EFFECTS OF AGRICULTURAL EXTENSION SERVICE DELIVERY ON RICE PRODUCTIVITY AMONG SMALLHOLDER FARMERS IN LIBERIA: A CASE OF FOYA DISTRICT

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A DISSERTATION SUBMITTED TO THE FACULTY OF AGRICULTURAL SCIENCES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURE AND RURAL DEVELOPMENT OF UGANDA CHRISTIAN UNIVERSITY

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ABSTRACT

This study sought to assess the effects of agricultural extension service delivery on rice productivity among farmers in Liberia. A cross-sectional research design was employed to assess the effects of extension service delivery on rice productivity. Krejcie and Morgan's table was used to choose 352 smallholder farmers, and simple random sampling technique was adopted to select the respondents. Questionnaires, key informants interview guide and focus group discussion guide were used to collect primary data from stakeholders and farmers from seven villages of Foya District.

Major challenges, which affected service delivery were use of wrong communication channels, poor conditions of farm-to-market roads, limited education levels among farmers, and limited access to mobility and inadequate institutional support for extension workers.

Supporting the creation of farmers' cooperatives, improving farm-to-market roads, strengthening the capacity of extension workers through regular refresher training and the provision of extension tools/equipment including mobility were the major government strategies toward enhancing extension service delivery. Use of appropriate communication channels, provision of needs-based training programs for farmers and integration of local language were key strategies for extension workers. Recommended farmers' strategies included joining farmers' cooperatives by individual farmers, maintaining technical experts within farmers' cooperatives, and regular training of all farmers.

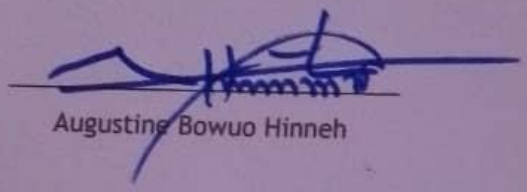
The study recommends that the government and partners should support the implementation of the above-mentioned strategies, which will increase extension services delivery that will increase rice productivity.

Key words: climate change, good agricultural practices, farmers' cooperatives, sustainable agriculture

DECLARATION

DECLARATION

I, Augustine Bowuo Hinneh, hereby declare that this thesis is my original work, not plagiarized, and has never been presented for any award of a degree in this or any other institution of learning. All the sources of materials used for the study have been duly acknowledged.



Augustine Bowuo Hinneh

APRIL 25, 2025

Date

DEDICATION

This work is dedicated to my two beautiful daughters, J. Bannie Hinneh and J. Gbene Hinneh for their love, patience, and commitment throughout my study, and to my beloved mother, Elizabeth Mah-dee Kumeh, and my late father, Captain Sakpeh Bloh Hinneh for being positive, supportive, and prayerful.

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APPROVAL

We the undersigned, declare that the dissertation by Mr. Augustine Bowuo Hinneh, titled "Effects of Agricultural Extension Service Delivery on Rice Productivity Among Smallholder Farmers in Liberia: A Case of Foya District", has been done under our guidance as university supervisors.

Barbara Mugwanya Zawedde, PhD. — Date: 26/04/2025

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GLOSSARY OF TERMS AND ACRONYMS

ACC ----------Agriculture Coordinating Committee

AEASs ----------Agricultural Extension and Advisory Services

AEWs ---------- Agriculture Extension Workers

AIIC ---------- Agriculture Infrastructure and Investment Company

ASRP ---------- Agricultural Sector Rehabilitation Project

CAC ---------- County Agriculture Coordinator

CRS ---------- Catholic Relief Services

CSA ---------- Climate Smart Agriculture

DAO ---------- District Agriculture Officers

FAO ---------- Food and Agriculture Organization

GAPs ---------- Good Agricultural Practices

GIZ ---------- Deutsche Gesellschaft fur Internationale Zusammenarbeit

GOL ---------- Government of Liberia

GTZ ---------- Deutsche Gesellschaft fur Technische Zusammenarbeit

IPM ---------- Integrated Pest Management

MOA ---------- Ministry of Agriculture

NGOs ---------- Non-Governmental Organizations

SAPEC ---------- Smallholders Agriculture Productivity Enhancement and Commercialization

SRI ---------- System of Rice Intensification

CHAPTER ONE:
INTRODUCTION

1.1. Background

Increasing agricultural productivity is critical for most countries' food security and economic development (Kumar *et al.*, 2018). Productivity is defined as the relationship between farm inputs and outputs over a given period (Fuglie, 2018). On the other hand, land productivity is measured by dividing the crop produced by the size of the planted land, expressed in an area unit in hectares or acres (Pells, 2018). Although increasing productivity is an integral part of attaining food security, it is challenged by poor agricultural activities reflected in a limited capacity to diminish climate change effects, limited financial support, poor agricultural infrastructure, low manpower, and poor coverage of extension activities. Other challenges include limited access to productive resources, including information, and poor sources of planting materials, among others, in many developing nations (Xin et al., 2021).

Due to low rice productivity, the gap between food demand and food production continues to widen as the global population grows (Kumar *et al.,* 2018). At least 700 million people are facing hunger, and about 2.4 billion women, children, and others in rural populations have little access to a balanced diet and sufficient food security throughout the year (Newing *et al.*, 2023 & Burki, 2022).

The African continent also bears the more significant burden of low rice productivity due to climate change, limited capacity to adopt resilience practices, and weak financial capacity, among other things. As a result, 20.2% of Africans are affected by hunger compared to 8.6% in Asia, 5.8% in Latin America and the Caribbean , 2.5% in North America, and 2.5% in Europe (FAO *et al.*, 2022)

The productivity of most agricultural commodities in Africa is also affected by weak agricultural extension service delivery (Osumba & Recha, 2021 & Danso-Abbeam *et al.*, 2018). For instance, Danso-Abbeam *et al.*, (2018) established that maize farmers who received extension services had a better output compared to those who did not receive any in Ghana. Additionally, a study conducted in South Africa shows that farm productivity is proportionally related to the quality of agricultural extension services provided (Camillone *et al.*, 2020). In Nigeria, a study that focused on the factors influencing rice productivity showed that extension service delivery played a critical role (Hinnou *et al.*, 2022).

Access to agricultural extension services means that farmers have face-to-face contact with the extension workers in the form of farmers' field school activities, field visits, and field demonstrations, among others. It also includes accessing information via radio, social media podia, and the use of the internet to support self-learning (Yusuf *et al.*, 2022; Hamma & Idrisa, 2022).

Several characteristics are attributed to an effective extension service delivery.These include knowledge and skills of extension officers, technical advice and information, and farmers' organization motivation among other skills in project management. Other skills include leading multidisciplinary teams, monitoring, evaluation, and impact assessment, participatory research methodologies; using gender and value chain approaches, integration of indigenous knowledge, among others (Gikunda *et al.*, 2021 & Nord *et al.*, 2022).

The Liberian government prioritizes agriculture because about 80% of the populace depends on the sector (Gobewole, 2020). Therefore, transformation in the agricultural sector has been one of the key areas of focus. Numerous

agricultural initiatives of considerable expenditure were launched to mend the sector. Consequently, to enhance productivity and increase farm income, the Agricultural Sector Rehabilitation Project (ASRP) was formed to repair agricultural roads, improve farmers' access to water, and postharvest facilities (FAO & ECOWAS Commission, 2018).

Knowing the importance of extension services in knowledge propagation and agrarian development, the Agricultural Extension and Advisory Services (AEAS) Policy was established to enable a decentralized, inclusive, and demand-driven extension system (Ministry of Agriculture, 2023). Extension services are delivered by the public sector, private sector, and NGOs, (Moore, 2017). Nevertheless, as Liberia tries to recover from the war, the existing extension system is yet to handle the problem of limited access to new knowledge and productive resources, which due to inadequate money and contending developmental urgencies. As a result, government is incapacitated to entirely fund the Liberian extension system. Thus, NGOs and private service providers are augmenting government efforts in this regard (Witinok-Huber *et al.*, 2021).

Small scale farmers, who make up at least 71% of total rice production, face partial access to better varieties, agrarian loan, functional markets, postharvest knowledge among others (Sumo *et al.*, 2023), which could lead to postharvest loses. Although rice production amplified sharply after the war from 110,000 MT in 2011, to 335,180 MT in 2016, the years following 2016 experienced a downward trend in rice production to 255,600 MT in 2021 (FAO, 2022). The crop yield has also been as low as 1.2 MT/ha compared to the would-be level of 4 MT/ha (FAO, 2019). This study seeks to assess the effects of agricultural extension service delivery on rice

productivity in Liberia.

1.1.1. **Problem Statement**

In Liberia, about 38.9% of the population is undernourished, and 45% of under-five deaths are attributed to poor dieting and an increase in the market prices for food commodities (Kumeh et al., 2020). Rice remains the principal food in Liberia, representing around half of the adult calorie consumption, 22% of agricultural GDP, and a per capita consumption of 133 kg (Saysay *et al*., 2018). Rice production is done by small scale growers on an average area of 1.6 hectares, primarily for consumption (Moore, 2017). Rice farmers obtain an average output of less than 2 MT/ha compared to the would-be level of 4 MT/ha (Saysay *et a*l., 2018).

Lofa County is among the country's top three food-producing counties; before the 14 years of the civil war, it was the number one food-producing county in Liberia (Broderick, 1989). Foya district is the most populated district of Lofa County (LISGIS, 2022). The low rice productivity has contributed to 47% of Liberian households being food insecure; in Lofa County, about 67% of households face food security challenges (WFP, 2022).

Low rice output is attributed to ecological constraints, climate change, limited access to quality planting materials, poor storage of planting materials, limited accessto labor, high cost of input materials, and weak extension system (Saysay et al., 2018). However, the Agricultural Extension and Advisory Services system is to provide technical support and knowledge about appropriate agronomic and post-harvest technologies. Despite the presence of extension workers, service delivery remains a challenge to address the farmers' constraints in the country (Moore, 2017). Besides, there is inadequate knowledge about the effects of agricultural extension services on productivity among smallholder rice farmers in

Liberia. Therefore, this study seeks to assess the effects of agricultural extension services and their implications on rice productivity among farmers in Lofa County in particular and in Liberia in general.

1.1.2. Overall Objective

To assess the effects of agricultural extension service delivery on rice productivity among farmers in Liberia.

1.1.3. Specific Objectives

1.1.3.1. To characterize agricultural extension services delivery to rice-producing farmers in Foya District.

1.1.3.2. To assess the influence of the frequency, methods, and quality of extension service delivery on the adoption of improved rice production practices and yields

1.1.3.3. To identify strategies for improving agricultural extension service delivery to enhance rice productivity among smallholder farmers in Foya district

1.2. Research Questions

1.2.1. How are agricultural extension services delivered to rice-producing farmers in Foya district?

1.2.2. How do the frequency, methods, and quality of extension service delivery influence the adoption of improved rice production practices and rice yields among smallholder farmers in Foya district?

1.2.3. What strategies can be adopted to improve agricultural extension service delivery for increased rice productivity among smallholder farmers in Foya district?

1.3. Scope of the Study

This research was carried out in the Foya district of Lofa County, Liberia, in January- March 2024 period. Respondents were largely smallholder farmers involved in upland and lowland rice production, agriculture officials from the Ministry of Agriculture, county and district-level, and local authorities.

