DETERMINANTS OF DEMAND FOR QUALITY DECLARED RICE SEEDS IN NWOYA AND GULU DISTRICTS, NORTHERN UGANDA

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BSc. ECONOMICS (GU)

RE. NO: 18/U/2869/MAE

A DISSERTATION SUBMITED TO THE INSTITUTE OF RESEARCH AND GRADUATE STUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN AGRI-ENTERPRISES DEVELOPMENT OF GULU UNIVERSITY

JANUARY, 2024

DECLARATION

I, Apiyo Scovia Perphency declare that this research is entirely my own original work and that it has not been submitted and /or published for any academic award at any other University.

Signature.....Date 11/01/2024

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ACKNOWLEDGEMENT

I acknowledge with gratitude the support of all those who contributed towards the successful completion of this study especially the Rice Community Action Research Programme Plus (Rice CARP+) project for financing this study. My heartfelt special gratitude goes to Assoc Prof. Basil Mugonola for his financial support at the time when all my hopes of the completion of this study was no more. I also acknowledge the kind guidance, encouragement, and support from my second supervisor; Dr. Akite Irine. My sincere thanks also go to my enumerators, friends and everyone who contributed positively and meaningfully in one way or the other towards achieving this. I further extend my heartfelt gratitude to my lovely mother Mrs. Florence Okello, my brothers Okello Innocent, Odong Okwonga Reagan, Olanya Derick, Rwotngeyo Jerimiah, Marparwot Isaac and my only sister Lagum Hazamaveth, for your moral support.

I wish to sincerely appreciate the father of my children Mr. Ochan Geoffrey for his relentless support and encouragement.

Above all, I give special thanks to God Almighty for His love, favor and guidance. Without Him this journey would have been impossible. Thank you, Lord.

DEDICATION

This work is dedicated to my beloved children Agenorwot Charity Kimberly, Deyoparwot Cephas and their father Ochan Geoffrey. Furthermore, I would love to dedicate this work to my beloved mother Mrs. Florence Okello and my deceased father who relentlessly and tirelessly loved, cared, supported and sacrificed all they had for my academic career; May the Almighty God bless you abundantly.

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LIST OF ACRONYMS

CGIAR	Consultative Group on International Agricultural Research
DQDRS	Demand for Quality Declared Rice Seeds
EA	East Africa
EFA	Exploratory Factor Analysis
FAO	Food and Agriculture organization
GUREC	Gulu University Research Ethics Committee
KMO	Kaiser-Meyer-Olkin
LSB	Local seed business
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
NaCRRI	National Crop Resource Research Institute
NARO	National Agricultural Research Organization
NERICA	New Rice for Africa
NGOs	Non-Governmental Organizations
NSCS	National Seed Certification Service
OLS	Ordinary Least Square
QDRS	Quality Declared Rice Seeds
SHFs	Smallholder Farmers
SSA	Sub-Saharan Africa
SHRF	Small Holder Rice Farmers
SPSS	Statistical Package for Social Scientists

ABSTRACT

Most (over 89%) smallholder rice farmers in northern Uganda obtain rice seeds from informal sources which are uncertified and unregistered and this affects the yields and seeds quality in the rice farming business. This study investigated the determinants of smallholder farmers' demand for quality-declared rice seeds in Northern Uganda. A cross-sectional study was conducted, and data were collected from 196 selected smallholder rice farmers from Nwoya and Gulu districts using simple random sampling method. All data obtained were entered, cleaned and analyzed using Statistical Package for Social Sciences (SPSS) version 27.0. Exploratory factor analysis and descriptive statistics was used to examine attitudes and quality declared rice seed distribution channels used by smallholder farmers respectively. Binary logistics regression model, chi-square tests and t-tests were generated to compare means at 10%, 5% and 1% significant level. Significance ($p \leq 0.01$, $p \leq 0.05$ and $p \leq 0.1$) were observed in the use of communal labour**, participation in rice seeds demonstration/trials*, access to extension services**, attitude on ease of getting quality declared rice seed** respectively. The study also revealed that farmers possess a positive attitude towards quality declared rice seeds, much as they face challenges in accessing and affording such seeds. Formal, informal and semi-formal distribution channels for quality declared rice seeds were identified. Formal channels involved seeds sourced from the national research organization that produce foundation seeds and supply them to private business-oriented seed companies, which then produce quality-declared rice seeds on a commercial scale. Informal sources comprised of farmer-saved seeds or seeds obtained from traders within the community who stock them for sale to smallholder farmers in subsequent seasons. Semi-formal channels involved quality declared seeds produced by NARO supplied to local seed business who then sell to local smallholder farmers. Based on the findings, the study proposes that government should provide incentives to smallholder rice farmers to facilitate their purchase of quality-declared seeds, thereby boosting their production. Government or commercial organizations should establish quality-declared rice seed outlets across the region to enhance accessibility. Lastly, policymakers in collaboration with private companies could enact policies aimed at reducing the cost of quality-declared rice seeds, making them more affordable to smallholder farmers.

Keywords: Rice seed, declared quality, demand, smallholder farmers

CHAPTER ONE: INTRODUCTION

1.1 Background

Rice is the most widely consumed and the world's most important food crop. This is attributed to that fact that it is the staple food for over 50% of the world population particularly for a number of countries in Asia and Africa (Nandi et al., 2012). It comes second to corn in terms of worldwide production and provides one-fifth of the calories consumed worldwide (Wagan et al., 2016). Rice has the potential to foster rural development, improve nutrition and boost food security and the worldwide consumption rate has been increasing due to the growing population (Ghose, 2014). Rice plays a vital role in the nutrition and livelihoods of billions of people across the World (Gadal et al., 2019a). It is a primary source of sustenance for a significant portion of the world's population, particularly in Asia, where it is a dietary staple for many cultures.

Rice cultivation dates back thousands of years and has deep cultural, social, and economic significance in many regions (Spengler et al., 2021). Rice production has steadily increased over the years to meet the growing demand with the major producing countries being China, India, Indonesia, Bangladesh, Vietnam, Thailand, and others in Asia (Milovanovic & Smutka, 2017). These countries account for a substantial portion of global rice production. Additionally, some African countries like Nigeria and Egypt, as well as South American countries like Brazil, also contribute to the world's rice supply (Singh et al., 2021).

As the global population continues to grow, the demand for rice is expected to increase, putting pressure on the agricultural sector to produce more efficiently. To meet this demand, farmers must have access to high-quality rice seeds that are disease-resistant, stress and salinity tolerant, high-yielding, and well-suited to local climatic conditions. Quality declared rice seeds are essential for ensuring consistent crop yields and maintaining the overall quality

of the rice produced (Chauhan, 2017). These seeds are produced and certified by agricultural authorities to guarantee their authenticity, purity, and genetic traits. Quality declared rice seeds generally have higher germination rates, better resistance to pests and diseases, and improved yield potential compared to traditional seeds (Wimalasekera, 2015).

New rice varieties are newly developed rice seeds with potentially improved characteristics like higher yields, pest resistance, or better adaptability to specific environments. Not all new varieties are automatically deemed quality declared. They undergo testing and evaluation (including factors like yield, grain quality, and disease resistance) before receiving this designation.

