally with medium to large household sizes and are engaged in microbusinesses as an alternative livelihood. They mostly depend on family labour and self finance for their post-harvest value addition activities and AEAs for their extension information. Extension services in rice post-harvest value addition are provided mainly by mid-career male AEAs who are in their productive age bracket (30-49 years). Most of them hold diplomas or higher degrees, and are very experienced but lack the needed logistical support to perform their duties and are therefore demotivated.

1. The farmers use low-input value addition technologies which are locally available and affordable but little or none of the high input value addition technologies. High-external-input technologies, such as power tillers,

threshing machines, moisture meters, de-stoners, specialised parboiling containers and dehusking machines are used less by the farmers because they are too costly for the farmers and most often not available. As such, rice post-harvest value addition in the Southern Region of Sierra Leone is very low. The agricultural extension service in the Southern Region of Sierra Leone is characterised by few number of AEAs and limited resources including subject matter specialists, funding, transport and other support systems such as materials for demonstration, meeting venues, and storage facilities. Smallholder value-added rice in the Southern Region of Sierra Leone has a high market, but it is characterised by imperfect market conditions and low returns due to low-value addition. As such, the majority of the farmers are not realising the full benefits of post-harvest value addition and therefore, have divergent views on its contribution to improving their livelihoods.

2. Farmers and AEAs in the Southern Region of Sierra Leone have moderate competencies in undertaking rice post-harvest value addition. For farmers, the competence is more in the traditional technologies, than the modern technologies such as the use of planting calendar, moisture metre, combine harvesters, packaging and marketing and milling. Similarly, the AEAs have more competencies in the traditional technologies, than the high mechanisation and automation technologies in rice post-harvest value addition.
3. The main source of labour, alternative livelihood, the key source of information, and the main source of income highly predicted the competence of the smallholder farmers in RPHVA.

4. There is a significant correlation between smallholder farmers' competencies and AEAs in the study areas in rice post-harvest value addition.
5. Farmers in the Southern Region of Sierra Leone have varying training needs in the rice post-harvest value chain, but the priorities are in packaging and marketing, drying, winnowing, paddy harvesting, transportation, storage, parboiling, threshing and paddy drying technologies. Similarly, training needs for the AEAs in the Southern Region of Sierra Leone vary across the post-harvest value chain. However, the prioritised training needs are milling, packaging and marketing, parboiling, harvesting and drying.
6. Farmers and AEAs in general prefer group extension teaching methods in rice post-harvest value addition compared to individual and mass methods.
7. A dynamic extension training model based on the key findings of the study has been developed to provide a guide for the provision of need-based training in rice post-harvest value addition for farmers and AEAs in the Southern Region of Sierra Leone.

Recommendations

Based on the findings and conclusions from the study, the following recommendations are made.

1. MAFS and donor partners should work together to provide the needed resources for AEAs, including incentives to improve the morale of the AEAs and work effectiveness in rice post-harvest value addition in Sierra Leone. For the preceeding socio-demographic characteristcs of the farming actors;

a. MAFS should encourage gender equity that will bring in more female AEAs into extension work as this may inspire more female smallholder farmers into rice post-harvest value addition activities in Sierra Leone.

b. The government through MAFS should take advantage of the teeming active working population in rice post-harvest value addition activities in Sierra Leone and promote functional literacy to increase their ability to effectively use rice post-harvest value addition technologies.

c. The Ministry should collaborate with other development partners in Sierra Leone to provide value addition resources and support services for smallholder farmers. This will enhance their capacity in rice post-harvest value addition, profit maximization and livelihood enhancement.

2. MAFS and other development partners are to deliver training to the farming actors to reduce their competency gaps in their RPHVA training needs in Sierra Leone, especially in the areas of packaging and marketing of rice, milling, parboiling, and drying of paddy.

3. Training of the farming actors must take into consideration the preferred training methods (especially group methods) and contents (harvesting, heaping, transporting technologies among others) in RPHVA.

4. Smallholder Farmer Based Organisations (FBOs) should improve their activities and position themselves well to attract credits and other forms of

support from MAFS and other donors for their post-harvest value addition practices.

5. The Ministry and other extension service providers in the Southern Region of Sierra Leone should adopt the developed need-based training model to improve extension delivery and adoption of rice post-harvest value addition in the Southern Region of Sierra Leone.

Contribution of the Study to Knowledge

The study has helped in the identification of the prioritised training needs and the preferred training contents of the smallholder farmers and the AEAs in rice post-harvest value addition. Significantly, the study developed an agricultural extension training model, a context-specific and dynamic model which can be utilised to improve the capacity of smallholder farmers and AEAs in rice post-harvest value addition in the Southern Region of Sierra Leone.

Areas for Further Research

The following areas are recommended for future research:

1. This study focused only on the Southern Region of Sierra Leone. The study should therefore be replicated in the other remaining four (4) regions in the country to validate the extension training model for a possible generalisation.
2. From the study limitations,
    a. Future studies should endeavour to incorporate the contributions of the totality of the key informants of the Ministry to provide first-hand information on the opportunities and challenges of the ministry.

b. The ministry, through the Planning, Evaluation, Monitoring and Statistics Division (PEMSD) must generate a current database of all its smallholder farmers and AEAs for policy-making and use by prospective researchers.

c. Future research should exclusively target farming actors in other parts of the country with multiple sources of income to ascertain how their access will affect their level of competence in RPHVA.

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APPENDICES

Appendix A: Structured Interview Schedule for Smallholder Rice Farmers

Department of Agricultural Economics and Extension
(Sasakawa Centre)
School of Agriculture
College of Agriculture and Natural Sciences
University of Cape Coast, Ghana, West Africa
2020/2021 Academic Year

"*An Extension Training Model for Improving Capacity of Smallholder Farmers and AEAs in Rice Post-harvest Value Addition in Southern Region, Sierra Leone*".

Introduction and Consent Form

Hello, my name is Philip J. Kamanda, a PhD candidate of the above institution researching on the above topic. This survey is to access first-hand information on the development of an extension training model for improving the capacity of smallholder farmers and AEAs in rice post-harvest value addition in the Southern Region of Sierra Leone. Your participation in this study requires that you complete some survey items. The exercise is a major course requirement for the award of a Doctorate degree pursued by the researcher. It will take up to 45-60 minutes to complete the interview. The information you are to provide will be treated with the utmost confidentiality to achieve the aim of this study. I hope the results of this study will benefit both smallholder farmers and AEAs in this community and beyond. Besides, I do trust that the results will be beneficial to tertiary institutions, agricultural extension policymakers, and researchers to address rice post-harvest value addition issues in this country. Would you be therefore interested to hear more about this research and to possibly participate in it? If the respondent says **"Yes",** the enumerator will please proceed. Nonetheless, if he/she says **"No",** please thank him/her and move on to another respondent.

Principal Investigator: Philip J. Kamanda – philip.kamanda@ucc.stu.edu.gh
Principal Supervisor: Prof. Ernest L. Okorley – eokorley1@ucc.edu.gh
Co-Supervisor: Dr. Albert Obeng Mensah – aobeng.mensah@ucc.edu.gh
Name of respondent:……………………………………**Phone No:**……………………....