1.4. Justification

The provision of agriculture extension services is crucial in addressing low rice productivity; nevertheless, it is confronted with low manpower, limited financial support, poor coverage of service, poor infrastructure, and a top-bottom approach, among other things. Thus, it leads to poor farm output and subsequently contributes to food insecurity. Assessing the effects of agricultural extension service delivery on rice productivity among smallholder rice farmers will provide insights to determine its role in farm output, which is crucial in food security.

1.5. Significance of the study

The outcomes of this study will provide insights for improving agricultural extension service delivery for rice productivity and serve as a basis to guide policymakers and the government, especially the Ministry of Agriculture, to design appropriate strategies that will improve agricultural extension service delivery and rice productivity for smallholder farmers. This study will be a future reference for scholars and academicians who are interested in research related to effective agricultural extension services delivery.

1.6. Theoretical and Conceptual Framework

1.6.1. Theoretical Framework

The study adopted the Participatory Extension Model, as proposed by Paulo Freire in 1968. It is a community-centered approach to agricultural and rural development (Roche et al., 2020). The Participatory Extension Model utilizes participatory tools and approaches to enable locals, especially farmers, to actively participate in decisions and processes that impact their lives. In contrast to conventional top-down approaches, it places a strong emphasis on learning by doing, which characterizes the presence of extension services (field demons and other farmers' field school activities) making perfect community involvement, and local knowledge.

This model is effective for developing and disseminating practices that require farmers' adaptation and ownership, such as climate-friendly farming techniques or water conservation, which are necessary for enhancing productivity. Additionally, it is an ideal tool for research involving smallholder farmers, who frequently feel excluded from government and partner support when it comes to obtaining basic extension services meant to increase adoption rates, address issues related to farmers, improve livelihoods through increased productivity, and leverage local knowledge.

1.6.2. Conceptual Framework

It illustrates the relationship between agricultural extension services delivery (Independent Variable) and rice productivity (dependent variable), with household head characteristics as intervening variables.

Several studies have shown how agricultural extension service delivery influences productivity. Agricultural technology and poverty reduction in Sub-Saharan Africa

are the subject of existing research (Lee et al., 2020). At the same time, knowledge and skill delivery may be a crucial component of farmers' ability to generate higher growth. According to Owens et al. (2003), agricultural extension involvement and farm productivity are positively correlated. With better extension worker to farmers ratio, which contributes to more extension workers on farms, training, and farmers' field school activities have had a positive effect on farm productivity in Kenya (Evenson & Mwabu, 2001). According to a prior study, extension consultations had a notably good impact on Zimbabwean agricultural productivity (Owens et al., 2003).

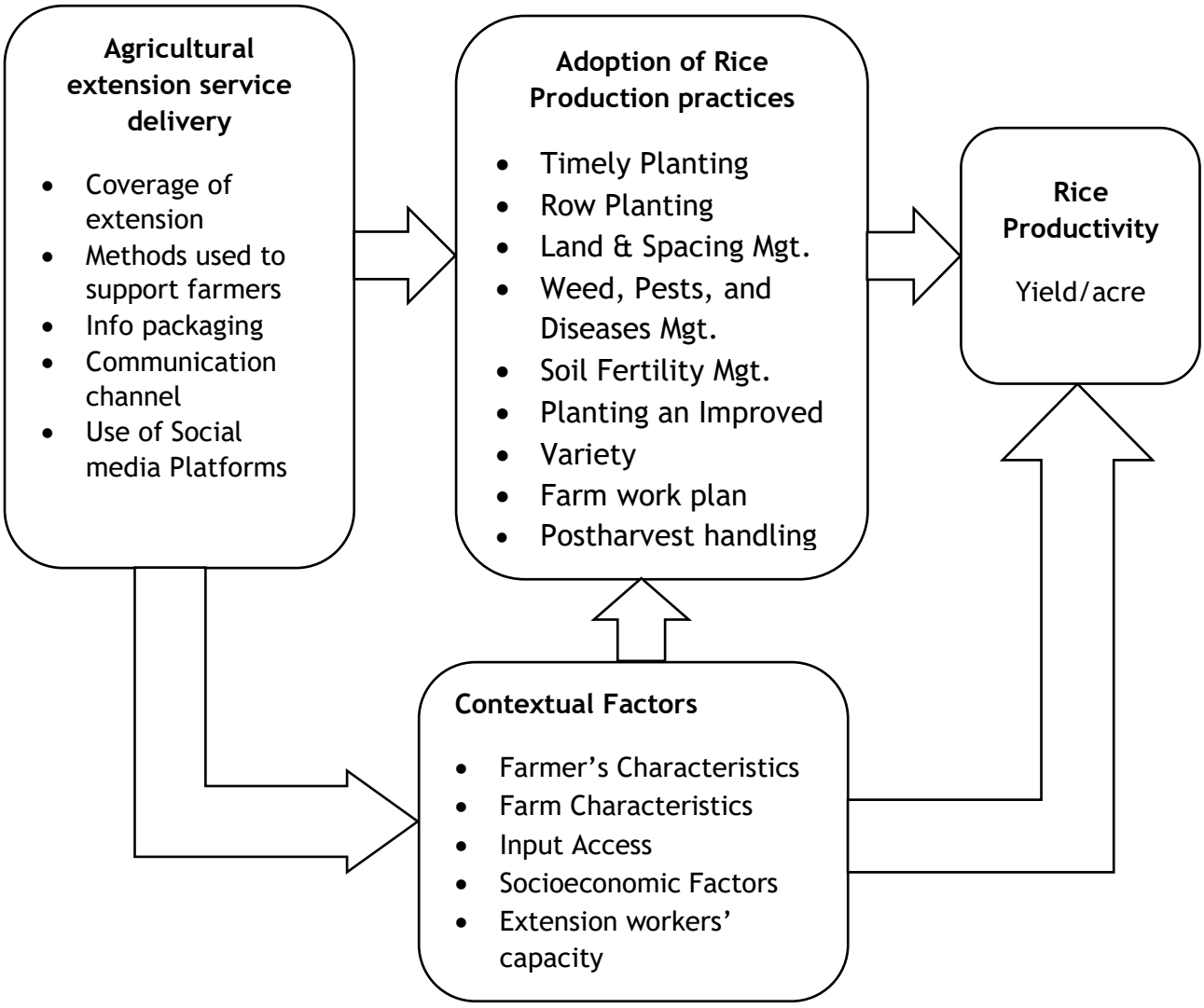

Figure 1: Conceptual Framework linking agricultural extension services delivery to rice productivity

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

In the past two decades, national and international food bodies have identified the gap between food production and consumption demand (Merugu *et al.*, 2021), and the strong desire to narrow the gap is rooted in effective agricultural extension services delivery (Abhijeet *et al.*, 2023). Many African countries have realized the importance of agricultural extension services, but the delivery of these services has been unsuccessful in meeting the demand of the agricultural sector (Msuya *et al.*, 2017). In Liberia, several extension-oriented programs have been developed to help improve service delivery. For instance, the Smallholders Agricultural Productivity Enhancement and Commercialization (SAPEC) Project was initiated in 2015, but service delivery is still ineffective (Moore, 2017).

2.2. Overview of agricultural extension services for rice productivity

In an agricultural-driven economy like Liberia, agricultural extension services play a major role in developing the agricultural sector (Danso-Abbeam *et al.*, 2018). The effects of climate change which contribute to low farm output have increased the demand for agricultural extension services. Therefore, knowing the status of the extension service is critical to understanding the sector (Danso-Abbeam *et al.*, 2018).

Globally, the public and private sector are significant actors in extension service delivery, where the private sector supports the public extension system. In developing nations, the extension system is challenged with inadequate technical skills, poor logistics, and limited support (Masambuka-Kanchewa *et al.*, 2020). In 2003, heads of African nations committed to allocating 10% of the annual budget towards agriculture, but this has not been implemented (Fontan *et al.*, 2019). As a

result, in Sub-Saharan Africa, the policies for extension services are not fully implemented due to low budgetary allocations towards the agricultural sector (Fontan et al., 2019).

For instance, in Nigeria the delivery of agricultural extension services is affected by structural and organizational challenges such as low manpower, limited technical skills, and poor logistic capacity (Davis *et al.*, 2019). According to Davis *et al.*(2019), there are 7,000 extension workers, with a ratio of 1 extension worker to between 5,000-10,000 farmers in Nigeria (1: 5,000-10,000). In Liberian, the ratio is 1:33,000 (Government of Liberia, 2023), coupled with challenges of low capacity, structural inefficiency, poor coverage due to logistical constraints, and poor farm-to-market roads, characterized the extension landscape. These challenges affect farmers' uptake of good agricultural practices and technologies (Moore, 2017a). Therefore, understanding the status of agricultural extension service delivery will inform how services to smallholder rice farmers can be improved.

2.3. Agricultural extension service delivery in Liberia

Agricultural extension service delivery has experienced several transitions over the years, from a solely public sector service provision, where services were delivered by public entities, to a more pluralistic service provision, where extension services are provided by both the public and private sector actors. The service providers use top-bottom approaches where development initiatives are implemented with little or no involvement of the end users, to bottom-top approach, where services delivery are based on the expressed needs of the farmers (Osumba & Recha, 2021).

The shift in agricultural practices has made it possible to increase food

production worldwide. However, like many countries in Africa, Liberia's agricultural extension service delivery has many traces of a top-bottom approach (Moore, 2017a); more than half of smallholder farmers still practice shifting cultivation, with some traces of subsistence farming, particularly common with farmers cultivating in the upland (Sumo et al., 2022).

The West African nation’s agricultural sector has developed several policies intended to enhance service delivery among smallholder farmers. For instance, the Liberia extension and advisory service strategy developed in 2012 and improved in 2023 is focused on fighting hunger and eradicating poverty. The strategy focuses on research, access to markets and market information, land and profitable technologies, financial services, and creating an enabling environment that enhances access to productive resources (Government Of Liberia,2023). These efforts were initiated to cause a shift in the delivery of services toward a demand-driven service provision. Nevertheless, service provision is still inadequate in addressing the needs of the farmers.

2.4. Quality of extension service delivery on the adoption of improved rice production practices and rice yields

Agricultural extension workers cannot be separated from the uptake of good agricultural practices (Purwidyaningrum et al., 2021); rice production is no exception. Factors affecting the performance of extension workers include qualities of extension workers, institutional and individual farmer constraints, and farmers’ willingness and perceptions of GAPs. Institutional factors are based mainly on the extension system's support level towards updated training, logistics to improve coverage of activities, better incentives to extension workers, and prospects of

growth from within, among other things (Anesukanjanakul *et al*., 2019). According to Mncina *et al*. (2021), the performance of extension workers is also based on farmers' willingness and perception of new technology, which is key for the uptake of good agricultural practices and crop productivity. For instance, a study conducted in Central Liberia shows that at least 65% of smallholder rice farmers still practice shifting cultivation in Liberia (Sumo *et al*., 2023).

In Nigeria, coordination of activities due to a pluralistic system is among the institutional factors that affect performance, and in Indonesia, age, the number of training programs attended, topography, and infrastructure/facilities are among the major factors affecting performance (Purwidyaningrum *et al*., 2021). Also, workload due to the high ratio (1: 5,000-10,000) and satisfaction level of extension workers are part of the factors that influence performance (Purwidyaningrum *et al*., 2021 & Davis *et al*., 2019). However, this study focuses on those factors affecting the performance of extension workers based on Liberia's context. This study seeks to identify the gaps in the agricultural extension service system for the rice sub-sector.