Quality declared rice seeds on the other hand are certified seeds of specific rice varieties that have met predefined quality standards set by an authority (e.g., government agency). To be quality declared, seeds must be from an approved variety which may or may not be a new variety, genetically pure and free from contamination, grown under specific good agricultural practices to ensure high quality, and treated & packaged according to approved standards. A new rice variety can become quality declared seeds if it meets the necessary quality standards and certification processes. However, not all new varieties will achieve this status, and some farmers may still choose to use uncertified seeds of new varieties even though they wouldn't qualify as quality declared.

Ensuring the availability of quality declared rice seeds on a global scale is crucial for enhancing agricultural productivity, food security, and the livelihoods of smallholder farmers. Governments, international organizations, and agricultural research institutions collaborate to develop and disseminate quality declared rice seed varieties (Mangeni, 2019). This process involves breeding programs, field trials, and seed distribution initiatives to reach farmers in various regions. However, despite efforts to promote quality declared rice seeds, challenges still exist on a global scale. Some farmers face difficulties accessing quality declared rice

seeds due to factors such as limited distribution networks, affordability, or lack of awareness about their benefits (Ariga et al., 2019). Furthermore, climate change poses additional challenges as rice cultivation may need to adapt to changing weather patterns and environmental conditions (Schneider & Asch, 2020).

In Africa, rice has become a strategically important food crop in many African countries where consumption among urban poor households has increased substantially.

This has therefore made rice an important economic crop and the major staple for millions of people in Sub-Saharan Africa (Nandi et al., 2012). The rice market in Africa is filled by the imported rice especially in sub-Saharan Africa that transformed from a net food exporter to a net food importer for the last four decades (Oyejide et al., 2019). It has been argued that consumption of imported rice increased from 2.2% in 1961 to 43% in 2009 and it has not been able to match the growth in demand with the domestic supply. This means that the consumption of rice in Africa exceeds its production. More so, rice that is imported has high quality standards and it outcompetes the domestic rice that has very low quality standards (Demont & Ndour, 2015).

In Uganda, rice was not the major food security staple Leliveld et al., (2013), however according to Akongo et al (2016), rice has recently become a major food security and cash crop in Ugandan economy making it the second major cereal crop after maize. Rice production has steadily increased from 8,200 tons in 1996 to 237,000 tons in 2014. Despite the increase in production, Ugandan domestic rice production cannot meet the rising demands of especially all the urban consumers and therefore the deficit is covered via imported rice. This is because of the rapid population growth and urbanization that resulted into increase in rice consumption hence, the increase in importation of 60,000 tons of rice annually (Kijima, 2019)

Northern Uganda's fertile plains are increasingly being covered with rice paddies and its contribution to the national harvest steadily rising. Northern Uganda contributes a remarkable 25-30% of the national rice harvest, translating to roughly 175,000 to 210,000 metric tons annually (Chandio & Yuansheng, 2020). This impressive figure underscores the region's rapid growth, placing it firmly on the map as a significant contributor to Uganda's rice basket.

Production levels in Northern Uganda have been steadily increasing over the past few years. Reports suggest a growth rate of approximately 5-7% annually (MAAIF Performance Report, 2017). This upward trend signifies the collective efforts of farmers, government initiatives, and private sector investments in the region's rice sector.

Ugandan seed sector is composed of seed systems that include institutions or individual carrying out production, multiplication, breeding research, selection development, processing, storage, distribution, and marketing of seeds. The seed sector is characterized by the production and marketing of minor and major crop species and this implies that, the seed industry comprises of actors who are producing crop seeds of different varieties with quality assurance and the way in which the seeds should be distributed. In summary, a seed system incorporates all the different ways by which farmers can easily access seed including the actors involved in the chain. Therefore smallholder farmers get involved in any seed system that helps them obtain the seed they need for their production (Kansiime & Mastenbroek, 2016). In Uganda, there are three different seed systems namely; informal, formal and intermediate/semi-formal systems and they all have different meanings. Waithaka et al (2021) explains that seed in the informal seed system is sourced mainly from farmers' saved seed for own use, farmers exchanging seeds with neighbors, farmers' groups growing seeds for sale through informal channels and community-based seed multiplication and dissemination.

On the other hand, formal seed system is regulated by the public sector. It is responsible for

improved and Quality declared rice seeds in Uganda through structured system of variety development, release, quality control, multiplication and distribution (Kansiime & Mastenbroek, 2016). The public sector ensures the regulation by inspection process known as certification which enables the seed to be of recognized variety with low incidents of pest and disease susceptibility.

Lastly, intermediate/semi-formal seed system which is a new seed system in Uganda has been created due to the market oriented groups that are beginning to invest in the production of quality declared Seed (QDS) of major food crops in which companies are not fully involved (Kansiime & Mastenbroek, 2016). The delivery of quality seeds to smallholder farmers who cannot afford more expensive quality declared rice seeds have been made easier by creating the intermediate system.

The semi-formal or intermediate, seed system operates at the intersection of the formal and informal seed systems, offering a unique blend of structure and flexibility (Agriculture and Food Security, 2018). In this system, seeds undergo a level of certification and quality control, ensuring they meet minimum standards (Louwaars et al., 2013). Government agencies typically regulate and provide oversight, and private seed companies play a significant role in producing and distributing seeds that meet these standards (Dorward et al., 2019). Agricultural extension services often bridge the gap between research institutions and farmers, disseminating information about improved varieties and best practices. What sets the semi-formal system apart from the formal one is its adaptability and lower regulatory burden (Spielman et al., 2010). It can quickly respond to local needs and preferences, making it well-suited for diverse agro-ecological conditions and cropping systems.

In contrast to the informal system, the semi-formal system offers quality control and commercialization, making it a vital link between formal research and small-scale farmers

(Maredia et al., 2012). Central to this system are local seed businesses (LSBs), community-based entities that produce, process, and distribute seeds, often bridging the gap between formal and informal sources, and contributing to agricultural sustainability at the grassroots level (Louwaars et al., 2019).

The formal seed system industry was derived from initiation of public seed industry in 1968 under the ministry for Agriculture and cooperatives (Waithaka et al (2021). However, before 1968, the seed sector in Uganda was predominantly informal and improved varieties were passed on from farmer to farmer (Ssebuliba, 2010).

Furthermore, currently the seed system is still dominated by the informal system that contributes up to 91% of the seeds for farmers (Kansiime & Mastenbroek, 2016). Both NARO and NaCRRI are involved in rice seed breeding and multiplication where the seed certification unit of MAAIF certifies the released and multiplied foundation before sale to farmer (MAAIF Performance Report, 2017). However, smallholder farmers (SHFs) in northern Uganda are faced with so many challenges that hinder them from increasing their rice productivity level among which, is inaccessibility to improved quality declared rice seeds. According to Palladium (2020), the smallholder farmer's lack of access to quality declared rice seeds (QDRS) in northern Uganda is attributed to local seed businesses supplying weather tolerant rice seeds to mostly large scale farmers who can afford to pay in cash thus making it difficult for smallholder rice farmers to acquire QDRS hence, partly excluded from its business.