Managing the Interview						
Date and Time			District *Code* *1,2,3,4*	Chiefdom name	Section name *1-n*	Serial No. of Instru-ment
Date: *(DD/MM/YY)*	**Start Time:** *(HH:MM)*	**End Time:** *(HH:MM)*	1. Bo 2. Bonthe 3. Moyamba 4. Pujehun	Indicate name of chiefdom below.	Indicate name of section below.	001-400

SECTION A: Personal Information on Respondents
Instruction: Please tick [√] or complete the blank spaces provided where necessary in response to the questions or statements below.
Demographic characteristics
1.Sex of respondent: 1=Male [ ], 2=Female [ ]
2. Age at last birthday: …………years
3. Marital status: 1=Married [ ], 2=Single [ ], 3=Co-habitation [ ], 4=Divorced [ ], 5=Widowed [ ]
4. Religion: 1=Christianity [ ], 2=Muslim [ ], 3=Traditionalist [ ], 4=Others [ ]
5. Type of education: 1=Formal [ ], 2=Non-formal [ ], 3=Informal education [ ]
6. Level of formal education completed: 1=Primary [ ] 2=JSS [ ], 3=SSS [ ],
7. Technical/Vocational [ ], 5=Tertiary [ ], 6=Islamic education [ ]
8. Household size: ………. [males =………; females = …………]
9. What is your position in the household? 1=Household head [ ], 2=Spouse of household head [ ], 3=Member of household [ ]
b. Socio-economic characteristics
Please indicate the type of rice variety you grow1=Improved [ ], 2=Local [ ], 3=Both [ ].
10. what is your main source of farm labour? 1= family labour [ ] , 2. = hired labour [ ], 3=Rotatory labour [ ], 4=Others (specify)……………………
11. What kinds of task do your farm labour perform for you? a…………. b…………. c………….d………….e…………f………………
12. How many of your household members are used as farm labour?..................
13. Do you have any physically challenged farm labour? 1=No [ ], 2=Yes [ ]
14. If yes, how many of them are challenged/disabled?...........persons
15. State the type of challenge/disability……………………..
16. In your estimation, what percentage of the total rice post-harvest value addition activity is performed by your farmhands/labour?..................%?
17. In which main ecology do you farm? 1=Upland [ ], 2=Inland valley swamp (IVS) [ ], 3=Boli land [ ], 4=Mangrove [ ]
18. Is your farmland; a) developed? 1=Yes [ ], 2=No [ ], b) stumped? 1=Yes [ ], 2=No [ ]
19. What type of land ownership do you work on? 1=Personal land [ ], 2=Family land [ ], 3=Rented land [ ], 4=Leased land [ ]
20. How long have you been farming?...................years

21.	Are you a member of a farmer-based organization? 1=Yes [ ], 2=No [
22.	What is your key source of reliable information on rice post-harvest value
	addition and marketing? 1=Extension agent [ ], 2=Local mass media [
	3=Colleague farmers [ ], 4=Traders/marketers [ ], 5=Service providers [ ],

25. Do you have access to credit? 1=No [ ], 2=Yes [ ]
26. If yes, which main type of credit do you receive? 1=Cash [ ], 2=In kind [ ], 3=Both [ ]
27. What is your primary occupation? ……………………..
28. What is your main source of income? 1=Farming [ ], 2=Employment [ ], 3=Commerce [ ], 4=Family remittance [ ].
29. What other livelihoods/entrepreneurial activity are you involved in? 1=Formal employment [ ], 2=Micro business, [ ] 3=Cottage industry.

SECTION B: Context of the smallholder rice post-harvest value addition
Resourcing
Tick Yes or No to indicate whether or not these resources are 1) available in your community, 2) accessible when you need them, 3) can be afforded by you, and 4) if you are using them to add value to your rice at post-harvest stages.

	Type of resource	Availability		Accessibility		Affordability		Usage	
		No	Yes	No	Yes	No	Yes	No	Yes
1	Harvesting knife	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
2	Handheld sickle	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
3	Human labour to transport paddy from the field to the processing centre after harvest	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
4	Animal labour to transport paddy from the field to the processing centre after harvest	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
5	Power tiller to transport paddy from the field to the processing centre after Harvest	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
6	Threshing machine	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
7	Moisture content meter	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
8	De-stoner	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
9	Mat for drying	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
10	Tarpaulin for drying	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
11	Concrete drying floor	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
12	Big parboiling pot	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
13	Specialised parboiling container	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
14	Mortar and pestle	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
15	Dehusking or dehulling machine	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
16	Milling machine	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
17	Round/oval shape-weaved bamboo-strip manual winnower	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
18	Oscillating sieves and aspirators (mechanical winnower)	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
19	Grading/sorting of rice grains machine	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
20	Platform type of rice weighing scale	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
21	Hanging type of rice weighing scale	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
22	Packaging and labelling materials	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
23	Empty rice bag for rice storage	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
24	Baskets to store rice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

25	Wooden boxes to store rice	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
26	Wooden racks to stack rice 20cm above floor level	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
27	Transport to markets	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
28	Financial support	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
29	Post-harvest value addition input suppliers	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
30	AEAs	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

Value addition

31. Do you undertake the following rice post-harvest value addition activities? 1=Yes [ ], 2=No [ ]. If yes, to what extent? (1=To a small extent, 2=To some extent, 3=To a moderate extent, 4=To a great extent, 5=To a very great extent).

	Item	No	Yes	Extent				
				1	2	3	4	5
a	Timely harvesting of paddy	[	[ ]					
b	Harvesting paddy by panicle selection with knife	[	[ ]					
c	Harvesting paddy with a combine harvester	[	[ ]					
d	Threshing paddy with mechanical thresher	[	[ ]					
e	Use of moisture meter to determine moisture content in the paddy	[	[ ]					
f	Sun drying of paddy on tarpaulin/plastic sheet	[ ]	[ ]					
g	Sun drying of paddy on a cemented floor	[	[ ]					
h	Sun drying of paddy on a raised platform	[	[ ]					
i	De-stoning paddy	[	[ ]					
j	Parboiling paddy	[	[ ]					
k	Milling/processing paddy	[	[ ]					
l	Sorting and grading processed rice	[	[ ]					
m	Weighing processed rice for packaging	[	[ ]					
n	Packaging and labelling processed rice	[	[ ]					
o	Use of ventilated and insect free storage facility	[	[ ]					

Marketing	
32.	Do you sell your rice after harvest? 1=No [ ], 2=Yes [ ]
33.	If yes, in which form do you sell? 1=Paddy [ ], 2=Milled [ ], 3=Both [ ]
34.	Do you have a ready market for your rice? 1=No [ ], 2=Yes [ ]
35.	If Yes, at which level? 1=Farm gate [ ], 2=Local/Periodic Market
	("Lummur") [ ], 3=Big towns/cities [ ], 4=Barter system [ ]
36.	Are good prices offered for your rice? 1=No [ ], 2=Yes [ ]

37. What is the shortest distance to the nearest market? …………(km)

38. What quality of milled rice do customers want? (Please, list) a)……………………………b)…………………………c)……… d)………………….……..

39. Would your customers pay a higher price for the quality of rice they want? 1=Yes [ ], 2=No [ ]

40.	Do you package your rice for sales? 1=No [ ], 2=Yes [ ]
41.	If yes, which form of packaging do customers prefer?.................................