2.5. The role of the study outcome in improving rice productivity

Improving the uptake of good agricultural practices is crucial for increasing crop productivity. According to a study conducted in Ghana, understanding the mode of field-level communication, coverage of extension workers, the number of visits perseason, and extension workers and farmers' relationship are essential for improving the uptake of good agricultural practices among farmers. (Antwi-Agyei & Stringer, 2021). Antwi-Agyei and Stringer (2021) also indicated that radio and television are some of the channels for delivery of extension services. Developing extension workers' technical skills, especially in using Information communication technology (ICT), increasing support to extension workers by providing mobility, and

reducing the vast extension worker-to-farmer ratio, among others, are essential strategies to improve service delivery. Amadu and McNamara (2019) argued that providing incentives to public extension workers' is one of the strategies for improving service delivery at farmer level.

A study conducted in Nigeria proved that the village adoption concept was helpful in improving the uptake of good agricultural practices among smallholder farmers (Sennuga *et al.*, 2020). The National Agricultural Extension and Research Liaison Services of the Ahmadu Bello University adopted and worked with villages in Kaduna and Katsina states in Northern Nigeria. This method has facilitated the adoption of good agricultural practices in selected villages (Sennuga *et al.*, 2020).

Another study conducted in Uganda shows that the video-driven extension method has enhanced the adoption of good agricultural practices among small-scale farmers (Karubanga *et al.*, 2019 & Karubanga *et al.*, 2017). Learning by seeing and doing was practical and helped enhance the adoption of GAPs and innovation among smallholder farmers (Karubanga *et al.*, 2017).

In addition to the common limiting factors shared by developing nations, Liberia's extension service delivery is still dominated by a top-bottom approach (Álvarez-Mingote & McNamara, 2018). It faces structural challenges (Moore, 2017a). This scenario suggests that extension workers may be limited in communication and that information flow from farmers to the researcher through extension workers is complex. To move towards a bottom-top approach is one way of improving service delivery to farmers (Álvarez-Mingote & McNamara, 2018). Reducing these structural challenges, access to updated information, providing logistics, and regular in-service training are strategies to enhance extension workers' confidence and improve service delivery (Moore, 2017). Improving service delivery is crucial to the

nation's efforts toward becoming food secure, and understanding current improvement strategies will inform decisions for future strategies towards improving the delivery of agricultural extension services for crop productivity in the rice sub-sector. This study seeks to assess the effect of agricultural extension services on rice productivity in Liberia, using Foya District, Lofa County as a case study.

CHAPTER THREE: METHODOLOGY

3.1. Introduction

This section presents the overall methodology, including the research design, study area, sources of information, population and sampling techniques, variables and indicators, measurement levels, procedure and protocols for data collection, quality and error control, strategy for data processing and analysis, ethical consideration, and anticipated methodological constraints.

3.2. Research Design

The study used a cross-sectional research design because it was necessary to collect and examine data for the study variables at a given time within a sample population, offering a depiction of the population's characteristics. Therefore, the study obtained data for parameters on the effects of agricultural extension service delivery on rice productivity among farmers in Liberia from sampled rice farmers and used a mixed research method for collecting, managing, analyzing, and interpreting data within a limited time and a limited budget.

3.3. Area of Study

The study took place in Foya District, Lofa County. Foya district is the highest rice-producing district in Lofa County, with about 5,000 smallholder rice farmers. The County is among the first three highest food-producing counties in the country (Ministry of Agriculture Liberia, 2014 & LISGIS, 2017), and before the 14 years of the civil war, it was a leading food-producing county in Liberia (Broderick, 1989). LOFA County Action plan (2015 – 2020) indicates that more than 50% of the population depends on agriculture and that the county has a high potential to increase its rice production and combat food insecurity (Ministry of Agriculture Liberia, 2016 & LISGIS, 2017).

Figure 2: Maps of Liberia and Lofa County Sources: ontheworldmap.com

3.4. Sources of Information

The study obtained primary data in March 2024 from interviews and FDGs with smallholder rice farmers, public and private extension workers, farmer groups, and local authorities like the district superintendent, district commissioner, community leaders within the farming communities, and the Ministry of Agriculture. Secondary data were obtained from policy documents like the extension and advisory policy, progress reports of the Ministry of Agriculture and NGOs like FAO, and scholarly articles about agricultural extension service delivery and rice productivity.

3.5. Population and sampling techniques

The study population was 5,000 smallholder rice farmers in the Foya District (LISGIS, 2017). The researcher selected seven villages using purposive sampling to ensure the representation of the different rice ecosystems in the study. A simple random sampling technique was necessary to select 357 smallholder rice farmers as

study participants; however, only 352 participated in the study either because of lack of knowledge or unwillingness to take part in the study. Krejcie and Morgan's table of 1970 indicated below formed the basis for the sample size determination.

Table 1: Sample Determination Table

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	155	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	100000	384

Note: N is Population Size; S is Sample Size Source: Krejcis & Morgan, 1970

Six focus group discussions and twelve key informants were targeted in the study; they included the Development Superintendent, District Commissioner, one farmer's cooperative head, two district agricultural officers, one extension worker, three field technicians, one farmers-based organization representative (rice processing company), and two county agricultural coordinators. However, only four FGDs were possible due to limited financial resources. The sizes of the FGDs ranged between 6-15 participants. Participants of the key informant interviews were

selected using purposive sampling; this sampling method ensured the participation of men, women, and youth in the study.

The four focus group discussions were held with rice actors with adequate knowledge about rice production and agricultural extension service system. During the discussions, data on the main rice varieties and their sources, complementary inputs, information sources, views and opinions regarding the quality of extension services, challenges faced in accessing extension services for rice and how to address the challenges. Discussions lasted one and a half hours per session. As a result, they provided rich insights and an in-depth understanding of how the service delivery affected rice productivity in the Foya district.

3.6. Definition of variables and measurement level

The study objectives and research questions formed the basis of the data collection tools. The independent variable for the study was agricultural extension service delivery, and the dependent variable was rice productivity.

Table 2: Variables and indicators

Objective	Variables	Indicators
Characterization of AESD	Household particulars	Bio-data characteristics, the area planted, output produced, frequency of GAPs awareness, number of GAPs workshops attended, and GAPs practices carried out
	Coverage of AESD	Number of farm visits made and Number of extension staff
	Access to updated extension information	Type of information accessed, rice training attended, farmer-to-farmer interaction

Quality of extension service delivery on the adoption of improved rice production practices and rice yields	Skills and abilities of extension workers	Number of communication and interpersonal skills training programs attended, Frequency of service delivery methods and approaches training attended, Quality of extension workers, and Access to productive information
	Farmers' capacity	The education level of farmers, rice production training attended, and membership of farmer groups
	Extension methods and approaches	Mode of service delivery, frequency of farm visits, frequency of field demonstrations, and frequency of mass media use,
	Institutional support to extension workers	Staff transportation, Number of improvement training, frequency of ICT training, and access to productive resources
Strategies for improving agricultural extension service delivery	Rice production strategies	Government strategies, extension service strategies, farmer group and individual farmer strategies

The table above outlines variables and indicators by objective. Two sets of data were collected: qualitative and quantitative data. For qualitative or String data, the level of measurement was nominal and ordinal scales. Quantitative or numerical data measurement was at least interval scale. The arrangement of data was either on a continuous scale or as categorical data.

3.7. Procedure and protocols for data collection

Study participants signed the consent forms before participating in the survey and focus group discussions. Enumerators read every question on the questionnaire and interview guide to ensure that participants understood the question before

providing answers. In the areas where English was a challenge, an interpreter elicit responses during the survey and focus group discussions. The study used different data collection instruments, as indicated in the table below.

Table 3: Data Collection equipment and instruments

Type of Data	Equipment	Instrument
Primary Data	Focus group discussions	FDG guide, voice recorder, notebook
	Key Informant Interviews	Interview guide, notebook, voice recorder
	Survey	Structured questionnaire
Secondary Data	Reviews	Reports, policies, and articles on rice productivity and effective extension service delivery

3.8. Quality and Error Control

Peers and experts reviewed the data collection instruments, while four enumerators received training in data collection. The researcher worked closely with the enumerators to monitor their activities and ensure quality data collection. In addition, the researcher removed personal values, beliefs, and feelings/perceptions to reduce the researcher's bias by entering data as they were collected; recordings of the FGDs were transcribed and transcripts were corrected. A database for entering collected data was set up, and data was organized into analyzable forms. The researcher saved transcriptions from focus group discussions (FGDs) and quantitative data in Microsoft Word 2016 and Excel 2016, respectively. A data analysis roadmap was developed to guide the analysis process of both qualitative and qualitative data.

3.9. Data processing and analysis

Raw data were received from the field and entered an electronic database. The researcher cleaned and edited the database, and raw data sources were corrected and clarified. The topic, specific objectives, and research questions guided the data analysis. Quantitative data were organized in Microsoft Excel 2016, and the data were analyzed using SPSS 23, appropriate for analyzing social-related data (Kauray *et al*., 2020).

Descriptive and inferential statistics were used to characterize the extension service delivered. Frequency tables were generated to understand how services were delivered across selected villages. Cross-tabulation was used to understand how the different household characteristics accessed extension services. Pearson correlation test was performed to determine how household characteristics and extension characteristics and quality correlated with rice productivity. In addition, to understand the productivity across each household's characteristics, a One-way ANOVA was used to compare if there were statistical differences in means within each household's characteristics.

Recordings were transcribed, and the transcripts were organized in ATLAS.ti 23, a tool for qualitative analysis (Ronzani et al., 2020). For FDG, thematic analysis was applied; codes were identified from the dataset, in relation to the research question; the codes were reviewed to ensure accuracy. From the codes, themes were generated to determine broader patents and meaning. Key themes included main rice varieties and their sources, sources and quality of extension, challenges faced in accessing agricultural extension services. For KII, coding scheme and codebooks were developed and data coding was done in ATLAS.ti and content analysis was performed to analyze the KII data. Descriptive statistics in terms of

frequency were used to analyze the recommended strategies to improve extension service delivery for increased productivity.

For Objective 2, a cross-tabulation was used to understand how the different household characteristics influenced the performance of extension workers and how sampled farmers perceived the abilities of extension workers. Dummy variables were created, and a simple linear regression analysis was applied to understand how the abilities and characteristics of extension workers influenced productivity. Additionally, Pearson correlation was done to determine the relationship between extension workers' ability and extension characteristics, extension workers' capacity and rice productivity.

To analyze objective 3, cross tabulation was used to understand the proposed improvement strategies of the different categories of respondents. Frequency tables were used to show how often different values occurred within the data collected. Pearson correlation test was performed to determine how recommended communication channels correlated with rice productivity.

3.10. Ethical considerations

The researcher obtained a recommendation letter from the Faculty of Agricultural Sciences at the Uganda Christian University to seek approval from the Research and Ethics Committee (REC) and submitted an application seeking REC approval. The university research and ethics committee assigned a reference number, (UCUREC 2024-789).

The researcher sought voluntary informed consent from all respondents who participated in the study. To ensure the privacy and confidentiality of the interviewees, the responses were anonymized during reporting. Since respondents

were requested to have voluntary participation, no financial incentives were given in return for their responses.