1.2 Statement of the problem

Despite government efforts like releasing improved rice varieties such as NARIC 1, NERICA 4, and NARO RICE 1 (PR107) to boost productivity (Chandio & Yuansheng, 2018), 89% of Northern Ugandan farmers still rely on low-quality seeds from informal sources (Teeken et

al., 2018). This includes own saved seeds, local produce markets, and neighbors (Teeken et al., 2018), impacting their farming business as these seeds are often uncertified and unregistered, leading to lower yields compared to quality declared, certified seeds (Chandio & Yuansheng, 2018). While the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) actively promotes improved varieties and engages in rice seed research and development (MAAIF, 2017), studies like those by Kikuchi et al. (2016) on upland rice seed quality and Nangoti et al. (2019) on seed demand and supply in Eastern and Northern Uganda only partially address the issue. Notably, factors influencing the demand for quality declared rice seeds specifically traded under Local Seed Businesses (LSBs) in Northern Uganda hinges on both their attitude on these seeds (adaptability, income potential, ease of access) and their own circumstances (land, finances, labor). Strong government policies, supportive markets, and community buzz can further boost adoption. This study, therefore, aims to identify the key determinants of demand for such seeds within this context, filling this critical knowledge gap and informing targeted interventions to promote LSB-mediated adoption of improved varieties, ultimately maximizing their impact on farmer livelihoods and regional rice productivity.

1.3 General objective of the study

The overall objective of the study was to explore the determinants of demand for quality-declared rice seeds in northern Uganda

1.4 Specific objectives

1. To assess the smallholder farmers' attitude towards quality declared rice seeds in northern Uganda.
2. To determine the factors that influence smallholder farmers' demand for quality declared rice seeds in northern Uganda.

3. To assess the quality declared rice seed distribution channels in northern Uganda

1.5 Research questions

1. What are the attitudes of the smallholder farmers towards quality declared rice seeds in northern Uganda?
2. What are the factors that influence the smallholder farmers' demand for quality declared rice seed varieties in Northern Uganda?
3. What are the different distribution channels for quality declared rice seeds in Northern Uganda?

1.6 Significance of the Study

The study generated information that can be useful to small-scale rice farmers in addressing the impediments to increase their productivity levels. The report on mapping out the quality declared rice seed distribution channels could help smallholder farmers to know where to get quality declared rice seeds. The study also provided a guide to policy makers to come up with strategies and interventions that could encourage smallholder farmers to undertake planting of quality declared rice seeds. Furthermore, the research findings could be relevant to NGOs, the government, research institutions, and academia as a foundation for their future studies.

1.7 Scope of the study

The study was conducted from January 2020 to May 2020 which enabled a deep investigation into the determinants of smallholder farmers' demand for quality declared rice seeds during the specific planting season in Gulu and Nwoya districts. This period aligns with the crucial timeframe when farmers make decisions about seed choices for planting, providing relevant and timely data to understand their preferences and challenges. The study was conducted in Gulu and Nwoya districts justified by the significance in rice cultivation and the concentration of smallholder farmers in the area. Additionally, the study focused on farmers'

attitudes, demand factors, and distribution channels for quality declared rice seeds. These aspects directly influence farmers' seed choices and are critical components to understand the factors affecting the adoption of quality declared rice seeds.

1.8 Conceptual Framework

Based on the conceptual framework, socioeconomic characteristics as well as attitudes of smallholder farmers towards quality declared rice seeds often influence farmer’s decision to plant improved rice seeds. For instance, the young, educated farmers with higher income levels and positive attitudes towards innovation may exhibit higher demand, especially when they have access to agricultural extension services and well-established distribution channels (Gitleman & Kleberger, 2014). Experienced farmers with larger land holdings and negative attitudes may be less inclined to plant the quality declared rice seeds (Awan et al., 2015), highlighting the importance of addressing barriers and tailoring interventions to foster greater demand for quality declared rice seeds among smallholder farmers in Gulu and Nwoya districts.

Independent variables. **Dependent variable**

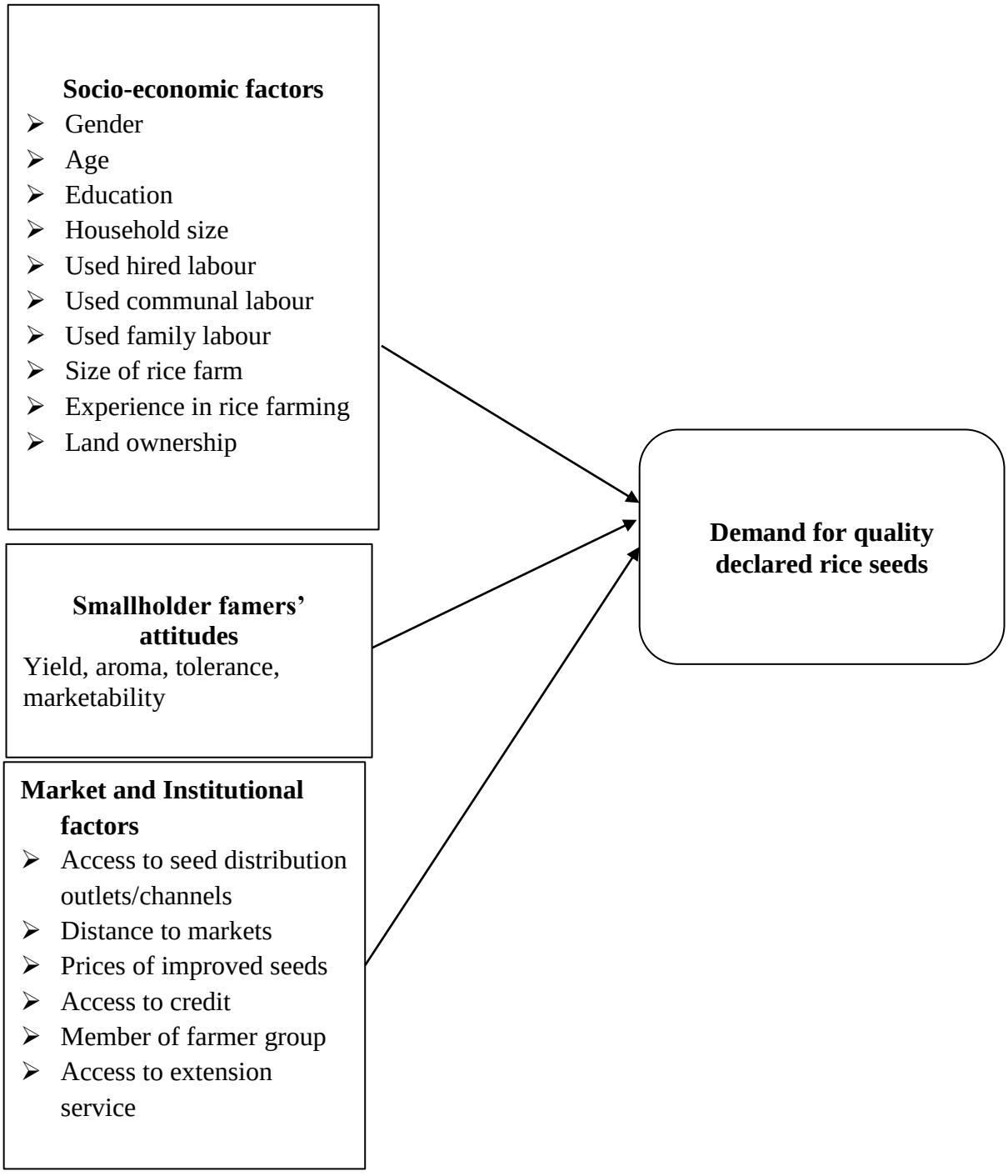


Figure 1. 1: Conceptual framework (Researcher's construction, 2023)