42.	Do you have some complaints from buyers of your rice? 1=No [ ], 2=Yes [ ]

43. If yes, list them. a)……………………….b)……………………….c) d)……………….……..
44. If yes to question 43 above, what have you done or intend to do about each of the complaints?...
45. What challenges do you face with the marketing of your rice? a)……….. b)…………… c)………
46. Is there a low transportation cost of rice to the markets? 1=No [ ], 2=Yes [ ]
47. Are there minimum market charges/dues for sales and storage of rice? 1=No[ ], 2=Yes [ ]
48. Are there improved marketing facilities (storage, and other public services)? 1=No [ ], 2=Yes [ ]
49. Are there multiple and diverse marketing channels to avoid poor sales of rice /disappointment? 1=No [ ], 2=Yes [ ]
50. Do you have a unique niche/link in the chain difficult to imitate by other farmers (e.g. method of parboiling, drying, grain size, etc.) 1=No [ ], 2= Yes [ ]

Extension services

51. Do you have regular access to extension services in your rice production? 1=No [ ], 2=Yes [ ]
52. If yes, how often? 1=Monthly [ ], 2=Bi-monthly [ ], 3=Quarterly [ ], 4=Half-yearly [ ], 6=Rarely [ ].
53. Do you receive extension information on rice at post-harvest stages? 1 =No [ ], 2=Yes [ ]
54. If yeas to Q 54, which areas of rice post-harvest value addition activities do AEAs provide services?) a)……………b)……………….c)…………….d)…………….e)………….
55. Which extension method(s) do AEAs use when they visit you?...........
56. What time of the day do the AEAs normally visit you?...............
57. When is your preferred timing for receiving extension training in rice post-harvest value addition activities ***(give multiple responses)****?* 1=Prior to harvesting rice [ ], 2=During harvesting time [ ], 3=Early in the morning before going to the farm, 4=Late in the evening when we farmers return from our farms [ ], 5=On farm [ ]
58. Please indicate whether or not you have received extension training in the following areas of rice value addition in the past 4 years.

	Item	**No**	**Yes**
a	Timely harvesting of paddy	[ ]	[ ]
b	Harvesting paddy with sickle	[ ]	[ ]
c	Harvesting paddy with a combine harvester	[ ]	[ ]
d	Harvesting non-weed-infested rice straws or panicles	[ ]	[ ]
e	Transportation of paddy using animal labour	[ ]	[ ]
f	Threshing paddy with mechanical thresher	[ ]	[ ]
g	Use of moisture meter to determine moisture content in the paddy	[ ]	[ ]
h	Drying paddy on a cemented floor	[ ]	[ ]
i	Drying paddy on a raised platform	[ ]	[ ]
j	De-stoning paddy	[ ]	[ ]
k	Improved parboiling of paddy	[ ]	[ ]
k	Dehulling and milling paddy by use of a machine	[ ]	[ ]
m	Sorting and grading processed rice by use of a machine	[ ]	[ ]
n	Weighing processed rice for packaging	[ ]	[ ]

o	Packaging and labelling rice for marketing	[ ]	[ ]
P	Meeting the quality and traceability standards of rice	[ ]	[ ]

59. Please indicate your rating by ticking [√] on a five-point scale (1= Strongly Disagree, 2=Disagree, 3=Fairly agree, 4=Agree, 5=Strongly Agree) the overall quality of extension services offered for rice post-harvest value addition stages.

Quality	**Statement**	**S.D.**	**D**	**U**	**A**	**SA**
		1	**2**	**3**	**4**	**5**
Relevance	Extension services for rice post-harvest value addition activities are relevant for farmers					
Availability	Extension services for rice post-harvest value addition activities are readily available for farmers					
Accessibility	Farmers have easy access to extension services in rice post-harvest value addition activities					
Affordability	Extension Services are easily affordable by farmers in rice post- harvest value addition					
Simplicity/ Flexibility	Extension promotes simple and flexible rice post-harvest value addition technologies for farmers					

Profitability of operations

60. Please kindly provide your average production areas, costs, and crop yields for the following cropping seasons (2017-2020) to determine a given trend.

	Item	**2017**	**2018**	**2019**	**2020**
a	What was the area of farmland (acres) you Cultivated/year?				
b	What was the estimated cost of land/year?				
c	What was the average cost (Le) of farm labour you used per year?				
d	What was the cost (Le) of seed rice as input did you plant/year?				
e	What was the total cost (Le) of farm tools did you use/year?				
f	What was your total average yield (bushel)/year?				
g	How much of your yield (bushel) did you sell/year?				
h	What were your leftover yield (bushel) after marketing/year?				

Improving farmer livelihood

61. To what extent do you agree (1=Strongly Disagree, 2=Disagree, 3=Fairly agree, 4=Agree, 5=Strongly Agree and NI) that rice post-harvest value-addition have improved your livelihood outcomes based on the following livelihood items?

Definitions of rating scales of farmer livelihood

1=I totally and entirely do not accept	4=I do accept
2=I do not accept	5=I totally and entirely accept
3=I am not sure	

	Farmer livelihood items	**1**	**2**	**3**	**4**	**5**	**NI**
A	***Natural capital***						
a	Have increased yield per unit area						
b	Have increased income from the harvest						
c	Have increased access to extended farmlands						
d	Have increased access to livestock						
e	Have improved the fertility of my farmland						
B	***Physical capital***						
a	Own a rice harvesting machine						
b	Own a power tiller to transport harvested rice						
c	Own a rice thresher						
d	Own a rice miller						
e	Own a destoner						
f	Own a storage facility for my harvested rice						
g	Able to access the market to sell my processed rice						
h	Capable of educating my children						
i	Cable to pay for medical services						
j	Use bore-hole water well						
k	Access to good roads						
l	Ability to buy or hire a vehicle for use						
m	Ability to build or renovate a dwelling home						
C	***Human capital***						
a	Access to technical staff						
b	Access to non-technical staff						
c	Access to AEAs						
d	Competent in the use of farm machines						
e	Access to other sources of information						
D	***Financial capital***						
a	High level of income						
b	High level of savings						
c	Reduction in the level of debt						
d	Access to credit facilities						

SECTION C: Competencies of smallholder farmers

62. Post-harvest training needs of farmers in rice post-harvest value addition

Choose the appropriate item by ticking [√] on a five points scale your level of importance and current status of knowledge (awareness) and skill from the following competency areas using the ratings below:

Importance of the Knowledge		**Current competence**	
Ratings	**Importance**	Ratings	**Competence**
1	Unimportant	1	Incapable
2	Less important	2	Less capable
3	Moderately important	3	Moderately capable
4	Important	4	Capable
5	Very important	5	Highly capable

Definitions of rating scales for the importance of knowledge and skills (competence)
1=It is not useful
2=It is of less use
3=It is somehow useful
4=It is useful
5=It is very useful
Definitions of rating scales of your current competence
1=Cannot do it
2=Can barely do it
3=Can do it somehow
4=Can do it well
5=Can do it very well

	Knowledge and Skill in Rice Post-harvest Value Addition Technologies	**Importance of the Knowledge and Skill to You**					**Your Current Performance in the Knowledge and Skill**				
		1	2	3	4	5	1	2	3	4	5
A	**Technologies used to harvest paddy**										
a	Use of planting calendar to determine harvesting date										
b	Use of moisture meter to determine moisture content in paddy										
c	Harvesting paddy with a knife to select panicle										
d	Harvesting paddy with handheld sickles										
e	Harvesting paddy with a combine harvester										
f	Harvesting paddy by cutting straws 4-5cm above ground level										
B	**Technologies used by farmers to heap paddy**										
a	Use of coned heap style to pack paddy										
b	Heaping paddy on tarpaulin										
c	Heaping harvested paddy for not more than a day										