3.11. Methodological constraints

Not all of the selected participants could complete the study due to either a lack of knowledge of the subject matter or unwillingness to take part in the study. As a result, only 352 of the 357 sampled farmers participated in the study. Additionally, not all the study respondents could speak or clearly understand English. This led to the hiring of an interpreter; as a result, the data collection took more time than expected. Subsequently, additional resources had to be sought to complete the study.

4.0. CHAPTER FOUR: DATA ANALYSIS, PRESENTATION, AND INTERPRETATION, DISCUSSION OF FINDINGS

4.1. Respondents' Household Characteristics

Understanding the characteristics of the respondents helps to improve the categorization of the findings based on the farmer's status. The table below describes the household characteristics of respondents.

Table 4: Description of household characteristics

Household characteristics	Description
Gender	One if a farmer was male, two if female
If the household head belonged to Group	One if a farmer belongs to a group, otherwise 0
Age of household head	Age of household head in years
The main occupation of the HH head	1(agriculture: crop), 2(livestock), 3 (Mixed farming), and 4(formal employment)
Education Level	0 (No formal Edu.) 1 (Elem.) 2 (High school) 3(Tertiary)
Size of farmland	Small (2 acres & below) Medium (2.5-7 acres) Large (above 7 acres)
Productivity	Farm output divided by area planted (Unit: Kg/Ha)

4.2. Demographic characteristics

Table 5 shows that the dependent variable was rice productivity, determined by dividing farm output by the size of the area planted. The mean productivity (430kg/Ha) was below the national mean productivity of about 2,000kg/Ha (Saysay *et al.*, 2018); the low productivity was partly attributed to limited access to extension services. Thus, extension services delivered in 2022 did not boost rice productivity in the Foya district. The mean age of household heads was 44 years, below the average age of 60 years of farmers in Africa (Yeboah & Jayne, 2020). This age bracket implies that rice farmers in the Foya district are in a wide age range

from youth to the elderly. This provides the opportunity to promote online and social media extension services to the youthful and middle-aged farmers. The mean household size was six people, above the national average household size of four people (LISGIS, 2022), signifying that farmers' households could tap into the household's labor, which reduces hired labor costs.

Male household heads accounted for 54%, while female-headed households accounted for 46%; an almost balanced gender farm decision-making environment. Therefore, gender responsive farm solutions and extension service delivery are necessary (Sell, M., & Minot, N. (2018). A substantial number of household heads had no formal education (64%), which is likely to be a factor leading to low productivity. Farmers with limited educational capacity tend to heavily rely on extension service to access production information (Gebremariam, *et al.*, 2021).

This finding correlates with Ferreira (2018), who found that education has a considerable effect on farm productivity in China. About 76% of household heads belonged to farmers' group, which suggests that efforts were made to support the government's plan to create farmers' group for effective and efficient service delivery (Ministry of Agriculture, 2023), which according to Kehinde *et al.*, (2023) is a factor for increased productivity. The average farm size was 6 acres which is greater than the national average (Saysay, *et al.*, 2018).

Table 5: Household characteristics

Variables	**Mean**
Productivity	430kg
Average household head age	44
Average household size (in acres)	6
Pooled Sample (N=352)	**%age**
Gender (%)	
Male	54

Female	46
Education Level (%)	
No formal education	**64**
Elementary Level	11
High School level	21
Tertiary level	4
Main Occupation (%)	
Crop	90%
Livestock	1
Mixed Farming	6
Formal Employment	
HHH belonging to farmers' group	
Yes	**76**
No	24
Size of farmland (%)	
Small farmland	41.2
Medium farmland	**51.7**
Large farmland	7.1

Source: Survey data, 2024

4.3. Characterizing Extension services delivery

4.3.1. Farm characteristics and rice productivity

There was no significant difference observed among farm characteristics including cropping systems, production ecosystem environment, varieties used or seed sources variation (Table 6). However, on average, farmers who cultivated both local and improved varieties had high productivity (472kg) compared to farmers who planted only improved varieties (406kg). The high productivity of both local and improved varieties may be attributed to a symbiotic relationship between the varieties and favorable ecosystems. Intercropping contributes to reduced pest infestation, disease outbreak, leaf folders, and support pollination, thus leading to higher crop yields (Xiang *et al.*, (2021).

More than half of the farmers obtained seed from sources other than seed companies, probably due to insufficient distribution channels and limited awareness

about quality seed. The average rice productivity for farmers who obtained seed from seed-company/Stockiest was 480kg/ha compared to (550kg/ha) for home-saved seed. The variation could be attributed to seed viability due to limited numbers of buyers, which leads to seeds being stored beyond their recommended shelf life. De Vitis *et al.,* (2020) reported similar findings.

Table 6: Farm Characteristics and Rice Productivity

Variable	% of response	Average rice productivity (kg/ha)
Cropping system		
Pure stand	70.7	453
Mixed stand	29.3	390
Ecosystem		
Low land	74.7	459
Upland	25.3	364
Variety used		
Improved	48.8	417
Local	6%	300
Both	45.2	471
Seed source		
Stockiest	20.5	480
Local Market	50.3	413
Home saved	12.5	550
Others	16.8	361

Source: Survey data, 2024

4.3.2. Extension services delivered

Extension services delivered were cross-tabulated with the size of farmland. The percentage of farmers receiving the extension services delivery options was close across different farm sizes except field demonstrations. Large scale farmers received more field demonstration opportunities than medium and small-scale farmers. The results revealed that access to improved variety was common among sampled farmers irrespective of the size of farmland. At least 90% of farmers across

the different sizes of farmland had access to improved variety. The enhanced seed access must have been influenced by government and partners' efforts of providing seeds to farmers or that most individual farmers obtained improved seeds from farmers' cooperatives. This finding correlated with data from the focus group discussion. One respondent said that "even after transplanting, there can still be more seedlings, which we sell to other farmers" (Cooperative head, Foya, 2024). Similar results were reported in northern Bangladesh, where farmers obtained planting material from the government and other partners instead of from seed companies (Sarkar *et al.*, 2024).

On the other hand, training in rice production was the least accessed extension services regardless of farm size. The slight variation in training based on farm size is a result of medium and large-scale farmers having the capacity to attend training programs outside of Foya District. A similar finding was made by Hu et al., (2022) that farmers with larger farms in China were willing to spend more time and money to acquire new agriculture knowledge in China.

A One-way ANOVA test was performed to determine if there was a significant difference in the services delivered across the three different sizes of farmland (table 7). The results show that there was a significant difference in field demonstration activity (F=3.888; p-value= 0.009); access to market information (F= 4.613, p-value=0.004); and access to training in rice production (F= 4.829, P-value =0.003) across the different sizes of farmland. These variations can be attributed to farmer capacity; farmers with large farmland might have attracted more extension services and had better financial capacity to attend rice production training outside

Foya District. This finding correlates with the study conducted in Margibi County that large farm size showed high demand for extension services (Sumo *et al.*, 2022).

Table 7: Extension services delivered

Variables	Farm Size (%) (n= 352), Productivity, and One-Way ANOVA results				ANOVA Test	
	Small (n=145)	*Medium (n=182)*		*Large (n=25)*	*F*	*P-value*
Farm Visit	34.5	32.4	40	0.45		0.718
Field Demonstrations	26.9	26.4	56	3.888		**0.009**
Access to Improved Variety	92.4	97.3	92	1.5		0.214
Access to Loan	15.9	13.1	4	0.872		0.456
Access to market Information	23.4	37.4	25	4.613		**0.004**
Access to training	3.4	9.9	24	4.829		**0.003**

Source: Survey data, 2024

4.3.3. Farming practices used in 2022

Table 8 revealed that weed management (99%), having a farm work plan (94%), planting of improved varieties (92%), and postharvest management (92%) were the most used GAPs used in 2022. Row planting (10%) and farm records keeping (11%) were the least applied GAPs among the farmers. The low adoption of planting rice in rows is attributed to farmers feeling that it is time-consuming, lack of labor-saving technology, scarcity of labor, and cost implications. Reed *et al.*, (2024) reported that planting rice in rows allows easy field management practices and contributed to better yields. Limited record keeping on farm is attributed to low illiteracy level and lack of awareness of the benefits (Kuteesa and Kyotalimye, 2019).

Table 8: Farming practices used in 2022

Farming practices	Responses (%age)	
	No	Yes
Timely Planting	29	71
Row Planting	90	**10**
Recommended Spacing	41	59
Weed Management	1	99
Pests & Diseases Management	61	39
Soil Fertility Management	42	58
Planting Improved Variety	7	93
Postharvest Management	18	92
Farm Work Plan	6	94
Farm Records Keeping	89	11

Source: Survey data, 2024

4.3.4. Institutional Support and Policy Context

Reports about agricultural extension and policies were reviewed to understand extension delivery at policy and institution levels. When it comes to institutional support, the Liberian Ministry of Agricultural Extension System assessment report revealed that the major service providers are staff at the Ministry of Agriculture (Ministry of Agriculture, 2023). Yet, there are 64 field-level extension staff providing services to about one million farmers, making the ratio of extension worker and farmers is 1: 33,000 (Ministry of Agriculture, 2023). However, private sector service providers like NGOs, farmers' cooperatives, processors, and input dealers also provide services. According to Sigma and Davis (2017), there were 60 international non-governmental organizations that provided extension support to the efforts of government and local NGOs; but several of them have withdrawn due to program closure or lack of funding. This withdrawal has reduced the number of service providers, which could be one of the major factors leading to limited extension services, as supported by Sigma and Davis (2017).

The assessment also revealed that the service delivery system is challenged with a high ratio of extension workers to farmers, poor execution, monitoring, and evaluation of planned activities. The activities of the private extension system are not adequately coordinated. This supports a respondent from the key informant interview that:

> *"There is a need to create a centralized system to coordinate the activities and help to address the poor coordination of extension service delivery activities"* (County Agricultural Coordinator, Liberia, 2024*).*

The Liberia's extension service suffers inadequate funding to effectively support extension and advisory services activities. This also correlates with FDGs:

> *"The extension workers are facing serious challenges, from bad roads and lack of extension service tool like GPS, which could be used to measure the farmer's field" (Extension worker, Foya District. 2024).*

When it comes to mobility, FDG data showed that only one government assigned motorcycle was found in Foya:

> *"Only the District Agriculture Officer was given on Yamaha motorcycle for the purpose of visiting and engaging farmers, but one person cannot provide extension services to all the farmers in Foya District" Extension worker, Foya District 2024.*

Several policies like the National Agricultural Extension and Advisory Service policy (Ministry of Agriculture, 2023), Pro-poor Agenda for Prosperity and Development policy (Government of Liberia, 2018), and now the "Feed Yourself Policy" (Ministry of Agriculture, 2024), each with a component to enhance service delivery across the country with emphasis on farm-to-market roads, support the formulation of farmers' cooperatives, strengthening access to market and market

information, among others. However, both the National Agricultural Extension and Advisory Service policy, pro-poor Agenda for Prosperity and Development policy had one challenge: limited financial resources to implement the policies, which correlated with key informant data that:

> *"The major challenges facing extension service delivery are limited manpower, poor condition of farm-to-market roads leading to limited access to extension service and low productivity"* extension officer, Foya District 2024.