CHAPTER TWO: LITERATURE REVIEW

2.1 Overview of rice production

Rice is one of the cereal crops that is grown globally and Asia stands as the leading producer of rice among the six continents (Dawe et al., 2010). Asia alone accounts for over 90% of the world rice production. Accordingly, there has been a growth rate of over 2.5% in global rice production (Pandey *et al.*, 2010). However, Bandumula (2018) reports a slight lower account on rice production in the Asian countries from over 90% to 87%. Gadal et al (2019) recently reviewed Nepal as well as global rice production. They asserted that the Asian countries currently lead in the production of rice as compared to any other countries in the world. Of these, India dominates with the largest rice cultivation area while China is the leading world's largest producing country (Fahad et al., 2019). Gadal et al (2019) also point out that China is the largest producer recording approximately 145,500 million tons, followed by India with 103,500 million tons and lastly 7,900 million tons for Japan among the top ten producing countries worldwide.

Prasad et al (2017) pointed out that over 80% of the areas in the Asian countries are covered with rice. This shows why Asian countries dominate in the production of rice. Approximately 75% of this rice is paddy cultivated in the lowland areas (Fahad et al., 2019).

In Sub-Saharan African, approximately 10% to 15% of the arable lands in Africa are under rice cultivation, of which, the western region dominates the production on the continent (Niang et al., 2017). According to Boateng et al (2019), East and West Africa have greatly contributed to the increased production rice in the Sub-Saharan African.

East and West Africa have emerged as critical contributors to the ever-evolving landscape of rice production in Sub-Saharan Africa (Boateng et al., 2019). These regions, characterized by

diverse agro-ecological conditions and a deep-rooted dependence on rice as a staple food, have made substantial strides in boosting their rice production volumes.

West Africa has seen Nigeria take center stage as a powerhouse in rice production. As of 2020, Nigeria claimed the top spot in the region, with an estimated rice production exceeding 4.9 million metric tons (FAO, 2020). The Nigerian government's proactive efforts to promote domestic rice cultivation, driven by initiatives like the Anchor Borrowers' Program and the Rice Farmers Association of Nigeria (RIFAN), have been instrumental in achieving this self-sufficiency goal. Additionally, Senegal, another prominent player, contributed an estimated 950,000 metric tons in 2020 (FAO, 2020). Rice stands as a fundamental dietary staple in Senegal and the nation has committed to enhancing its domestic production capacity.

East Africa, with its own unique agricultural landscape, has witnessed countries such as Tanzania and Uganda emerge as significant rice producers. In 2020, Tanzania's rice production reached an estimated 2.7 million metric tons (FAO, 2020), marking its prowess in the region. Rice plays a vital role in Tanzania's food security, and the government has been implementing various strategies to bolster production, including the promotion of improved rice varieties and farming practices. Meanwhile, Uganda, while on a smaller scale, contributed an estimated 250,000 metric tons to the regional production in 2020 (FAO, 2020).

In comparison to other cereals, rice production covers over 29% of the grain crops produced globally with approximately 13% in the 54 African countries (Atera et al., 2018). Comparatively, an earlier study by Prasad et al (2017) revealed that an approximate 20% contribution of the rice grains to the overall cereal production globally. In Uganda, a survey report by Masao, (2013) pointed out that the production of rice was negligible in the last decades. Even though, Haneishi (2014) shows that there has been a rise in the production of rice in Uganda since 2010. He asserted that this rise has been contributed by the increase in

knowledge, access to land, and favorable weather condition among other socio-economic and biophysical factors.

Historically, the production of rice in northern Uganda was relatively modest, as indicated by local surveys (Campenhout, 2021). However, the agricultural land use and crop choices began to shift around 2010, as highlighted by (Kijima, 2019). This transformation was not isolated, it was part of a broader trend in which rice production started to gain traction across the country. Kijima's research underscores the importance of local socio-economic and biophysical factors, such as increased farmer knowledge, improved access to arable land, and favorable weather conditions, in driving this growth.

In Nwoya and Gulu districts, rice farming began to emerge as a significant agricultural activity, marking a pivotal departure from previous decades when rice production was limited. As these districts embraced rice farming, smallholder farmers faced various challenges and opportunities, including access to improved rice seeds, which forms the core focus of this study.

2.2 Overview of quality declared rice seeds in Uganda

Quality declared rice seeds (QDRS) are a subset of rice seeds that have earned a quality stamp of approval. They meet rigorous standards for germination rate, purity, disease resistance, and agronomic traits, ensuring optimal yield potential and resilience. QDRS are produced under controlled conditions and distributed through formal channels, guaranteeing their quality and trustworthiness.

Quality declared rice seeds (QDRS) play a pivotal role in enhancing agricultural productivity, food security, and rural livelihoods in Africa, including Uganda. QDRS represent improved seed varieties that have undergone testing, evaluation, and certification by national seed regulatory bodies or agricultural institutions (Vernooy et al., 2022). These seeds are

characterized by their genetic purity, high germination rates, resistance to pests and diseases, and suitability for specific agro-ecological zones. QDRS aim to provide farmers with reliable access to high-quality seeds, which can significantly boost crop yields and contribute to sustainable agricultural development.

In Uganda, where agriculture is a crucial sector employing a substantial portion of the population, the adoption of quality declared rice seeds is of paramount importance. Rice is a staple food for many Ugandans, and its cultivation supports both rural economies and urban markets (Ntakyo & van den Berg, 2019). QDRS adoption can lead to improved yields, reduced post-harvest losses, and enhanced resilience against climate variability. However, despite their potential benefits, the widespread adoption of QDRS in Uganda faces challenges. These challenges can include limited awareness among farmers about the advantages of using quality declared rice seed, inadequate distribution systems, affordability issues, and sometimes a preference for traditional seed varieties due to cultural practices or familiarity.

The Ministry of Agriculture (MAAIF), in collaboration with research institutions like the National Agricultural Research Organization (NARO) and development partners like the Food and Agriculture Organization (FAO), are driving QDRS adoption through seed multiplication by companies like Victoria Seeds (NERICA 4, NAROs 1) and SeedSol (NERICA 10, 17) (UNSP, 2023). This is coupled with farmer training and awareness campaigns highlighting the benefits of using high-quality QDRS varieties certified by the Uganda National Seed Project (UNSP) and Uganda Seed Regulatory Authority (USRA) (MAAIF, 2022).