C	**Technologies used by farmers to transport paddy**										
a	Use of bags to transport by humans										
b	Use of baskets to transport by humans										
c	Use of power tiller										
D	**Technologies used by farmers to thresh paddy**										
a	Whipping paddy straws on the floor with sticks to remove grains										
	Knowledge and Skill in Rice Post-harvest Value Addition **Technologies**	**Importance of the Knowledge and Skill to You**					**Your Current Performance in the Knowledge and Skill**				
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
b	Beating paddy straws in bags to remove grains from panicles										
c	Use of threshing machine										
d	Threshing paddy with feet on a mud floor										
e	Threshing paddy with feet on concrete/drying floor										
f	Threshing paddy with feet on tarpaulin										
g	Threshing paddy the very day it is harvested										
h	Drying wet paddy before it is threshed										
E	**Technologies used by farmers to winnow paddy**										
a	Use of round/oval shape-weaved bamboo-strip manual Winnower										
b	Use of oscillating sieves and aspirators (mechanical winnower)										

F	**Technologies used by farmers to parboil paddy**										
a	Use of specialised parboiling container										
b	Use of rice separator/net to sieve broken grains from paddy										
c	Removal of chaffs on paddy before soaking it										
d	Removal of unfilled/empty grains										
e	Washing paddy twice with clean water										
f	Soaking paddy for about 18 hours in warm water										
g	Use of jute bags to cover container during steaming										
h	Steaming paddy for about 30-40 minutes										
F	**Technologies used by farmers to dry paddy**										
a	Use of tarpaulin/plastic sheet to dry paddy										
b	Use of concrete/drying floor to dry paddy										
c	Use of mechanical dryer to dry paddy										
d	Use of shed with fire underneath to dry paddy										
e	Mechanical dryer										
f	Solar energy to dry paddy by occasionally stirring it to dry										
g	Use of moisture meter to test for moisture content in the paddy										
G	**Technologies used by farmers to mill paddy**										
a	Use of a machine to remove unfilled grains										
b	Use of a dehusking or dehulling machine to dehusk rice										
c	Use of mechanical miller to mill rice										
d	Use of rice separator to grade broken rice										
e	Use of de-stoner to remove stones/pebbles from rice										
	Technologies used by farmers in rice storage										
a	Stack bags of rice 20cm above the floor on wooden racks										
b	Use of sacks/jute bags to store rice										

c	Cleaning storehouse three weeks before the arrival of fresh harvest										
d	Checking moisture content of store by using a moisture meter										
e	Use of rice barns										
f	Use of containers (wooden box, drums/kegs, etc.)										
g	Keep moisture content of grains at or below 14%wb										
	Technologies used by farmers to package and market rice										
a	Weighing paddy on weighing scale to determine the selling weight										
b	Weighing rice on weighing scale to determine selling weight										
c	Packing rice at 8-13% moisture content										
d	Use of laminated and zipped bags to package rice										
e	Use labels/tags for traceability/identification of rice types and quality										
f	Use of phone to facilitate marketing negotiations										
g	Use groups to market rice										

Section D: Extension educational methods

63. Please state your most suitable extension teaching method, AEAs are to use to train you in the following rice post-harvest value addition activities.

Knowledge and Skill in Rice Post-harvest Value Addition Technologies		The Most Preferred Extension Teaching Method
A	**Technologies used to harvest paddy**	
a	Use of planting calendar to determine	
	harvesting date	
b	Determining moisture content in paddy	
	in the field by using a moisture meter	
c	Harvesting paddy with a knife to select	
	panicles only	
d	Harvesting paddy with handheld sickles	
e	Harvesting paddy with combine harvester	
f	Harvesting paddy by cutting straws 4-	
	5cm above ground level	
B	**Technologies used by farmers to heappaddy**	
a	Use of coned heap style to pack paddy	
b	Heaping paddy on tarpaulin	
c	Heaping harvested paddy for not morethan a day	
C	**Technologies used by farmers to transport paddy**	
a	Use of bags to transport by humans	

b	Use of baskets to transport by humans	
c	Use of power tiller	
D	**Technologies used by farmers to thresh paddy**	
a	Use of threshing machine	
b	Threshing paddy with feet on	
	concrete/drying floor	
c	Threshing paddy with feet on tarpaulin	
d	Drying wet paddy before it is threshed	
E	**Technologies used by farmers to**	
	winnow paddy	
a	Use of oscillating sieves and aspirators	
	(mechanical winnower)	
F	**Technologies used by farmers to**	
	parboil paddy	
a	Use of specialised parboiling container	
b	Use of rice separator/net to sieve broken	
	grains from paddy	
c	Removal of chaffs on paddy before soaking it	
d	Removal of unfilled/empty grains	
e	Washing paddy twice with clean water	
f	Soaking paddy for about 18 hours in warm water	
g	Use of jute bags to cover the container during steaming	
h	Steaming paddy for about 30-40 minutes	
F	**Technologies used by farmers to dry paddy**	
a	Use of tarpaulin/plastic sheet to dry paddy	
b	Use of concrete/drying floor to dry paddy	
c	Use of mechanical dryer to dry paddy	
d	Use of shed with fire underneath to dry	
	paddy	
e	Mechanical dryer	
f	Solar energy to dry paddy by occasionally stirring it to dry	
g	Use of moisture meter to test for moisture content in the paddy	
G	**Technologies used by farmers to mill paddy**	
a	Use of a machine to remove unfilled grains	
b	Use of dehusking or dehulling machine to dehusk rice	
c	Use of mechanical miller to mill rice	
d	Use of rice separator to grade broken	

	Rice	
e	Use of de-stoner to remove stones/ pebbles from rice	
H	**Technologies used by farmers in rice storage**	
a	Stack bags of rice 20cm above the floor on wooden racks	
b	Keep moisture content of grains at or below 14%w.b.	
c	Cleaning storehouse three weeks before the arrival of fresh harvest	
d	Checking moisture content of store by using moisture meter	
e	Use of sacks/jute bags to store rice	
f	Use of rice barns	
g	Use of containers (wooden box, drums/kegs etc.)	
I	**Technologies used by farmers to package and market rice**	
a	Weighing paddy on weighing scale to determine selling weight	
c	Weighing rice on weighing scale to determine selling weight	
d	Packing rice at 8-13% moisture content	
e	Use of laminated and zipped bags to package rice	
f	Use labels/tags for traceability /identification of rice types and quality	
g	Use of phone to facilitate marketing negotiations	
h	Use of groups to market rice	

Thank you very much for your generous offer of time

Appendix B: Questionnaire for AEAs
Department of Agricultural Economics and Extension
(Sasakawa Centre)
School of Agriculture
College of Agriculture and Natural Sciences
University of Cape Coast, Ghana, West Africa
2020/2021 Academic Year
Research Topic

"*An Extension Training Model for Improving Capacity of Smallholder Farmers and AEAs in Rice Post-Harvest Value Addition in Southern Region, Sierra Leone*".