4.3.5. Extension Service and Relationship with Rice Productivity

Linear regression was used to determine the relationship between extension services characteristics and rice productivity (Table 9). The results showed that access to both local and improved varieties (p=0.023) and access to information on good agricultural practices (GAPs) (p=0.029), farm visit (0.034) and Field demos(0.004) had a statistically significant relationship with rice productivity, implying a significantly positive influence on rice productivity. This correlates with the study conducted in Tanzania, which reported that access to information on GAPs was responsible for substantially higher productivity (Senthilkumar *et al.,* 2018). In addition to farm visits and field demos, other sources of GAP information for rice farmers in the Foya district included fellow farmers, NGOs, and government project-specific teams such as the Smallholder Agriculture Transformation and Agribusiness Revitalization Project (STAR-P) (Survey data, 2023).

Table 9: Extension service and relationship with rice productivity

Extension Service Characteristics	P-value
Presence of farm visits	0.034*
Presence of field demos	0.004*
Accessed and planted improved Seed Rice	0.983
Accessed improved and planted both improved and local varieties	**0.023***
Access to credit services	0.659
Access to Market Information	0.083
Access to information on GAPs	**0.029***

Dependent Variable: Rice Productivity Source: survey data, 2024

4.3.6. Extension service based on location

The coverage of extension services was limited across selected villages over the past 3-5 years (Table 10). In 2022, accessing trained extension workers was among the challenges faced by farmers. Most farmers accessed extension services from fellow farmers, particularly in Lorloe (62%) and Sorlumba (67%). The reliance on fellow farmers as sources of extension services could be attributed to the poor road networks, which affected the mobility of trained extension service providers, high ratio (1: 18,000), which is lower than 1: 33,000, a ratio found by Ministry of Agriculture (2023).

Table 10: Extension Service Accessed across selected Villages

Extension Characteristics	%age of farmers across Villages (N= 352)						
	Wors	**Kpord**	**Yass.**	**Lorl.**	**Yegb**	**Sorl**	**Yall.**
Presence of a farm visit	37	32	27	23	**51**	25	32
Presence of field demos	41	**59**	44	25	4	21	15
Access to improved rice seed	**91**	**79**	**93**	**100**	**100**	**100**	**98**
Access to credit services	0	0	17	**51**	5	4	2
Access to Market Information	24	0	41	36	**58**	0	17
Access to Information on GAPs	25	27	15	11	16	8	15
Sources of extension Service							
Public Service Provider	5	14	10	3	3	0	0

Fellow Farmers	31	48	49	**62**	32	**67**	0
Others	22	20	0	3	23	0	41
None	42	18	41	32	42	33	**59**
Mean Productivity (Kg)	488	460	472	466	294	456	487

Source: Survey data, 2024

In addition, the limited use of mass media platforms that could enhance the dissemination of production information was a challenge (Ibrahim *et al.*,2020). However, information on GAPs was obtained from public project-specific field-level staff like Smallholder Agriculture Transformation and Agribusiness Revitalization Project STAR-P and Rural Economic Transformation Project (RETRAP) and other service providers like NGOs. This means that in areas where trained service providers were scarce, farmers found other sources from which extension services could be accessed. In this case, fellow farmers were the alternative sources.

This finding agrees with a study done in South Africa, which found that limited access to service providers makes farmers depend on other sources, regardless of the quality of information provided (Loki *et al.*, 2020). This finding also highlights the importance of creating farmer-based organizations (FBOs) or farmers' cooperatives to bridge the gaps in accessing extension services.

The quality of extension service delivery on the adoption of improved rice production practices and yields

Farmers' educational capacity was low, about 64% had no formal education, which might have had negative implications on technology adoption and might have been the affecting access to extension services. The low education level of farmers contributed to a language barrier, which might have affected the flow of information between the extension workers and farmers, and would require an interpreter as an

intermediary, leaving the dissemination of production information at the mercy of the intermediary. Therefore, the limited education of the farmers was among the factors that affected the performance of extension workers. Biru & Korgitet (2019) also reported that the limited education capacity of farmers had affected the performance of extension workers. However, many farmers belonged to farmer groups with peers of similar dialects. This highlights the importance of FBOs and farmer cooperatives as a strategy to enhance services delivery.

Table 11: Farmers' educational level and correlation with rice productivity

Variable	**Responses in % (n=352)**	**Pearson Correlation**	
	Percent	*Coefficient*	*P-value*
No formal education	64	-0.09	0.092
Elementary Level	11	-0.035	0.051
High School	21	0.621	**0.041**
Tertiary Education	4	0.893	**0.039**
Correlation is significant at 0.05		Source: Survey data, 2024	

Pearson correlation was performed to determine the relationship between farmers' education level and rice productivity. The results showed that both tertiary level and high school level had a positive and strong correlation with rice productivity (Table 14). This implies that if the farmer's education level is increased to secondary level, then productivity will increase regardless of the limited extension service delivery. Similar results were reported by Paltasingh & Goyari, (2018) who worked on paddy rice in India. This finding emphasizes the need for improved extension services delivery for farmers with limited education ability.

4.1.2. Correlation between farmers' education and use of GAPs

Data about the correlation between farmers' educational level and the use and adoption of good agriculture practices reveals that a positive correlation was

between farmers' education level and the keeping of farm records (0.176). This signifies that improving farmers' education levels could lead to improving their ability to keep farm records which guides future farming practices by learning from past experiences and future investments (Gichohi, 2020).

Table 12: Correlation between farmers' education capacity and adoption of GAPs

Variables	Correlation Coefficient
Timely Planting	0.058
Row Planting	0.034*
Recommended Spacing	0.09
Weed management	0.009*
Pests and Diseases Management	0.055
Soil Fertility Management	0.045
Planting an Improved variety	0.005*
Postharvest management	0.008*
Farm Work Plan	0.031*
Records Keeping	***0.176****

Correlation is significant at 0.05 (2-tailed). Source: Survey data, 2024

4.4.2. Relationship between Extension qualities and rice productivity

Table 12 presents the correlation between extension service quality and rice productivity, and how farmers perceive the performance of extension workers. The data shows that the abilities of field-level extension workers were one of the factors that limited access to service, as less than 12% view that the ability to be good. A Pearson correlation test shows that an extension worker's ability to provide production information (correlation coefficient =0.934, p-value =0.048), had a strong-positively correlation with rice productivity, implying that if an extension worker's ability to provide production information are enhanced, productivity is likely to increase. This finding correlates with Tamsah & Yusriadi, (2022), who

argued that improvement in extension workers' ability led to increased productivity among the smallholders' farmers.

Table 13: Correlation of extension qualities and rice productivity

	Farmers responses				Pearson Correlation	
	I don't Know	Poor	Fair	Good	Coefficient	p-value
Communicate with farmers	42.3	39.8	10.8	**7.1**	-0.95	0.76
Related with farmers and stakeholders	51.1	33.2	14.5	**1.1**	0.019	0.719
Provide production Information	63.4	25.9	9.1	**1.7**	**0.9.38**	**0.048**
Provide Nutrition Information	53.7	26.4	19.3	**0.6**	0.019	0.004
Provide Market Information	70.2	16.8	10.5	**2.6**	0.298	0.05
Information on Climate change & CSA	50.9	23	15.1	**11.1**	0.409	0.044
Business Development information	54.5	24.1	12.8	**8.5**	-0.142	0.008

Dependent variable: Rice Productivity, Source: Survey data, 2024

4.4.3. Correlation between extension worker abilities and extension services characteristics

Extension workers' abilities and extension services characteristics were analyzed to determine how they influenced each other. The Pearson correlation test shows that highest positive correlation was observed between the extension worker's ability to provide production information and field demonstration (coefficient =0.178 and p-value = 0.002). There was also a positive correlation between the extension workers' ability to communicate and field demonstrations (coefficient =0.175 and p-value = 0.045). For farm visits, there was a positive correlation with extension workers' ability to provide information on climate-smart agriculture (coefficient =0.105 and p-value = 0.001).

These results mean that improvement in extension workers' abilities to communicate, provide production information, and provide information on climate change and climate-smart agriculture will enhance quality of extension services

provided during farm visits and field demonstration activities. This will boost trust in the information provided by the extension worker during the farm visits and demonstration, which enhances farmers' learning. However, the high extension worker-to-farmer ratio and poor infrastructure for training were identified among the factors influencing extension workers' ability to carry out farmers' field school activities like training, farm visits, and field demonstrations (Oyegbami, 2024).

Table 14: Correlation between extension quality and extension characteristics

Extension worker Abilities	**Pearson**			
	Farm visits		*Field demos*	
	Coefficient	P-value	Coefficient	P-value
Ability to communicate	0.075	0.051	**0.175**	0.045
Ability to provide production information	0.083	0.056	**0.178**	0.002
Ability to provide information on Climate Change &CSA	**0.105**	**0.001**	0.146	0.06
Ability to follow up	0.048	0.032	-0.066	0.713

Correlation is significant at 0.05 **Source: Survey data, 2024**

4.5 strategies for improving agricultural extension service delivery to enhance rice productivity among smallholder farmers in Foya district

This section presents strategies for improving agricultural extension service delivery to boost rice productivity among smallholder farmers in Liberia, which are major outcomes of this study. The strategies are presented in three categories: government, extension service system, farmer groups and individual farmer

strategies. To analyze objective 3, cross tabulation was used to understand the proposed improvement strategies.

4.5.1: Government strategies for improving extension service delivery

Farmers and extension workers identified the top 5 Government strategies that would help improve extension service delivery and increase rice productivity (Table 18). Improving conditions of farm-to-market roads and minimizing rice price fluctuation were identified as the most critical recommendations for increasing rice productivity by both stakeholders' categories. Improving the condition of farm-to-market roads will reduce the cost of transporting farm produce from the farm to the nearby markets; it will also help enhance farm gate activities, which eliminate the cost of moving the produce to market site and increase farm income. Chengappa, (2018) also found that improving access to markets has contributed to increased farm income in India.

The extension workers and the farmers encouraged the government and partners to support extension workers with tools and equipment, and provide refresher training sessions. This will not only improve the quality of services; but will also boost extension workers' confidence to effectively deliver services to the farmers. This study correlates with Raidimi, & Kabiti, (2019) who found that refresher training for extension workers raised skill level and enhanced extension workers' capacity.

Similarly, both the farmers and the extension workers stressed the need to enhance extension workers' mobility. Enhanced mobility will strengthen farm visits, and other farmers' field school programs/activities, improve coverage of extension activities, and subsequently lead to increased rice productivity. This finding

correlates with Raina, (2020) who argued the importance of transportation facility for extension workers and valued it as a major driver for enhancing coverage of extension services.

Table 15: Institutional support recommended by farmers and extension workers

Variables	Farmers (N=352)	Extension Workers (N=12)
	%age	*%age*
Price stability for rice	98.9	100
Farm-to-market roads	100	100
Access to tools and equipment to support extension services	99.4	83.3
Access to refresher trainings for extension workers	99.1	91.6
Access to transport means for extension workers	85.2	100

Source: Survey data, 2024

4.5.2. Strategies proposed by extension workers

Table 16 shows that supporting access to market and market information (100%) and conducting periodic agricultural training sessions (90%) were the top two (2) extension system strategies recommended to boost rice productivity. For instance, rice production training is helpful in improving the adoption and effective use of GAPs, enhances extension workers' confidence, reduces the sole reliance of farmers on extension workers, and enhance farm management practices, including seeing farming as a business. This also suggest that with regular refresher trainings, extension workers will be able to improve farmers' skills in financial management and farm record keeping, which could support informed decision making as confirmed by Wonde *et al*., (2022).