Additionally, strengthening distribution networks and improving access to QDRS in remote and rural areas are crucial components of enhancing adoption rates.

2.2 Attitudes of smallholder farmers towards Quality declared rice seeds

Smallholder farmers' attitudes play a crucial role in shaping the demand for quality declared rice seeds (QDRS), impacting sustainable agriculture and crop productivity (Ojiewo et al., 2019). Positive attitudes stem from the benefits of improved yields, resilience, and economic gains. This outlook aligns with a readiness to embrace innovation and is bolstered by awareness programs. Neutral attitudes result from limited awareness, with farmers neither endorsing nor opposing QDRS due to insufficient information or pressing concerns. Negative attitudes may arise from risk aversion, cultural ties to traditional seeds, and affordability concerns. These attitudes are not fixed; they evolve over time influenced by education and experiences. Successful QDRS adoption hinges on targeted interventions. Effective communication emphasizing benefits and addressing concerns can shape positive attitudes. Acknowledging issues like risk and affordability can mitigate negative attitudes, fostering informed decision-making. Understanding and addressing these attitudes are vital for promoting widespread QDRS adoption, advancing agricultural sustainability and productivity (Kansiime and Mastenbroek, 2016).

Smallholder farmers' attitudes towards QDRS are as diverse as the paddies they cultivate. These attitudes not only shape the demand for QDRS but also impact overall agricultural sustainability and crop productivity (Ojiewo et al., 2019).

Farmers who prioritize high yields tend to exhibit positive attitudes towards QDRS. Improved varieties promise significant yield increases, translating to enhanced food security and income. This resonates with farmers' eagerness to embrace innovation, especially when supported by effective awareness programs (Kansiime and Mastenbroek, 2016). For some farmers, aroma and taste take center stage. Studies like Karim et al. (2014) in Bangladesh showcase positive attitudes towards aromatic rice varieties, with education and experience playing a crucial role. Policymakers can support this segment by investing in research and

development of high-yielding, aromatic rice varieties.

Farmers facing unpredictable weather patterns or disease outbreaks often value QDRS for their tolerance to stress factors. This aligns with Karami & Mansoorabadi's (2008) findings in Iran, where farmers displayed a positive environmental attitude and preference for sustainable practices. QDRS varieties offering inherent resilience resonate with such farmers, promoting environmentally conscious agriculture. Some farmers see QDRS as a gateway to better marketability. Joshi & Bauer (2006) emphasize the diverse attitudes of smallholders, with some readily embracing commercialization opportunities when they understand the market potential of specific QDRS varieties. Linking farmers to quality management practices, as suggested by FAO (2014), further empowers them to capitalize on QDRS benefits.

A neutral attitude often stems from limited awareness. Farmers may neither endorse nor oppose QDRS due to insufficient information or pressing concerns unrelated to seed choice. Effective communication campaigns addressing knowledge gaps and concerns can nudge them towards a positive stance. Some farmers exhibit negative attitudes driven by risk aversion, cultural ties to traditional seeds, or affordability concerns. These concerns are valid and require acknowledgement. Tailored interventions addressing perceived risks and exploring cost-effective QDRS options can foster informed decision-making and mitigate negativity.

Attitudes evolve over time influenced and are often influenced by education, experiences, and local contexts. Understanding these dynamics and addressing them through targeted interventions is crucial for widespread QDRS adoption. By nurturing positive attitudes towards yield, aroma, tolerance, and marketability, we can pave the way for a more sustainable and productive agricultural future for smallholder farmers.

Understanding the attitudes of farmers has been one of the unpredictable concerns in the agricultural sector (Gaffney et al., 2019). Accordingly, Joshi & Bauer (2006) stressed that

attitudes of smallholders have never been the same. FAO (2014) analyzed smallholder farmers' attitudes towards commercialization in the case of maize in Kenya using the probit model. The results revealed that farmers had a positive attitude toward the commercialization of maize quality seed. The authors recommended that smallholder farmers should be linked to quality management practices such as drying and moisture content measurement tools.

2.3 Demand for quality declared rice seeds

A farmer demonstrates demand for QDRS when they exclusively use the QDRS varieties for all rice-growing activities across their entire landholding during the previous rice season (e.g., the harvest just concluded). This definition signifies active engagement with QDRS, emphasizing complete reliance on these improved seeds for optimal rice production. Research suggests that such complete adoption often stems from positive experiences with QDRS benefits, including increased yields, resilience to disease, and improved marketability (Ojiewo et al., 2019; Kansiime & Mastenbroek, 2016).

On the other hand, a farmer exhibits lack of QDRS demand when they choose not to use QDRS for any rice-growing activity on their land during the previous rice season. This definition includes non-adoption due to external constraints like lack of awareness or access, focusing on conscious decisions against QDRS despite availability (FAO, 2014). Understanding the reasons behind such non-adoption is crucial, as it might reveal concerns about affordability, perceived risks, or cultural preferences for traditional seeds (Joshi & Bauer, 2006; Karami & Mansoorabadi, 2008).

Quality declared rice seed (QDRS) creation and supply system, a notion mainly led by the United Nations Food and Agricultural Organization (FAO) in 1993 and restructured in 2006 is one of the alternatives to ensure a more supportive environment for smallholder farmer led initiatives (FAO, 2006). QDRS are central for reducing food insecurity and have relatively great commercial value catering for farming systems where advanced seed-quality regulator

activities are challenging to implement and often accommodate open pollinated varieties like legumes, minor cereals, as well as roots tubers more easily (Barriga and Fiala, 2020).

For nationally recognized seed companies, the demand for quality declared seeds represents a tricky business case, it is costly to deliver seeds to the last mile due to underprivileged market setup including roads and the network of agro-input dealers (Mastenbroek and Ntare, 2016). In Uganda, QDRS is a seed class fashioned by qualified and registered farmer-led enterprises, with seed field inspection done by authorized district agricultural officers (DAOs) and seed-testing done by National Seed Certification Service (NSCS) under MAAIF) and sold in the geographical region in which it is made (Molenaar *et al*., 2015).

2.4 Determinants of demand for quality declared rice seeds

Manan et al (2018) assessed the influencers of farmers' adoption of quality declared rice seeds in Punjab within India using the descriptive statistics. It was revealed that the selection and willingness to adopt the rice variety depends on the level of gross returns. Further, the results of the study pointed out that the majority of rice farmers were influenced by their land sizes, education level, market availability, extension activities, as well as seed sources and costs. Manan et al (2018) added that the demand for quality declared rice seeds increases with the release of a new variety.

Similarly, Kangile et al (2018) carried out an investigation on the dynamics of quality declared rice seeds among rice farmers in Tanzania. Both descriptive statistics and multinomial logit regression analysis methods were used in examining socio-economics characteristics of smallholder rice farmers. The factors mainly included gender, level of education, age, family type, land ownership status that influence the choice (preference) of a particular source of rice seed.