Introduction and Consent Form

Hello, my name is Philip J. Kamanda, a PhD candidate of the above institution researching on the above topic. This survey is to access first-hand information on the development of an extension training model for improving the capacity of smallholder farmers and AEAs in rice post-harvest value addition in the Southern Region of Sierra Leone. Your participation in this study requires that you complete some survey items. The exercise is a major course requirement for the award of a Doctorate degree pursued by the researcher. It will take up to 45-60 minutes to complete the interview. The information you are to provide will be treated with the utmost confidentiality to achieve the aim of this study. I hope the results of this study will benefit both smallholder farmers and AEAs in this community and beyond. Besides, I do trust that the results will be beneficial to tertiary institutions, agricultural extension policymakers, and researchers to address rice post-harvest value addition issues in this country. Would you be therefore interested to hear more about this research and to possibly participate in it? If the respondent says **"Yes",** the enumerator will please proceed. Nonetheless, if he/she says **"No",** please thank him/her and move on to another respondent.

Principal Investigator: Philip J. Kamanda – philip.kamanda@ucc.stu.edu.gh
Principal Supervisor: Prof. Ernest L. Okorley – eokorley1@ucc.edu.gh
Co-Supervisor: Dr. Albert Obeng Mensah – aobeng.mensah@ucc.edu.gh
Name of respondent:……………….………………….**Phone No:**……………….....

Managing the Interview						
Date and Time			District *Code* *1,2,3,4*	Chiefdom name	Section name *1-n*	Serial No. of Instru-ment
Date: *(DD/MM/YY)*	**Start Time:** *(HH:MM)*	**End Time:** *(HH:MM)*	1. Bo 2. Bonthe 3. Moyamba 4. Pujehun	Indicate name of chiefdom below.	Indicate name of section below.	01-50

SECTION A: Personal Information on Respondents
Instruction: Please tick [√] or complete the blank spaces provided where necessary in response to the questions or statements below.

Demographic characteristics

a. Sex of respondent: 1=Male [ ], 2=Female [ ]
b. Marital status: 1=Married [ ], 2=Single [ ], 3=Co-habitation [ ], 4=Divorced [ ], 5=Widowed [ ]
2. Religion: 1=Christianity [ ], 2=Muslim [ ], 3=Traditionalist [ ], 4=Others
3. Age at last birthday: …………years
4. Highest Educational level: 1=Certificate [ ], 2=Diploma [ ], 3=BSc/BA/BEd. [ ] 4=PGD [ ], 5=MSc/MA/MEd [ ]

Socio-economic characteristics

4. How long have you been working as an extension agent?.............years
5. How many post-university capacity building trainings in rice value addition have you received?..
6. What is your most reliable source of rice post-harvest activities and marketing information?
1=Attending special agricultural training courses [ ], 2=Local radio and TV programmes [ ], 3=Reading agricultural bulletins and books [ ], 4=Dialogue with knowledgeable agricultural colleagues [ ], 5=Agricultural universities/colleges, agricultural research institutes [ ], 6=Media document on CD format [ ]
7. List at least three key motivations you enjoy in your work as AEAs
a……………………………………………………………………………..
b……………………………………………………………………………..
c……………………………………………………………………………..
8.List at least five key general challenges you experience as AEAs in carrying out rice value addition activities
a……………………………………………………………………………..
b……………………………………………………………………………..
c……………………………………………………………………………..
d…………………………………………………………………………….
e……………………………………………………………………………..
9. What is the farthest distance to your operational area? …………(km)

SECTION B: Context of the smallholder rice post-harvest value addition.
13. Resourcing
Please tick to indicate the level of adequacy of the following resources you use to help farmers add value to their rice at post-harvest stages

	Type of resource	Level of Adequacy		
		Unavailable	Inadequate	Adequate
A	**Human Resource**			
a	Value addition Subject Matter Specialists	[ ]	[ ]	[ ]
b	Post-harvest value addition input suppliers	[ ]	[ ]	[ ]
c	Post-harvest value addition input suppliers	[ ]	[ ]	[ ]

B	**Materials/EquipmentForvalue Addition**			
a	Monetary/financial resources	[ ]	[ ]	[ ]
b	Mobility for use by AEAs	[ ]	[ ]	[ ]
	Processing and Storage facilities	[ ]	[ ]	[ ]
c	Computers and accessories	[ ]	[ ]	[ ]
d	Photocopier	[ ]	[ ]	[ ]
e	Stationery	[ ]	[ ]	[ ]
f	Projector	[ ]	[ ]	[ ]
g	Venue for meetings/workshops	[ ]	[ ]	[ ]
h	Office spaces	[ ]	[ ]	[ ]
i	Audio-Visual Aids	[ ]	[ ]	[ ]
j	Print and non-print materials	[ ]	[ ]	[ ]
k	Transport for the rice to markets	[ ]	[ ]	[ ]
C	**New Technologies**			
a	Use of combine harvester	[ ]	[ ]	[ ]
b	Use of animal labour to transport paddy from the field after harvest	[ ]	[ ]	[ ]
c	Use of power tiller to transport paddy from the field after harvest	[ ]	[ ]	[ ]
d	Threshing machine	[ ]	[ ]	[ ]
e	Moisture content meter	[ ]	[ ]	[ ]
f	De-stoner	[ ]	[ ]	[ ]
g	Specialised parboiling container	[ ]	[ ]	[ ]
h	Dehusking or dehulling machine	[ ]	[ ]	[ ]
i	Milling machine	[ ]	[ ]	[ ]
j	Oscillating sieves and aspirators (mechanical winnower)	[ ]	[ ]	[ ]
k	Grading/sorting of rice grains Machine	[ ]	[ ]	[ ]
l	Weighing scale	[ ]	[ ]	[ ]
m	Packaging and labelling materials	[ ]	[ ]	[ ]

Extension services

11. Do you pay regular extension visits to farmers at rice post-harvest value addition stages? 1=Yes [ ], 2=No [ ]

12. If yes, how often? 1=Monthly [ ], 2=Bi-monthly [ ], 3=Quarterly [ ], 4=Half-yearly [ ], 6=Yearly [ ].

13. Which extension method do you use to visit farmers?..................

14. Which areas of rice post-harvest value addition activities do you provide as services for farmers? a)……………b)…………….c)…………..d)……….

15. When is your preferred timing to be trained in rice post-harvest value addition activities ***(give multiple responses)?*** 1=Prior to harvesting rice [ ], 2=During harvesting time [ ], 3=Early in the morning, 4=Late in the evening [ ], 5=On weekends [ ], 6=Others (Specify)……………

19. When is your preferred timing to train farmers in rice post-harvest value addition activities ***(give multiple responses)?*** 1=Prior to harvesting rice [ ], 2=During harvesting time [ ], 3=Early in the morning before farmers go to their farms, 4=Late in the evening when farmers return from their farms [ ], 5=On weekends [ ], 6=Others (Specify)……………

19. To what extent do you require extension training for the training of farmers (0=Not at all, 1=To a small extent, 2=To some extent, 3=To a moderate extent, 4=To a great extent, 5=To a very great extent) in the following rice post-harvest value-addition activities on a six points scale?