Table 16: Extension services delivery improvement strategies as recommended by farmers across gender and education levels

Variables	Gender (%)		Education levels (%)			
	Male N=192)	*Female (N=160)*	*Non-formal (N=224)*	*Elementary (N=41)*	*High School (N=74)*	*Tertiary (N=13)*
Access credit services	93	93	83	73	93	100
Farmer field school activities	54	63	89	73	100	69
Access production information	**90**	**94**	**95**	**97**	**95**	**92**
Access to agro-inputs	**43**	**31**	**36**	**34**	**18**	**45**
Access to market information	**80**	**100**	**100**	**100**	**100**	**100**

Source: Survey data, 2024

4.5.3. Communication channel and correlation with rice productivity

Frequency of participants' responses was analyzed and Pearson correlation test was performed to determine the outstanding communication channels and how they correlate with rice productivity as recommended by farmers. The frequency results show that face-to-face with AEWs (79%), use of local language (80%), and use of radio (86%) were highly recommended by farmers. On the other hand, use of social media (27%) was the least recommended communication channels.

The variation between the highly recommended (face-to-face with AEWs, use of local language, and use of radio) and the least recommended (use of social media) could be attributed to low education among the farmers, which might have limited their capacity to engage in the use of the social media platforms. A study conducted in Kiambu County, Kenya, established the low educational level among smallholder farmers has affected the use of social media platforms (Kimani, 2019).

Pearson correlation test shows a positive correlation between face-to-face with AEWs (correlation coefficient =0.624; p-value = 0.026); use of local language (correlation coefficient =0.880; p-value = 0.008), and the use of radio (correlation coefficient =0.202; p-value = 0.016) and rice productivity; implying that if extension workers increase their engagement with farmers in the use of face-to-face with AEWs, use of local language, and use of radio as service delivery methods, productivity will increase proportionally. This finding agrees with Leema et al., (2018), who determined that face-to-face method contributed to increased productivity in Kancheepuram district, Tamil Nadu.

Table 17: Communication channel and correlation with rice productivity

Variable	Participants responses (%) n=352	Pearson Correlation	
		Correlation coefficient	P-value
Face-to-face with AEWs	79	0.624	0.026
Use of local language	80	0.88	0.008
use of social media	27	-0.763	0.068
Use of radio	86	0.202	0.016
Correlation is significant at 0.05		**Source: Survey data, 2024**	

4.5.4. Strategies for farmer groups and individual farmers

All respondents recommended individual farmers to join farmers' cooperatives within their farming community/village (Table 18). This improvement strategy could reduce challenges associated with accessing extension services, attract more support from the Ministry of Agriculture and partners, negotiate prices,

increase access to resources such as seeds, fertilizers, and equipment, including information, increase marketing power, and appreciate farming as a business among many others, all of which are necessary for increasing farm productivity. The proposal aligns with the study conducted in Denmark, where farmer cooperatives were found to enhance farmers' access to extension information and production resources, thus boosting farm productivity (Hansen, 2021).

Introducing or maintaining technicians/technical experts in already established farmer cooperatives was recommended by all respondents. Maintaining highly trained cooperative members enhances precision agriculture, addresses technical deficiencies like equipment operation and repair, increases the adoption rates of good agronomic practices through field demonstration activities, and strengthens financial and farm management practices. This, in turn, contributes to enhancing farmers' productive capacity. Additionally, 90% of the respondents proposed regular training for individual farmers while 100% suggested that farmers' cooperative should organize regular training activities. Attending training in rice production will enhance farmers' capacity to adopt good agricultural practices and employ agroecological farming methods, and proper use of farm inputs, which will encourage extension workers to do more training for increased rice output. This finding agrees with Erickson *et al.,* (2018), who indicated that having technicians in farm groups would increase farmers' capacity to increase farm productivity.

Table 18: Improvement Strategies for farmers' groups and individual farmers

Variable	**AEW responses in % n=12**	
	Individual farmers	*Farmers' Group*
Proper use of inputs	80	60
Joining cooperatives	100	0
Maintain technicians	0	100
Farming as a business	80	90

management practices	80	80
Regular training	90	100
Use of GAPS	100	50

Source: Survey data, 2024

CHAPTER FIVE: IMPLICATIONS, CONCLUSION AND RECOMMENDATION

5.1. Implications of Key Findings

The study's findings have important implications for policymakers aiming to improve extension services delivery, especially within Liberia and Africa in general. Addressing the current gaps in service delivery could be pivotal for improving agricultural productivity and ensuring food security.

5.2. Conclusions

This study concludes that the extension services provided in 2022 were not sufficient to improve rice productivity in Foya district, with average yields at 430 kg/ha—well below Liberia's national average of 2,000 kg/ha (Saysay et al., 2018). However, higher rice yields were linked to combining seed types and accessing GAPs, but weak extension coverage and low adoption of labor-intensive practices remain major constraints. As a result, many farmers have relied on each other as primary sources of information on Good Agricultural Practices (GAPs). Strengthening extension service delivery and seed access is key to boosting productivity

Extension workers' ability to provide production and market information was positively correlated with rice productivity, showing that strengthening their capacity directly benefits farmers. However, low farmer education levels created

communication barriers, underscoring the need for farmer cooperatives and groups to bridge information gaps and improve service delivery

Better roads, stable rice prices, well-equipped and mobile extension workers, effective communication channels and strong farmer cooperatives with regular trainings identified as the most effective strategies for improving extension delivery and boosting rice productivity

5.3. Recommendations

5.3.1. To enhance farmers' access to extension services, the following were recommended:

- **Support farmer cooperatives**: This approach will only improve access to extension information, but will reduce sole reliance on extension workers, and enhance access to productive resources.
- **Improve farm-to-market roads**: Improved Road infrastructure would enhance farmers' access to markets, stabilize prices, and increase farm-gate activities. The study recommends that policymakers prioritize investments in farm-to-market roads to create a more robust, more resilient value chain for smallholder rice farmers

5.3.2. Influence of frequency, methods, and agricultural extension service delivery on adoption and production practices.

The frequencies of agricultural extension services, the methods used and the quality of extension service providers are crucial for adoption and increasing farm productivity. The following recommendations could help address associated challenges.

- The use of communication channels like radio and other social media platforms are crucial for increasing the coverage of extension information,

which could lead to increasing productivity. Additionally, integrating local language as a mode of service delivery will contribute to enhancing communication and integrating local knowledge in agricultural production systems.

- Strengthen extension service capacity of service providers through providing regular need-based trainings, extension service delivery tools like Mobility, reduction of the huge extension worker to farmers ratio will be relevant to enhance confidence of service providers and subiquently improve the quality of extension system, which will be essential to boost productivity.

5.4. Further research for broader insights

A comprehensive study examining the impact of extension service delivery in the major rice-producing regions beyond Foya district is recommended. Research would provide valuable insights on how agricultural extension service delivery in the rice value chain contributes to farmers' livelihood due to increased productivity.

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Appendix A: Approval Letter

UGANDA CHRISTIAN UNIVERSITY
A Centre of Excellence in the Heart of Africa

UG-REC-026 Approval Version 4.0 1st March, 2024

1st March, 2024

Augustine Hinneh
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UG-REC-026 APPROVAL NOTICE

To: Augustine Hinneh, Principal Investigator

Re: UCU-REC Application titled **Effects Of Agricultural Extension Service Delivery On rice productivity Among Farmers In Liberia: A Case Of Foya District**

Application Number: UCUREC-2023-787

Version: 4.0

Type: [ ] **Initial Review**
[ ] Protocol Amendment
[ ] Letter of Amendment (LOA)
[ ] Continuing Review
[ ] Material Transfer Agreement
[ ] Other, Specify:

UGANDA CHRISTIAN UNIVERSITY APPROVED 01 MAR 2025 RESEARCH ETHICS COMMITTEE

I am pleased to inform you that the **UG-REC-026;** UCUREC approved the above referenced application.

Approval of the research is for the period from **1st March, 2024**, to **1st March, 2025**
This research is considered minimal risk category.
As Principal Investigator of the research, you are responsible for fulfilling the following requirements of approval:

1. All co-investigators must be kept informed of the status of the research.
2. Changes, amendments, and additions to the protocol or the consent form must be submitted to the REC for re-review and approval **prior** to the activation of the changes. The REC application number assigned to the research should be cited in any correspondence.
3. Reports of unanticipated problems involving risks to participants or other must be submitted to the REC. New information that becomes available which could change the risk: benefit ratio must be submitted promptly for REC review.

4. Only approved consent forms are to be used in the enrollment of participants. All consent forms signed by subjects and/or witnesses should be retained on file. The REC may conduct audits of all study records, and consent documentation may be part of such audits.
5. Regulations require review of an approved study not less than once per 12-month period. **Therefore, a continuing review application must be submitted to the REC eight weeks prior to the above expiration date of 1st March, 2025 in order to continue the study beyond the approved period.** Failure to submit a continuing review application in a timely fashion may result in suspension or termination of the study, at which point new participants may not be enrolled and currently enrolled participants must be taken off the study.
6. The REC application number assigned to the research should be cited in any correspondence with the REC of record.
7. Your research details have been shared with the Executive secretary of Uganda National Council for Science and Technology (UNCST) and you are **not** required to get clearance since you are a Masters Degree research. Refer to UNCST Research registration and clearance Policy and guidelines (July 2016) in Uganda section 6(e).

The following is the list of all documents approved in this application by **UG-REC _026:**

	Document Title	Language	Version	Version Date
1.	**Protocol**	**English**	1.0	2024-02-06
2.	Data collection tools	English	1.0	2024-02-06
3	Informed Consent Form	English	1.0	2024-02-06

Signed and Stamped

.....

Prof. Peter Waiswa.
UCUREC Chairperson,
pwaiswa@musph.ac.ug

Appendix B: Informed Consent Form

I am aware that my participation in the study is entirely voluntary and there will be no monetary compensation for my involvement in the survey. I understand that the findings from the study will help to improve the delivery of agricultural extension services to rice farmers to increase rice production. I also understand that the information that will be provided will be used only for this research. The findings of this study will serve as a reference for future research in and out of Liberia. I have been promised that my name will not appear in the report of this study and have the right to withdraw from the study at any stage of the individual or group interviews. I also have the right not to answer any question, which I am not comfortable with.

I am fully aware that the information I will provide will be recorded, my picture taken, will sign in the attendance log, and sign this form to consent to participating in this study.

You can contact the researcher for any clarity on, or in case you wish to withdraw from the study through the following means:

Phone Contacts: +231886957298/+23270352497

WhatsApp: +231886957298

Email: aughinn@gmail.com

If you accept the above conditions and agree to participate in the interviews and/or focus group discussion, please sign this consent form as indicated below:

_____ _____

Name& Signature Date

Appendix C: Survey Questionnaire for Farmers

RESEARCH STUDY: EFFECTS OF AGRICULTURAL EXTENSION SERVICES DELIVERY ON RICE PRODUCTIVITY IN LIBERIA: CASE OF FOYA DISTRICT

Questionnaire for Farmers

Dear Participant,

Thank you for your time, willingness and involvement in research initiatives intended to improve agricultural productivity in Liberia, especially this current study which focuses on the; “Effect of Agricultural Extension Services delivery on rice productivity in Liberia, Case Study of Foya District”. This study is aimed at contributing to increasing the uptake levels of good agricultural practices among smallholder rice farmers to improve farm productivity. The study is guided by three objectives namely 1). Characterize agricultural extension services delivery to rice-producing farmers in the Foya District. 2). Identify factors affecting the performance of agricultural extension workers towards supporting rice-producing farmers in the Foya District. 3). Explore strategies to improve agricultural extension service delivery to boost rice productivity among smallholder farmers in Liberia.