The results revealed that about 80% of the farmers had land ownership whereas the difference in the level of education and family type was not significant. Further, the study findings

revealed that 46.7% of the rice farmers had knowledge about quality declared rice varieties, although only 26% of farmers had grown one or more of the rice varieties. This implies that a quality declared rice seeds had gained popularity among rice farmers because local extension agents were the main source of information about the improved rice varieties. The authors concluded that the private sector and government institutions needed to embark on extensive demand and awareness campaigns regarding quality declared rice varieties to increase its demand among smallholder farmers.

Mogga et al (2019) investigated farmer's choice of rice types in the rice-growing areas of Southern Sudan using pairwise ranking. Participatory rural approach was used to collect data from the rice growers in the region. The authors, pointed out that the socio-economic factors that were important in predicting farmer's demand for rice varieties included age, family size, gender, education level, and marital status.

A study by Nandi et al (2012) examined socio-economic factors influencing farmers' adoption of high yielding rice varieties in Nigeria. The authors used descriptive statistics, logit regression and Likert scale measurement tools for analysis. Their study findings revealed that socio-economic factors such as age, education level, farming experience, access to extension services, farm size, household size, and labor positively influenced farmers' decision to adopt improved rice seed varieties. Further, the authors recommended that contact with extension agents should be adequately supported, monitored and assessed by the government to ensure effective dissemination of improved quality rice seed. Also, smallholder farmers should form associations to strengthen their capital base.

Another related study by Chidi et al (2015) analyzed socio economic factors and profitability of rice production in Nigeria using descriptive statistics, multiple regression model and factor analysis methods. Among the major socio-economic factors in the study area were age, gender, marital status, household size, education level, farming experience, occupation, farm

size, and income level. The study findings revealed that gender, occupation, and farmer acceptance had a positive and significant effect on rice production. However, rice production was constrained by unfavorable government policies such as economic and infrastructure problems. Further, the authors recommended that the government should work with social organizations and involve them in the distribution of necessary farm inputs to enhance rice production.

A study by Khanal & Maharjan (2014) on the factors influencing farmers' behavior in rice seed selling in Nepal found out that 65% of farmers sell 64% of rice seed produced by their households. Similarly, age, land, access to irrigation facilities and seed price posted a positive influence on both market participation and seed volumes sold. The authors concluded that training, irrigation, soil fertility, and shareholdings are important in motivating farmers in rice seed marketing.

2.5 Seed distribution systems in Uganda

Seed distribution channels play a key role in the sales of both agricultural and non-agricultural products. According to the World Bank (2007) & Mango et al. (2018), a larger percentage of agricultural producers' higher sales are through distribution channels that emerges after product-market liberalization which enables smallholder farmers to have multiple and potential marketing channels. This, therefore, calls for a stable and well-established channels that fetch more price spread (Shrestha, 2012).

Rice production in Uganda comprises of smallholder farmers, diverse stakeholders, and complex channels through which seeds, the lifeblood of the harvest travel. These farmers, the cornerstones of the system, cultivate their land across lowlands and sun-drenched uplands (MAAIF, 2017). But at the heart of this production lies a network of seed distribution, where formal and informal pathways intertwine, presenting both promise and risk.

Formal channels with government agencies, private seed companies, and agro-dealers offer

quality declared rice seeds (Agyemang et al., 2015). Yet, their reach is often narrow in the face of vast distances and remote villages, leaving farmers yearning for readily available options (Nangoti et al., 2004). This is where informal channels, a network of local markets, neighborly exchanges, and self-saved seeds step in, providing easy access but sometimes sacrificing quality assurance (Teeken et al., 2018).

Emerging as potential bridges between these two worlds are Local Seed Businesses (LSBs) holding the promise of bringing quality seeds closer to farmers while remaining sensitive to local contexts (Kiguli et al., 2020). However, their journey is often hindered by limited resources, training, and storage facilities, leaving their true potential untapped (Kiguli et al., 2020).

Access to quality seeds remains a hurdle, with cost, awareness, and limited distribution networks playing their part (Kikuchi et al., 2016). Weak quality control mechanisms further add to the uncertainty, while farmers grapple with the perceived risks of unfamiliar new varieties (Chandio & Yuansheng, 2018).

Despite these challenges, the seeds of hope are scattered throughout the system. Strengthening formal distribution networks while building trust and regulations around informal channels can pave the way for wider seed availability (Nyeko et al., 2015). Farmer education and knowledge-sharing initiatives can empower farmers to embrace the benefits of quality declared seeds (Ssekaaya et al., 2013). Robust quality control systems and empowered LSBs can further bolster confidence and bridge the gap between promise and reality (Kizito et al., 2012).

By harnessing these opportunities, Uganda can unlock the potential for a thriving rice landscape. Increased adoption of quality seeds holds the promise for robust harvests, improved food security, and ultimately, brighter livelihoods for the farmers who till the land, their dreams echoing across the fields like rustling rice stalks.

2.7 Summary of literature review

The literature review delves into the complex landscape of smallholder farmers' personalities and attitudes towards quality declared rice seeds (QDRS) and their implications for agricultural adoption. As key players in global food security, smallholder farmers' perspectives are pivotal in influencing the uptake of innovative seed varieties (McGuire & Sperling, 2016). Positive attitudes often stem from the benefits of QDRS, such as elevated yields, improved resilience, and economic gains. Farmers inclined towards these benefits often display a willingness to embrace agricultural innovation, viewing QDRS as a way to modernize practices and enhance competitiveness. Training and awareness initiatives further reinforce these positive attitudes, substantiating the advantages of QDRS through firsthand experiences. Conversely, negative attitudes manifest due to factors like risk aversion, cultural ties to traditional seeds, and financial concerns. Farmers who had a positive attitude on adoption of QDRS to local environment as uncertain or incompatible with their existing practices may resist change, especially if traditional methods have yielded success in the past.

It is crucial to recognize the malleability of these attitudes over time. Farmers' perspectives are dynamic and can evolve through education, experiences, and interactions with agricultural services.

Effective communication strategies emphasizing benefits and successes of QDRS can positively shape attitudes, particularly for those currently neutral or resistant. Addressing concerns related to risk and affordability is vital to mitigate negative attitudes, allowing for informed and confident decision-making.

CHAPTER THREE: METHODOLOGY

3.1 Study Area

The study was conducted in Nwoya and Gulu districts in Northern Uganda. The choice of the study areas was two-fold; firstly, these areas comprise of steady growth in rice production and secondly, the intensity of rice production is higher compared to other districts in the region. Nwoya district being one of the districts in the northern part of Uganda comprises of smallholder farmers dealing in rice production. Nwoya district is located at coordinates of 02 - 38 degrees north and 32 - 00 degrees east. Nwoya has a total land area of 4,736.2sq km with a population of 133,508 (UBOS, 2017). On the other hand, Gulu district has a total area of 3,626sq km with coordinates of 02 – 50 degrees north and 33 – 05 degrees, with a total population of 186,696 people (UBOS, 2017). Both districts embrace farming as the major economic activities given the fact that they both have vast fertile arable land and rice is one of the renowned commercial crops in the area.