	Item	**0**	**1**	**2**	**3**	**4**	**5**
a	Timely harvesting of paddy						
b	Harvesting paddy with sickle						
c	Harvesting paddy with a combine harvester						
d	Harvesting non-weed-infested rice straws or Panicles						
e	Transportation of paddy using animal labour						
f	Threshing paddy with mechanical thresher						
g	Use of moisture meter to determine moisture Content						
h	Drying paddy on a cemented floor						
i	Drying paddy on tarpaulin						
j	De-stoning paddy						
k	Improved parboiling of paddy						
l	Milling paddy by huller/machine						
m	Sorting and grading processed rice						
n	Weighing processed rice for packaging						
o	Packaging and labelling rice						
p	Meeting the quality and traceability standards of rice						

SECTION C: Competencies

21. Post-harvest training needs of farmers in rice post-harvest value addition

Choose the appropriate item by ticking [√] on a five points scale your level of importance and current status of knowledge (awareness) and skill from the following competency areas using the ratings below:

Importance of the Knowledge		Current competence	
Ratings	**Importance**	**Ratings**	**Competence**
1	Unimportant	1	Incapable
2	Less important	2	Less capable
3	Moderately important	3	Moderately capable
4	Important	4	Capable
5	Very important	5	Highly capable

Definitions of rating scales for the importance of knowledge and skills (competence)

1=It is not useful
2=It is of less use
3=It is somehow useful
4=It is useful
5=It is very useful

Definitions of rating scales of your current compete

1=Cannot do it
2=Can barely do it
3=Can do it somehow
4=Can do it well
5=Can do it very well

Knowledge and Skill in Rice Post-harvest Value Addition Technologies		**Importance of the Knowledge and Skill to You**					**Your Current Performance in the Knowledge and Skill**				
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
A	**Technologies used to harvest paddy**										
a	Use of planting calendar to determine harvesting date										
b	Determining moisture content in paddy by using a moisture meter										
c	Harvesting paddy with a knife to select panicle										
d	Harvesting paddy with handheld sickles										
e	Harvesting paddy with a combine harvester										
f	Harvesting paddy by										

	cutting straws 4-5cm above ground level										
B	**Technologies used by farmers to heap Paddy**										
a	Use of coned heap style to pack paddy										
b	Heaping paddy on tarpaulin										
c	Heaping harvested paddy for not more than a day										
C	**Technologies used by farmers to transport Paddy**										
a	Use of bags to transport										
b	Use of baskets to transport										
c	Use of power tiller to transport										
		Importance of the Knowledge and Skill to You					**Your Current Performance in the Knowledge and Skill**				
D	**Technologies used by farmers to thresh paddy**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
a	Whipping paddy straws with sticks to remove grains										
b	Use of threshing machine										
c	Threshing paddy with feet on a mud floor										
d	Threshing paddy with feet on concrete/drying floor										
e	Threshing paddy with feet on tarpaulin										
f	Threshing paddy the very day it is harvested										
g	Drying wet paddy before it is threshed										
E	**Technologies used by farmers to parboil**										
	Paddy										
a	Use of specialised parboiling container										
b	Use of rice separator/net to sieve										

	broken grains from paddy										
c	Removal of chaffs on paddy before soaking it										
d	Removal of unfilled/empty grains										
e	Washing paddy twice with clean water										
f	Soaking paddy for about 18 hours in warm water										
g	Use of jute bags to cover container during steaming										
h	Steaming paddy for about 30-40 minutes										
		Importance of the Knowledge and Skill to You					**Your Current Performance in the Knowledge and Skill**				
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
F	**Technologies used by farmers to dry paddy**										
a	Use of tarpaulin to dry paddy										
b	Use of concrete/drying floor to dry paddy										
c	Use of mechanical dryer to dry paddy										
d	Use of shed with fire underneath to dry paddy										
e	Use of solar energy to dry paddy by occasionally stirring it to dry										
f	Use of moisture meter to test for moisture content in the paddy										
G	**Technologies used by farmers to mill paddy**										
a	Use of mechanical huller to mill paddy										
b	Use of rice separator to grade broken rice										
c	Use of de-stoner to remove stones/pebbles from rice										
d	Use of a machine to remove unfilled grains										
e	Use of mortar and pestle to mill paddy										
H	**Technologies used by farmers in rice storage**										
a	Stack bags of rice 20cm										

	above the floor on wooden racks										
b	Keep moisture content of grains at or below 14%w.b.										
		Importance of the Knowledge and Skill to You					Your Current Performance in the Knowledge and Skill				
c	Cleaning storehouse three weeks before the arrival of fresh harvest	1	2	3	4	5	1	2	3	4	5
d	Checking moisture content of store by using a moisture meter										
e	of sacks/jute bags to store rice										
f	Use of rice barns										
g	Use of containers (wooden box, drums/kegs, etc.)										
I	**Technologies used by farmers to package and market rice**										
a	Weighing paddy on a weighing scale to determine selling weight										
b	Weighing rice on a weighing scale to determine selling weight										
c	Packing rice at 8-13% moisture content										
d	Use of laminated and zipped bags to package rice										
e	Use of phone to facilitate marketing negotiations										
f	Use of groups to market rice										

22	**Professional Knowledge and Skill Needed to Promote Rice Post-harvest Value Addition Technologies**	**Importance of the Knowledge and Skill to You**					**Your Current Performance in the Knowledge and Skill**				
		1	2	3	4	5	1	2	3	4	5
	Knowledge										
1	Negotiation in rice marketing strategies										
2	Group Facilitation for rice value addition										
3	Technical knowhow to perform task										
4	Knowledge of the rural life of farmers										
5	Awareness about the existing extension policy										
6	Ability to conduct adult education in rice post-										

	harvest activities										
	Personal skills										
7	Ability to organise and plan extension programmes										
8	Capable to communicate extension ideas										
9	Ability to analyse and diagnose problems										
10	Leadership qualities										
11	Initiative skills and style										
	Personal qualities										
12	Commitment to work										
13	Reliability in his/her work and to farmers										
14	Humility to work and with farmers										
15	Confidence in his/her own ability to achieve										
	Public speaking ability										
16	Ability to prepare before hand										
17	Preparation of content to be spoken about										
18	Has a perfect method to deliver content										
19	Entertain questions, answers, and discussions										
20	Ability to write a report										
21	Ability to prepare before hand										

Section D: Extension educational methods

29. Please state your most preferred extension strategy for you to be trained in the following rice post-harvest value addition activities.

	Knowledge and Skill in Rice Post-harvest Value Addition Technologies	**The Most Preferred Extension Teaching Strategy**
A	**Technologies used to harvest paddy**	
a	Use of planting calendar to determine harvesting Date	
b	Determining moisture content in paddy by using a moisture meter	
c	Harvesting paddy with a knife to select panicle	

d	Harvesting paddy with handheld a sickle	
e	Harvesting paddy with a combine harvester	
f	Harvesting paddy by cutting straws 4-5cm above ground level	
B	**Technologies used by farmers to heap paddy**	
a	Use of coned heap style to pack paddy	
b	Heaping paddy on tarpaulin	
c	Heaping harvested paddy for not more than a day	
C	**Technologies used by farmers to transport paddy**	
a	Use of bags to transport	
b	Use of baskets to transport	
c	I use a power tiller	
D	**Technologies used by farmers to thresh paddy**	
b	Use threshing machine	
d	Threshing paddy with feet on concrete/drying floor	
e	Threshing paddy with feet on tarpaulin	
g	Drying wet paddy before it is threshed	
E	**Technologies used by farmers to parboil paddy**	
a	Use of specialised parboiling container	
b	Use of rice separator/net to sieve broken grains from Paddy	
c	Removal of chaffs on paddy before soaking it	
d	Removal of unfilled/empty grains	
e	Washing paddy twice with clean water	
f	Soaking paddy for about 18 hours in warm water	
g	Use of jute bags to cover container during steaming	
h	Steaming paddy for about 30-40 minutes	
F	**Technologies used by farmers to dry paddy**	
a	Use of tarpaulin to dry paddy	
b	Use of concreted drying floor to dry paddy	
c	Use of mechanical dryer to dry paddy	
d	Use of shed with fire underneath to dry paddy	