A001	Question	Response
QA01	Questionnaire number	(Assign number per team)
QA02	Interview date (DD/MM/YYY)	
QA03	Interviewer	
QA05	Region	
QA06	County	
QA07	District	
QA08	Village	
QA09	Start time	
QA010	End time	

1B: HOUSEHOLD PARTICULARS

QB00	Question	CODE
QB01	Name of respondent	
QB02	Are you (respondent) the household head? (HHH)	1=Yes 0 =No,
QB03	If No, what is your relationship with the household head? B04	QB04: Relationship with the HHH 1=Spouse, 2=Child, 3=Grandchild, 4=Parent, 5=Sibling, 6=Nephew/Niece, 7=In-law, 8=Employee, 9=Others (specify
QB04	Name of household head	

QB05	Household head's telephone contact	
QB06	Sex of the household head	1=Female 2=Male
QB07	Age of Household Head (in complete years)	
QB08	Marital status of the household head QB08	QB08: Marital status 1= Single ,2=Married, 3= Divorced, 4= Separated, 5= Widowed
QB09	Level of education of household head - QB09	QB09 Education 0=No formal education, 1= Elementary level, 2=Junior High level 3= Senior High-level 4=Non-degree tertiary, 5=Diploma level, 6=University level
QB10	Number of completed years of schooling	
QB11	The main occupation of the household head - B11	B11: Main Occupation 1= Agriculture (crop), 2=Mixed farming, 3=Forestry, 4=Farm wage labor, 5=Off farm wage labor, 6=Formal employment (with salary), 7= Business (Specify – e.g. Input dealer, processor, produce dealer, general merchandise), 8=Transporter, 9=Others (specify)
QB12	Does the household head or spouse belong to any group/association?	1=yes, 0=No

QB13	If yes to QB12, what type of group does the household head or se belong to?	B13: Type of group 1=Produce marketing; 2 = Seed production; 3=. Farmer research group; 4=. Savings & credit; 5=Tree planting; 6= Church group; 7= Input supply 8= Others (Specify)

Record in the table below the number of household members (including the household head).

Sex	Below 5 yrs	6-15 yrs	16-65 yrs	Above 65 yrs
Male				
Female				

1. OBJECTIVE 1: Characterize agricultural extension services delivery to rice-producing farmers in the Foya District of Lofa County.

1.2: FARM PRODUCTION AND PRODUCTIVITY

1.2 a) Total land holding (acres) in 2022 _____

1.2 b) Own land holding (acres) owned by the farmer in 2022 _____

1.2c: What cropping system did you use to grow rice in 2022? _____ 1=Mixed 2=Pure stand 3=Relay cropping/ratooning 4=Others, (Specify)_____

1.2d: Select the types of rice ecosystem you used in 2022, and one reason why you used it (please tick).

Types of Ecosystems	Response	Reason

Irrigated Rice Ecosystem		
Rain-fed lowland rice Ecosystem		
Upland rice Ecosystem		
Flood-prone rice Ecosystems		

1.2e) Show in the table below acreage and output during 2022 farming season.

Type of ecosystem	Acreage	**Kg planted**	Kg harvested*
Irrigated Rice Ecosystem			
Rainfed lowland rice Ecosystems			
Upland rice Ecosystems			
Flood-prone rice Ecosystems			

*Kilos harvested include fresh, dry, consumed, bartered and donated produce.

1.2f: Select major rice varieties you planted in 2022

Rice Varieties	Response
Suakoko 8	
NERICA-L.19	
NERICA 14	
LAC 23	
ORYLUX 6	
Forbidden Brown Rice	
Bold Grain	
Local or own variety	

1.2g: During 2022 did you carry out any of the following farming practices? (Tick where appropriate) If, NO, State the reason why

Practice	Response: 1= Yes, 2= No	Reason
Timely planting (Onset of rains)		
Row/Line planting		
Recommended spacing		
Weed management		
Pests and diseases management		
Soil fertility management		

Planting improved seed		
Proper post-harvest management		
Farm work plan		
Record farm activities e.g. planting dates, seed/acreage planted, etc.		

*1 Cross-check for the appropriate GAP for rice, *3 Please ask for actual records as evidence

1 .2h. Do you keep farm records? _____ 1= Yes and 2= No

1.2i. If your answer to 1.2h is yes, provide estimated figures on the quantities of rice harvested, sold, consumed and other uses (Refer to 1.2e to confirm total quantities harvested per season

MF1Q01	MF1Q02	MF1Q03	MF1Q04	MF1Q05	MF1Q06	MF1Q07	MF1Q08	MF1Q09	MF1Q010	MF1Q11	MF1Q12	MF1Q13
Year (Season)	Acreage planted under rice	Quantity harvested Hint: Probe for the case	Unit (Kg/Bag)	Quantity sold (Kg/Bag)	Form of sale 1-Unmilled 2-Milled	Price per Kg	Place(s) of sale	% sold in the marketplace	Estimated distance (Km) to the marketpla	Quantity left for home consumption	Quantity used for seed (Kgs)	Quantity used for other purposes

		of gran ary & heap s							ce			

1.3 EXTENSION SERVICE DELIVERY IN RICE PRODUCTION AND MARKETING

1.3.1 Did you have access to extension services about rice production and marketing in the past 3-5 years?

1 = Yes 2 = No

Response

1.3.2. If yes, how many times in the season?

1.3.3. What type of services do you receive from the extension worker in 2022? (Tick as many answers as possible)

Types of Extension Service	Response
Farm Visit	
Field Demonstration	
Access to information on rice GAPs	
Access to rice seed	
Access to other farm inputs	
Access to market information	
Access to credit	

1.3.4. Agricultural Training in Rice Production

a. Have you ever had any rice farming training in the past 3-5 years? 1=Yes 0=No (If No, go to question 1.3.5)

b. When did you get the training (specify Year(s) _____

c. Where did you get training? _____

d. Who organized the training? _____ 1= MOA, 2=AfricaRice/IRRI, 3= CARITAS 4= BRAC, 6=FAO, 7= Feed the Future, 8=Other (specify)_____

e. What aspects of rice production were you trained in? _____ 1= Establishment method…….2= Cultivar selection…… 3= Water management…… 4= Nutrient management……5= Weed management…….…… 6=Post harvest management…… 7= Pests and diseases management ……., 8= All rice production practices 9. Others (Specify): _____

f. Would you like to receive additional training in rice production? 1=Yes 2 =No

g. If yes, what aspects of rice production would you like to receive additional training? (Circle appropriate) 1= Establishment method……. 2= Cultivar selection…… 3= Water management…… 4= Nutrient management……5= Weed management…….……6= post-harvest management…… 7= Pests and diseases management …… 8= All rice production practices 9= Other (Specify)_____

1.3.5: How will you rate the extension service delivery in 2022?

Rating	Respond by ticking
Very adequate	
Adequate	
Inadequate	

1.4: What was the source and cost of the following farm inputs in 2022?

Farm Inputs	Yes =1 No= 2	Source of farm inputs	If bought, state unit cost (UShs)
Upland rice (Kg)			
Lowland rice (Kg)			
Fertilizers (Kg) DAP, UREA, NPK			
Herbicide (Ltrs) (e.g., Roundup)			
Pesticides (Kgs/Ltrs)			
(e.g., Ambush, Bull dock) Bag (No.) where applicable			
Farm tools (e.g., hoes, cutlass, pangas, knives, power-saw,)			
Others (specify			

Codes for the source of farm inputs:

1=Stockist 2=Local shops/market 3=NGO (Specify) _____

4 = Family owned 5 = borrowed from a neighbor 6 = Other (Specify

1. OBJECTIVE 2: Identify factors affecting the performance of agricultural extension workers towards supporting rice-producing farmers in the Foya District.

2.1 The table below shows the qualities of a good extension worker. Rank their abilities in these areas from 1-5 and state one reason for the rank given. 1=poor; 2=fair; 3=good; 4= Very good; 5= excellence (Please probe and explain before recording responses)

Qualities	Rank	Reason
Ability to communicate		
Ability to relate with farmers and other actors		
Ability to provide production information		
Ability to provide nutrition information		
Ability to innovatively provide market information i.e. prices, market outlets, quality, etc.		
Ability to innovatively provide market information, climate change, and climate-smart agricultural practices		
Ability to innovatively provide information on business development services e.g. insurance, standards, transport, etc.		

Ability to provide information on value addition and value chain approaches		
Ability to constantly follow up with the farmers		

OBJECTIVE 3: Explore strategies to improve agricultural extension service delivery to boost rice productivity among smallholder farmers in Liberia.

3.1. How will you rank the rice production constraints in order of severity on a scale of 1-3? 1= very Severe, 2= severe, 3= mild (Prompt the respondent to mention the constraints as you tick from the list provided then rank the three most severe)

Constraint	Rank **1 = Very severe** 2 = Severe 3 = Mild	ONE suggested solution
Low soil fertility		
Effects of climate change		
Access to productive resources (labor, capital, seeds, and other farm inputs)		

Post-harvest losses due to poor infrastructure (roads, storage, processing facilities)		
Access to updated information on GAPs		

3.2. How will you rank the rice production constraints in order of severity on a scale of 1-5? 1= very Severe, 2= severe, 3= mild

Constraints	Rank **1 = Very severe** 2 = Severe 3 = Mild	ONE suggested solution
Access to market information		
High cost of farm inputs e.g. seed, fertilizers, agro-chemicals		
Low price of farm produce		
Unstable price of inputs and produce		
Little or no power to determine the price of produce		

3.2. Mention three areas where you think efforts to assist farmers by the extension agents should concentrate in the coming years.

1

2
3

Thank you for your time

Appendix D: Focus Group Discussion Guide

Focus Group Discussion Guide for Farmers

PROCESS

Step 1: Introduction session

- Opening remarks and introductions
- Background information about the location (District, villages, and location of interview)
- Explain the objectives of the meeting
- Request for consent to; a.) participate, b.) take notes, c.) photos, and d.) recordings. Use a voice recorder and transcribe information
- Create rapport
- Record the number of participants in each group, take attendance list: Age, telephone contact (where applicable), and signature, and be observant of the non-verbal expressions.

Background Information

No.	Items	

01.	FGD number	
02.	Date	
03.	Start time	
04.	End time	
05.	Facilitator	
06.	Note taker	
07.	County	
08..	District	
09.	Village/Farming Community	
010.	Type of group	
011.	Name of group	
012.	Composition of group study participants (Male, Female, Youth and Total)	

i. What are the main crops grown in this area? (Rank in order of importance)

- Do you have access to rice technologies?
- List rice varieties you grow in this area, improved and local.
- List of complementary technologies used under rice production.
- Sources for rice varieties used as well as agronomic and market information for rice

ii. What is the average total land acreage under (crop) production for households in this area?

iii. What is the average household land acreage under locally improved rice varieties?

iv. Which organizations and actors provide extension services regarding rice production in the Foya District? (Probe for both public and private extension agents).

v. Perception about the quality of extension agents in this area

a. Which actors have not been involved in your community and yet they are important for delivery of extension services for rice?

b. What challenges have you faced in accessing extension services for rice? Probe for any limitations for the different gender categories based on the activities and the process

c. How can those challenges be addressed?

d. What strategies should be used to enhance the uptake of rice Good Agricultural Practices in Foya District? Please rank the strategies and give reasons.

e. What roles should the Government play in supporting the extension service delivery in the Foya District? Please rank the roles and give reasons

Thank you for your time

Appendix E: Key Informant Interview Guide

I am aware that my participation in the study is entirely voluntary and there will be no monetary compensation for my involvement in the survey. I understand that the findings from the study will help to improve the delivery of agricultural extension to rice farmers to increase rice production. I also understand that the information that will be provided will be used only for this research. The findings of this study will serve as a reference for future research in and out of Liberia. I have been promised that my name will not appear in the report of this study and have the right to withdraw from the study at any stage of the group interviews and have the right not to answer any question, which I am not comfortable with.