3.2 Research Design

This study used a cross-sectional design in the two districts of Nwoya, and Gulu. The cross-sectional research design was chosen to collect data different individuals at a particular point in time. This approach is considered appropriate since the data on the determinants of smallholder farmers' demand on quality declared rice seeds and all the necessary information required was captured at once at a specified point in time.

3.3 Target population

The target population of this study was smallholder rice farmers in Nwoya and Gulu district districts.

3.4 Sample size determination

The sample size was calculated using the formula for an unknown population size below

$$n = \frac{Z^2 p(1-p)}{d^2} \quad \text{..... (Equation 1)}$$

Where, n = sample size; Z – z-value at confidence level (95%); *p* = proportion of an attributes in the sample population' and d = precision level. Basing on the above formula, with Z=1.96, p=0.85 and d=0.05, $n = \frac{1.96^2 * 0.85(1-0.85)}{0.05^2}$= 196 smallholder rice farmers.

3.5 Sampling technique

A multi-stage sampling technique was used where the two districts of Nwoya and Gulu were purposely selected in the first stage because they had a higher number of smallholder rice farmers in the region. The second stage involved purposive selection of leading rice producing sub-counties from the list of sub-counties that were obtained from the district production department in each district. Patira and Okir sub-county were randomly selected in Nwoya district while Owoo and Palaro sub-counties were selected in Gulu district.

In the third stage, leading parishes were randomly selected from each sub-county and leading villages were randomly selected from each parish. In the final stage, farmers in each village were randomly selected from lists of farmers developed with the help of the village local council chairpersons. A total of 196 smallholder rice farmers were interviewed out of which 110 were farmers from Nwoya district and 86 from Gulu district. The unequal sub samples in the two areas were because there were more farmers in Nwoya than Gulu.

3.6 Data Collection instrument

In this study, primary data were collected from the respondents using the survey method that consisted of face-to-face interview. This method helps researchers navigate complex or sensitive topics with sensitivity and discretion. The structured pre- tested questionnaire with both open- and closed-ended questions was used to collect the data. The structured questionnaire consisted of a five-point likert scale questions (Strongly disagree=1, Disagree=2, Not sure =3, Agree-4, Strongly agree=5) aimed at exploring the attitude of

smallholder famers on quality declared rice seeds as well carefully designed open ended questions where participants gave responses based on their rice production and output in the previous season.

3.7 Data collection procedure

The research process begun with the approval of the research proposal, which paved the way for the subsequent phases. The researcher then acquired an introductory letter from Faculty of Agriculture and Enviroment at Gulu University, marking the official commencement of the study. The research team arranged introductions to the Office of the Resident District Commissioner (RDC) and local LC1 offices within the targeted villages. This groundwork was crucial in establishing rapport, securing permissions, and ensuring a harmonious research environment.

The heart of data collection lay within the accurately prepared survey questionnaire, precisely crafted and digitized using the Open Data Kit (ODK) platform. Armed with these tools, the research team embarked on face-to-face interviews with the smallholder rice farmers, capturing their insights, attitudes, and perspectives.

Upon data collection it was initially submitted to the ODK server for central storage, and subsequently downloaded into MS. Excel for thorough cleaning. Errors and inconsistencies were accurately addressed, ensuring the reliability and accuracy of the dataset.

The culmination of this journey was the rigorous data analysis phase, where the Statistical Package for the Social Sciences (SPSS) played a pivotal role in unraveling patterns, correlations, and insights hidden within the collected data.

3.8 Data Analysis

All data obtained on determinants of demand for Quality declared rice seeds were analyzed using Statistical Package for Social Sciences (SPSS) version 27.0. Different analytical methods were used to achieve the study objectives which included; Binary logistics

regression model, chi-square tests, t-test, descriptive statistics, mean, and standard deviations.

To achieve objective one, the study employed exploratory factor analysis with principal component, where confirmatory factor analysis was done to establish the different factor loadings for the attitudes of smallholder rice farmers towards quality declared rice seeds. Attitudes of smallholder farmers were measured on a 5-point likert scale from 5- strongly agree, 4….., 3…., 2….. to 1- strongly disagree. Kaiser-Meyer-Olkin test greater than 0.7 and Bartlett's Sphericity test $p<0.05$ was used to show sampling adequacy and suitability of the dataset for Exploratory Factor Analysis (EFA). Factors with Eigen values greater than 1 were extracted.

To answer objective two, a binary logistics regression model was used in the analysis of the factors that influence the smallholder farmers' demand for improved quality declared rice seeds. These factors include access to credit, distance to market, gender, age, education level, marital status, household size, occupation, income level, land size (acreage), farmer's experience and distance to the nearest market among others. The equation is specified as;

$$Y= \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + + \beta_n X_n + e \quad \text{(Equation 2)}$$

Where, Y=Demand for Quality declared rice seeds, α=Constant coefficient, $\beta_1 \ldots \beta_n$ = Coefficient of the estimates, $X_1 \ldots\ldots X_n$= Vector of socio-economic factors that influence the demand for improved Quality declared rice seeds, and e = Stochastic error term.

Table 3. 1: Description of variables included in the Logistics regression model and their *a priori* signs

Variable	Measurement/description	*A priori* sign
Demand for Improved Quality Declared Rice Seeds	Use of Quality declared rice seed in the previous season	Yes or No
District	District	±
Gender	Gender of farmer	±
Age	Age of farmer	±
Education level	Number of years spent in school	±
Land size (Acres)	Acres allocated to rice farming	±
Years of farming experience	Number of years spent in rice farming	±
Off farm engagement	Other activities other than farming (yes/no)	±
Use of communal labour	Farmer used communal labour during rice production	±
Use of family labour	Farmer used family labour during rice production	±
Participation in on-farm demonstration/Trials	Farmer participated in on-farm demonstration/Trials in the previous season	±
Access to credit	Farmer has access to credit	±
Belong to famer group	Farmer belongs to a farmer group	
Access to agricultural extension services	Farmer has access to agricultural extension services	±
Distance to seed outlet	Distance to the nearest seed outlet (Km)	±
Attitudes of farmer on Quality declared rice seeds		±

For objective three to be achieved the researcher based on the different sources of Quality declared rice seeds reported by farmers to trace a map of the different seed distribution channels for instance, from local seeds business to farmers, from research station to farmers, from traders to farmers among others.

3.7 Ethical Considerations

The study emphasized professionalism in the entire research process. The respondents were given the freedom to express themselves towards the questions given to them without fear and force on them. Prior to data collection, all the necessary clearance in form of ethical approvals were obtained from Gulu University Research Ethics Committee (GUREC) to

conduct the study and informed consent was sought from participants to conduct the study for purely academic purposes. The researcher also sought permission from the relevant authorities of the two districts. Authorization was sought from; the Chief Administrative Officers of the Districts (CAOs), District Production Officers (DPOs), District Agricultural Officers (DAOs), District Commercial Officers (DCOs) and SASs (Sub County Chiefs).