	Knowledge and Skill in Rice Post-harvest Value Addition Technologies	**The Most Preferred Extension Teaching Strategy**
f	Solar energy to dry paddy by occasionally stirring it to dry	
g	Use of moisture meter to test for moisture content in the paddy	
G	**Technologies used by farmers to mill paddy**	
a	Use pf mechanical huller to mill paddy	
b	Use of rice separator to grade broken rice	
c	Use of de-stoner to remove stones/pebbles from rice	
d	Use of a machine to remove unfilled grains	
e	Use of mortar and pestle to mill rice	

H	**Technologies used by farmers in rice storage**	
a	Stack bags of rice 20cm above the floor on wooden Racks	
b	Keep moisture content of grains at or below 14%w.b.	
c	Cleaning storehouse three weeks before the arrival of fresh harvest	
d	Checking moisture content of store by using moisture meter	
e	Use of sacks/jute bags to store rice	
f	Use of rice barns	
g	Use of containers (wooden box, drums/kegs etc.)	
I	**Technologies used by farmers to package and market rice**	
a	Weighing paddy on weighing scale to determine selling weight	
b	Weighing rice on weighing scale to determine selling weight	
c	Packing rice at 8-13% moisture content	
d	Use of laminated and zipped bags to package rice	
e	Use labels/tags for identification of rice types and Quality	
f	Use of phone to facilitate marketing negotiation	

Thank you very much for your generous offer of time

Appendix C:

In-depth Interview Guide for Senior MAFS Officials
Department of Agricultural Economics and Extension
(Sasakawa Centre)
School of Agriculture
College of Agriculture and Natural Sciences
University of Cape Coast, Ghana, West Africa

2020/2021 Academic Year

"An Extension Training Model for Improving Capacity of Smallholder Farmers and AEAs in Post-Harvest Value Addition in Southern Region, Sierra Leone".

Introduction and Consent Form
Hello, my name is Philip J. Kamanda, a PhD candidate of the above institution conducting research on the above topic. I would like to kindly have a 1-on-1engagement with you to talk about the role of MAFS in ensuring improvement in agricultural extension service delivery mechanism. Additionally, I would like to understand the role of the ministry in training farmers and AEAs in rice post-harvest value addition in Southern Sierra Leone, and how these trainings have impacted on rice production in the country. The exercise is a major course requirement for the award of a Doctorate degree by the researcher. It will take up to 45-60 minutes to complete the interview. The information you are to provide will be treated with the utmost confidentiality to achieve the aim of this study. The interview will be very brief, approximately one hour and I am seeking your consent for this session to be recorded with a voice recorder for easy access to references should I miss any part of your very valuable contributions while discussing and taking notes.
Do you have any questions concerning my submissions? …………………..
Are you therefore now willing to contribute to this interview?.....................

Name of respondent:…..……………………………….
Phone No…………………………………………………
Principal Investigator: Philip J. Kamanda – philip.kamanda@ucc.stu.edu.gh
Principal Supervisor: Prof. Ernest L. Okorley – eokorley1@ucc.edu.gh
Co-Supervisor: Dr. Albert Obeng Mensah – aobeng.mensah@ucc.edu.gh

1. Personal Information on Respondents
Instruction: Please provide responses where necessary to the options, questions and statements below.
(Demographic characteristics)
a. Position…………………………………..
b. Sex of respondent: 1=Male [ ], 2=Female [ ]
c. Age at last birthday: …………years

d. Highest Educational level: 1=Certificate/Diploma [ ], 2=Bachelor [ ] 3=PGD [ ], 4=Master [ ], 5=PhD [ ], 6=Others (Specify)……………….

2. Resourcing smallholder rice post-harvest value addition

a. What are the general key challenges AEAs are confronted with in effectively executing their job?
b. What specific rice value addition challenges both AEAs and farmers experience in rice production?
c. Which areas of resource does the ministry involves itself in resourcing AEAs and smallholder farmers?
d. Does the nation has the requisite infrastructural base to invest in rice value chain development? If yes, give instances.
e. Do you think this idea will soon lead this nation to food self-sufficiency? If yes, give an assurance as to how this can be achieved.
f. Does the ministry has any collabouration with other private sector extension partners or NGOs in helping farmers to get engrossed in rice post-harvest value addition?
g. Does the extension agent-farmer ratio satisfy the growing needs of smallholder farmers in rice value addition activities?

3. Competencies of AEAs

a. Are AEAs competent and equipped enough to provide training for smallholder farmers in rice value addition?
b. Does the ministry provide refresher or in-service training for AEAs based on their training needs?
c. If yes to 3b, please give instances, types of needs, and frequencies of training offered by the extension division.
d. Does the ministry organise training for farmers in rice post-harvest value addition?
e. Is there any partnership between the ministry and other tertiary institutions for staff capacity development? If any, please comment on some instances.
f. Is the ministry involved in conducting a needs assessment of smallholder farmers and AEAs for possible training in the country?
g. If yes to 3f, what were some of the gaps discovered and how has the ministry dealt with those gaps?

4. Training content development

a. Based on your knowledge and experience as a ministry stakeholder, please outline few content areas for the development of an extension training model in building the capacity of smallholder farmers and AEAs in rice post-harvest value addition in Sierra Leone.
b. When is it appropriate to train AEAs and smallholder farmers in rice post-harvest value addition activities?
c. Is there any additional fact you might like to share with me about this interview?

Thank you very much for sparing time from your busy schedule.

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/2016/951
YOUR REF:
OMB NO: 0990-0279
IORG #: IORG0009096

11TH MAY, 2021

Mr. Philip Jimia Kamanda
Department of Agricultural Economics & Extension
University of Cape Coast

Dear Mr. Kamanda,

ETHICAL CLEARANCE – ID (UCCIRB/CANS/2021/13)

The University of Cape Coast Institutional Review Board (UCCIRB) has granted Provisional Approval for the implementation of your research titled **An Extension Training Model for Improving Capacity of Smallholder Farmers and Extension Agents in Rice Post-Harvest Value Addition Activities in Southern Sierra Leone.**. This approval is valid from 11th May, 2021 to 12th May, 2022. 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

Appendix E:

List of Publications From This Study (PhD. Thesis)

Published Articles

1. Training Needs Assessment of Smallholder Farmers in Rice Post-Harvest Value Addition Technologies in the Southern Region of Sierra Leone. **Philip Jimia Kamanda***, Ernest Laryea Okorley and Masa Veronica Motaung. *Journal of Agricultural Extension and Rural Development.* Vol.14(2), pp. 79-89**.** Corresponding author: Philip J. Kamanda, E-mail: pjkamanda@njala.edu.sl / kama.pj06@gmail.com