I am fully aware that the information provided will be recorded, and I give my consent by signing this form; also consent to sign the attendance log and to have my picture taken.

You can contact the researcher for any clarity on, or in case, you wish to withdraw from the study through the following means:

Phone Contact: +231886957298/+231778728630/ WhatsApp: +231886957298 Email: aughinn@gmail.com

If you accept the above conditions and agree to participate in the individual interviews and/or focus group discussion, please sign this informed consent form as indicated below:

_____ _____

Name & Signature Date

KEY INFORMANT AND GROUP INTERVIEWS GUIDE

Step 1: Introduction session

- Opening remarks and introductions
- Background information about the location (District, villages, and location of interview)
- Explain the objectives of the meeting
- Request for consent to; a.) participate, b.) take notes, 3.) photos, and 4.) recordings
- Record the number of participants in each group, take attendance list, and be observant of the non-verbal expressions.

OBJECTIVE 1: Characterize agricultural extension services delivery to rice-producing farmers in the Foya District of Lofa County

Access to Extension Information

i. How do you access updated information on good agriculture practices in Foya District? Which type of information do you access?
ii. Which initiatives have been implemented by either the government or non-governmental organizations to foster the integration of smallholder farmers, women, and the youth in rice production? Which institutions are they and which interventions are they implementing? What have been the effects of these interventions?

iii). How has rice production changed in Foya District in the past 10 years?

iv). What roles does the Government play in supporting the extension service delivery in the Foya District?

A. MARKETING OF FARM PRODUCE

Initiative/intervention	Organization	When was it introduced?	How are farmers supported (probe for methods and approaches)	How have farmers benefitted?	What are the constraints associated with the intervention?

A1: To whom do the majority of the farmers in this community sell their rice produce? How do farmers identify the various buyers? Where are the buyers located? What prices are offered by the buyers? Why do farmers sell their produce to the identified buyers? What are some of the challenges that farmers face when dealing with the identified buyers?

Buyer	How is the buyer identified?	Where is the buyer located?	Why do farmers sell to this buyer?	What challenges do farmers face	What kind of buyer would the	What are the reasons for preferring these buyers?

				when dealing with this buyer?	farmers prefer to sell to?	

A2. How would you describe trends in the price and volume of rice sold as well as quality requirements in the past? Can you provide us with reasons for the observed trend?

Variables	Past trend[1]	Reason
Price		
Volume sold		
Quality requirement		

[1]1=Increased, 2=Decreased, 3=Remained the same, 4=I don't know

A3. How do the majority of the farmers in this community sell their rice and its products? Which type of rice and its products **are marketed individually** by the majority of the farmers? Which ones are marketed collectively by most of the farmers? Are there specific reasons why these products are marketed individually or collectively?

Type of rice and its products marketed	Type of marketing (individual or collective)	Reason for the type of marketing	Challenges in using the type of marketing

A4. List of farmers selling rice collectively. What challenges and benefits of collective marketing do they experience?

Name of the group	Benefits	Challenges

B: ACCESS TO BUSINESS DEVELOPMENT SERVICES

B1. From which institutions/organizations do farmers in this community obtain the following business development services for rice? Where are these service providers located? How do you describe your level of satisfaction with the services provided? What can be done to improve the availability and quality of the services? ([1]satisfaction: 1=very satisfied, 2= partly satisfied, 3=not satisfied)

Services	Source	Location	Satisfaction[1]	Improvement
Credit				

Inputs				
Transport				
Storage				
Extension service				
Harvesting				

Post-harvest handling				
Processing				
Market information				
Quality assurance				

1. OBJECTIVE 2: Identify factors affecting the performance of agricultural extension workers towards supporting rice-producing farmers in the Foya District.

The table below shows the qualities of a good extension worker. Rank their abilities in these areas from 1-5 and state one reason for the rank given. 1=poor; 2=fair; 3=good; 4= Very good; 5= Excellent (Please probe and explain before recording responses)

Qualities	Rank	Reason
Ability to communicate		
Ability to relate with farmers and other actors		
Ability to provide production information		
Ability to provide nutrition information		
Ability to innovatively provide market information i.e. prices, market outlets, quality, etc.		
Ability to innovatively provide market information, climate change and climate-smart agricultural practices		

Ability to innovatively provide information on business development services e.g. insurance, standards, transport, etc.	
Ability to provide information on value addition and value chain approaches	
Ability to constantly follow up with the farmers	

1. OBJECTIVE 3: Explore strategies to improve agricultural extension service delivery to boost rice productivity among smallholder farmers in Liberia.

i. Which actors have not been involved in your community and yet they are important for delivery of extension services for rice production?

ii. Which challenges have you faced during the process of providing extension services for rice? Probe for any limitations for the different gender categories based on the activities and the process

iii. How can those challenges be addressed?

iv. What strategies should be used to enhance the uptake of rice Good Agricultural Practices in Foya District? Please rank the strategies and give reasons.

v. What roles should the Government play in supporting the extension service delivery in the Foya District? Please rank the roles and give reasons

Thank you for your time

Appendix F: Post VIVA Corrections

UGANDA CHRISTIAN UNIVERSITY

DIRECTORATE OF POSTGRADUATE STUDIES DISSERTATION CORRECTION COMPLIANCE FORM (POST VIYA FORM)

Date: September J6, 2025

Name of Candidate Reg. No: S21M43/002

Title of Dissertation: Effects of Agricultural Extension Service DeliYery on Rice Productivity in Liberia: A Case Study of Foya District

COMMENTS	CHANGES MADE	INDICATOR
1. Conceptual and Theoretical Frameworks		
The conceptual framework must be explicitly connected to the study title to avoid appearing detached from the research problem	The conceptual framework was improved; it now shows clearly how extension service delivery is tinked to ric e productivity in fig ure 1	Revised conceptual framework aligned to the research objectives Page 8
The theoretical framework is currently missing from the presentation. Incorporating a releYant theory is essential to ground the study academically and provide justification for linking extension services to productivity.	The Participatory Extension model was adopted as the theoretical framework to define key variables of the study and connect the study to existing literature.	A theoretical framework provided on Page 7
Productivity should be conceptualized and explained within a recognized theoretical	The new conceptual framework explains how agricultural extension services delivery is linked to rice	The Participatory Extension model used as a theoretical framework (Roche et al., 2020). Pages 6-7

framework rather than relying solely on personal interpretation.	productivity. The definition for rice productivity is stated on land productivity, which is measured by dividing the crop produced by the size of the planted land, expressed in a unit area in hectares or acres.	Definition of Productivity within the theoretical framework Page 7 The revised conceptual framework aligned to the research objectives - Page 8
2. Clarification of Variables	____	_____
The independent variable should be clearly identified as agricultural extension service delivery. The conceptual model presently creates confusion by presenting loosely connected boxes that resemble three separate studies rather than one coheFent analysis.	The conceptual framework has been improved, indicating the independent, dependent, Intermediate, and contextual variables.	Revised conceptual framework on Page 8
The notion of uptake is not a component of service delivery. Instead, uptake should be treated as an intermediate variable, since service delivery may or may not result in adoption depending on farmers' capacity and willingness.	Uptake was removed as an indicator of an independent variable. Intermediate variables, contextual factor, and adoptions/ uptake of improved rice production practices were added in the conceptual framework.	Revised conceptual framework on Page 8
Similarly, capacities are better positioned as intermediate Yariables and not as direct elements of extension service delivery.	The Conceptual Framework was modified and capacity was captured as intermediate variable	Revised conceptual framework on Page 8

The use of strategies within the framework appears misplaced. Strategies should be treated as potential outputs or outcomes of extension processes rather Lhan as study variables.	The framework has been revised, it focuses variables affecting the dependent variable, rice productivity	Revised conceptual framework on Page 8

2

3. Refinement of the Conceptualization of Extension Services		
Extension services, as the independent variable, should be broken down into identifiable delivery channels such as face-to-face training, demonstration plots, farmer groups, feedback sessions, and contact farmeF approaches. These can then be systematically linked to productivity outcomes.	Conceptualization of agricultural extension service delivery improved	Revised Conceptual Framework on page 8
4. Clarification of Productivity as a Dependent Variable		
Productivity should not be confused with general output. Instead, it should be properly measured as yield per unit area (e.g., kilograms per hectare). Indicators such as acreage planted or general production volumes do not directly capture productivity and must be carefully distinguished	Land productivity is measured by dividing the crop produced by the size of the planted land, expressed in a unit of area in hectares or acres. It IS presented as yield (kg/acre) in the conceptual framework on page 8	Revised Conceptual Framework on page 8
The study should illustrate how extension training or demonstrations influence measurable changes in productivity, thus allowing for a more direct cause-and-effect relationship.	Linear regression was used to determine the relationship between extension service delivery and rice productivity.	Table #1: Extension service and relationship with rice productivity r .c :.‹ t:' '/' .'.'
5. Methodological and Analytical Issues		
The design and rationale of the four focus group discussions need to be clearly articulated, specifying what guided them and how they generated useful insights for the study.	The data collection procedure was modified to clearly state what informed/guided the collection of FGD data, as well as the selection criteria for FGD participants, which formed the basis of the insights they	*3.5. Population and sampling techniques (pages I7 6 IB)* Table 2: Data Collection equipment and Instruments. Page 20

	provided to the study. The FGDs mainly informed communal factors such as rice varieties and their sources, and common extension challenges faced.	*Appendix D: Focus Group Discussion ifi uide (Page 72-74)*
The thematic analysis must be systematically presented, but it should not be treated as an output in itself. Rather, it should serve as a means of interpreting data that informs the results and discussion.	The section on Data Processing and Analysis was modified to describe how thematic analysts was used to interpret data in ways that informed the results and discussion on page 21	3.9. Data processing and analysis. page 21

Approved:

Supervisor

Barbara Mugwanya Zawedde, Ph.D. _____

Date: 18/09/2025

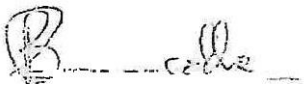
Date:

Damalie Babirye Magala, Ph.D. _____

Date: 18/09/2025

APPROVAL

’lle the undeisignec, öec\aï e that the dissertation by Mr. Augustine Bowuo Hinneh, ‹ítled “Efrec-s of agriculturcl E::censi0n Service Oe\ivery on Rice Produttivity Among Smzl!hoîce, ïc rmers in Liberia: A Case of Foya District”, has been done Finder our guidance as university supervisors.



26/04/2025

Da 18/07/2025

Post viva approved

18/09/2025

Date