2. Borich Needs Assessment Model for Assessing Rice Post-harvest Value Addition Training Needs of Agricultural Extension Agents, Southern Region, Sierra Leone. *International Journal of Agricultural Science, Research and Technology in Extension and Education Systems (IJASRT in EESs) 13*(1):45-54. **Philip Jimia Kamanda***, Ernest Laryea Okorley, Masa Veronicah Motaung Correspondence Author's Email: pjkamanda@njala.edu.sl / kama.pj06@gmail.com

Accepted Paper (Conference proceeding)

3. Status of rice post-harvest value addition by smallholder farmers in the Southern Region of Sierra Leone. **Kamanda, P.J***, Mensah, A. O., Motaung, M. V., & Akaba, S. *African Journal of Rural Development* Corresponding author: Philip J. Kamanda, E-mail: pjkamanda@njala.edu.sl / kama.pj06@gmail.com

Manuscript Under Review

4. Socio-demographic Characteristics of Smallholder Farmers That Influence Their Competence in Rice Post-Harvest Value Addition, Southern Region of Sierra Leone. **Philip Jimia Kamanda***, Masa Veronicah Motaung, Ernest Laryea Okorley. *Universal Journal of Agricultural Research* Correspondence Author's Email: pjkamanda@njala.edu.sl / kama.pj06@gmail.com

Appendix F:

Outputs from Tests of Hypotheses

Model	Sum of Squares	df	Mean Square	F	Sig.	Sum of Squares
4	Regression	15.930	4	3.982	14.125	.000
	Residual	111.372	395	.282		
	Total	127.302	399			

		Sum of Squares	df	Mean Square	F	Sig.
Sex of respondent	Between Groups	2.220	24	.092	.514	.946
	Within Groups	4.500	25	.180		
	Total	6.720	49			
Marital Status	Between Groups	6.167	24	.257	.464	.968
	Within Groups	13.833	25	.553		
	Total	20.000	49			
Age at last birthday in years	Between Groups	1402.247	24	58.427	.510	.948
	Within Groups	2865.833	25	114.633		
	Total	4268.080	49			
Highest educational level	Between Groups	20.653	24	.861	.890	.611
	Within Groups	24.167	25	.967		
	Total	44.820	49			
How long have you been working as an extension agent?	Between Groups	2449.667	24	102.069	.854	.649
	Within Groups	2986.333	25	119.453		
	Total	5436.000	49			
How many post university capacity building trainings on rice value chain addition have you received?	Between Groups	50.770	24	2.115	.547	.928
	Within Groups	96.750	25	3.870		
	Total	147.520	49			
What is your most reliable source of post-harvest and marketing information?	Between Groups	34.563	24	1.440	.644	.858
	Within Groups	55.917	25	2.237		
	Total	90.480	49			

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	
1	.260[a]	.068	.065	.54610	.068	28.869	1	398	.000
2	.306[b]	.094	.089	.53904	.026	11.485	1	397	.001
3	.338[c]	.114	.108	.53359	.020	9.161	1	396	.003
4	.354[d]	.125	.116	.53099	.011	4.877	1	395	.028

a. Predictors: (Constant), Labour1
b. Predictors: (Constant), Labour1, livelihood1
c. Predictors: (Constant), Labour1, livelihood1, Information1
d. Predictors: (Constant), Labour1, livelihood1, Information1, What is your main source of income?

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.609	1	8.609	28.869	.000[b]
	Residual	118.692	398	.298		
	Total	127.302	399			
2	Regression	11.946	2	5.973	20.557	.000[c]
	Residual	115.355	397	.291		
	Total	127.302	399			
3	Regression	14.555	3	4.852	17.040	.000[d]
	Residual	112.747	396	.285		
	Total	127.302	399			
4	Regression	15.930	4	3.982	14.125	.000[e]
	Residual	111.372	395	.282		
	Total	127.302	399			

a. Dependent Variable: Tot_Comp
b. Predictors: (Constant), Labour1
c. Predictors: (Constant), Labour1, livelihood1
d. Predictors: (Constant), Labour1, livelihood1, Information1
e. Predictors: (Constant), Labour1, livelihood1, Information1, What is your main source of income?

Coefficients[a]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B Lower Bound	Upper Bound	Collinearity Statistics Tolerance	VIF
1	(Constant)	2.393	.038		62.595	.000	2.318	2.468		
	Labour1	.293	.055	.260	5.373	.000	.186	.401	1.000	1.000
2	(Constant)	2.351	.040		59.174	.000	2.273	2.429		
	Labour1	.326	.055	.289	5.959	.000	.219	.434	.968	1.033
	livelihood1	.358	.106	.165	3.389	.001	.150	.566	.968	1.033
3	(Constant)	2.243	.053		42.113	.000	2.138	2.347		
	Labour1	.347	.055	.307	6.349	.000	.240	.454	.954	1.049
	livelihood1	.324	.105	.149	3.084	.002	.118	.531	.958	1.044
	Information1	.168	.055	.145	3.027	.003	.059	.277	.968	1.033
4	(Constant)	2.357	.074		31.817	.000	2.211	2.502		
	Labour1	.336	.055	.298	6.161	.000	.229	.444	.946	1.057
	livelihood1	.302	.105	.139	2.874	.004	.095	.509	.949	1.054
	Information1	.174	.055	.151	3.144	.002	.065	.282	.966	1.035
	What is your main source of income?	-.089	.040	-.105	-2.208	.028	-.168	-.010	.983	1.017

a. Dependent Variable: Tot_Comp

Best Predictors of smallholders and their socio-demographic characteristics

Model	Variables	B	S.E	t	Sig	R^2	Adj. R^2	R^2 Change	S.E.E	*F* Ratio
4	Constant	2.357	.074	31.817	.000	.125	.116	.011	.531	4.877
	Labour	.336	.055	6.161	.000					
	Livelihood	.302	.105	2.874	.004					

	Information	.174	.055	3.144	.002					
	Income	-.089	.040	-2.208	.028					

Variables	**Beta (Standardized)**	R^2	**Adj.** R^2	R^2 **Change**	**S.E.E**	**F Ratio**	**P. value**
(Constant)	2.393	.068	.065	.068	.54610	28.869	.000
Labour	.293						.000
(Constant)	2.351	.094	.089	.026	.53904	11.485	.000
Labour	.326						.000
Livelihood	.358						.001
(Constant)	2.243	.114	.108	.020	.53359	9.161	.000
Labour	.347						.000
Livelihood	.324						.002
Information	.168						.003
(Constant)	2.357	.125	.116	.011	.53099	4.877	.000
Labour	.336		.065	0.068			.000
Livelihood	.302		.089	0.026			.004
Information	.174		.108	0.020			.002
Income	-.089		.116	0.011			.028

Appendix G:
Certificate of editing/proofreading for academics

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DEPARTMENT OF COMMUNICATION STUDIES
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Cape Coast, GHANA

14th October, 2022

TO WHOM IT MAY CONCERN

CERTIFICATE OF EDITING/PROOFREADING FOR ACADEMICS

This is to certify that the PhD thesis "**An Extension Training Model for Improving Capacity of Smallholder Farmers and Agricultural Extension Agents in Rice Post-Harvest Value Addition in Southern Region, Sierra Leone**" has been thoroughly edited / proofread for clarity in spelling, punctuation, vocabulary and grammar.

Thank you.

Yours sincerely,

DEPT. OF COMMUNICATION STUDIES
UNIVERSITY OF CAPE COAST

SIGN...............................

Dr. Richard Torto
(COORDINATOR)