CHAPTER FOUR: DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Socio-economic characteristics

The results of the summary statistics of socio-economic variables in Table 4.1 indicated that the mean age of rice farmers in northern Uganda was 39.8 years with farmers in Gulu district significantly older than farmers in Nwoya district by about 4 years. This therefore suggest that the farming of rice in the region is being dominated by young and energetic individuals who still have the capacity to adapt to changing environments and technological advancements in the agricultural sector as opposed to the elderly people who are often described as rigid and hesitant.

The results of analysis of socio-economic variables also found that on average rice farmers in northern region had at least attained some formal primary education rated between primary four and primary five levels of education however farmers in Nwoya were significantly more educated compared to rice farmers in Gulu district. High level of education among farmers provides for the ease of adaption of advanced technologies and quickly understanding and comprehending knowledge acquired through extension visits, farmer to farmer knowledge transfer among others.

The study also revealed that more than three-quarter of the rice farmers in northern Uganda used their own land to plant rice with rice farmers in Gulu who use their own land significantly higher than rice farmers in Nwoya who farm on their own land. This is mainly because in northern Uganda most people own land in rural areas much as the size of land owned varies and before they go to hire land for agriculture majority of the farmers will have first exhausted their own land.

The study also found that less than one-quarter of the rice farmers in northern Uganda actually planted quality declared rice seeds with the use of quality declared rice seeds

significantly more common among rice farmers in Nwoya district as compared to rice farmers in Gulu district. The low level of adaption/demand of quality declared rice seed could be attributed to the idea that some farmers are still monitoring the output of such seeds comparing it the indigenous seeds in-order to make informed decisions on whether to plant the quality declared rice seed or the indigenous seeds. The study also revealed that the most common rice variety planted in northern Uganda was the upland variety with more than three-quarter of the rice farmers in the region engaging in farming upland variety of rice. Rice farmers in Nwoya district demonstrated a significant interest in the planting of upland variety more than rice farmers in Gulu district which can be attributed to the fact that Gulu district has significantly more wetlands and small water bodies which make it possible for lowland variety of rice to be planted successfully.

Access to agricultural extension services among rice farmers in northern Uganda was revealed to be relatively low with Gulu district rice farmers significantly having more access to agricultural extension services as compared to rice farmers in Nwoya district (See Table 4.1).

Table 4.1: Socio-economic characteristics of participants

Variables	Overall mean (SD)	Gulu Mean (SD)	Nwoya Mean (SD)	t/Chi^2
Gender	0.72 (0.45)	0.73 (0.44)	0.69 (0.47)	0.74
Age	39.8 (13.95)	41.14 (12.68)	37.82 (15.48)	-1.75*
Education	4.65 (3.46)	4.27 (3.28)	5.2 (3.66)	1.97**
Household size	7.34 (3.71)	7.64 (3.79)	6.91 (3.57)	-1.43
Used hired labour	0.49 (0.50)	0.45 (0.50)	0.56 (0.50)	1.59
Used communal labour	0.34 (0.48)	0.36 (0.48)	0.31 (0.47)	-0.81
Used family labour	0.78 (0.42)	0.77 (0.26)	0.80 (0.40)	0.61
Size of rice farm	2.81 (2.47)	2.66 (1.64)	3.03 (3.33)	0.99
Experience in rice farming	9.13 (8.22)	10.52 (7.79)	7.09 (8.45)	-3.11***
Used own land	0.77 (0.42)	0.81 (0.39)	0.70 (0.46)	-1.86**
Used hired land	0.04 (0.19)	0.02 (0.15)	0.06 (0.23)	1.19
Used both own and hired land	0.20 (0.40)	0.17 (0.37)	0.24 (0.43)	1.39
Seed type	0.22 (0.42)	0.15 (0.36)	0.32 (0.47)	2.91***
Upland variety	0.84 (0.37)	0.77 (0.43)	0.94 (0.23)	4.05***
Low land variety	0.16 (0.37)	0.23 (0.43)	0.06 (0.23)	-4.05***
Distance from home to seed outlet	1.89 (2.84)	1.89 (3.25)	1.88 (2.14)	-0.02
Access to credit	0.71 (0.45)	0.68 (0.47)	0.76 (0.43)	1.21
Member of farmer group	0.60 (0.49)	0.58 (0.50)	0.63 (0.49)	0.75
Access to extension service	0.40 (0.49)	0.49 (0.50)	0.33 (0.47)	2.35**

Data Source: Field research, 2020; Note: (*), (**) and (***) represent the levels of significance at 10%, 5%, 1% respectively. Figures in parentheses are Standard Deviation.

4.2 Attitude of smallholder farmers towards Quality declared rice seeds in northern Uganda

In examining the attitude of farmers towards quality declared rice seeds in northern Uganda, an exploratory factor analysis (EFA) with principal component analysis (PCA) was performed on the 14 attitude constructs on quality declared rice seeds.

The results of both Kaiser-Meyer-Olkin test (KMO=0.877) and Bartlett's Sphericity test (X^2 = 1,371.21; P<0.001) showed sampling adequacy and suitability of the dataset for Exploratory Factor Analysis (EFA) as shown in Table 4.2. The PCA with Varimax rotation extracted three factors with Eigen values greater than 1, explaining about 62% of the total variation in the observed attitude constructs. Factor 1 accounted for about 41% of the variances, while factor 2 and factor 3 accounted for about 12% and 8% respectively of the

total variances. The reliability tests demonstrated very high internal consistency among all the factors with Factor 1 having Cronbach's Alpha of 0.876, Factors 2 having Cronbach's Alpha of 0.780 and Factor 3 having Cronbach's Alpha of 0.759.

Table 4.2: EFA on rice farmer's attitude on quality declared rice seeds

Attitude on Quality declared rice seeds	**Factor loading**	**Eigen Values**	**Cronbach's Alpha**	**Variance explained (%)**
Factor 1 (Attitude on adaptability)		**5.798**	**0.876**	**41.42**
Easy to manage	0.763			
Resistant to pest and diseases	0.724			
Performs better than local seeds	0.745			
Highly resistant to drought	0.800			
Less costly to maintain in the field	0.753			
F2 (Attitude on revenue and income)		**1.693**	**0.780**	**12.09**
High yield	0.706			
Higher sales value	0.554			
Longer storage life	0.754			
Benefited many farmers in the community	0.442			
High germination rate	0.587			
Shorter maturity duration	0.601			
F3 (Attitude on ease of getting)		**1.167**	**0.759**	**8.34**
Affordable	0.720			
Available	0.484			
Accessible	0.489			
Total variance explained = 61.85%				
KMO = 0.877; Bartlett's test of Sphericity: X^2 =1,371.12, *(p<0.001)*				

Source: Field data, 2020

Certain measurement items had either crossed loadings or low factor loadings less than 0.4. Consequently, with crossed loadings the highest loading was selected while factors whose loadings was less than 0.4 were dropped off in an iterative process and excluded from subsequent analyses.

Factor 1 was related to attitude of rice farmers on the adaptability of quality declared seeds to local environment, and it had five (5) items including rice farmer's attitude on ease of managing quality declared seeds; resistance to pest and diseases; better performance than local seeds; resistance to drought; and limited costs of filed maintenance.

Factor 2 was related to attitude of rice farmers on the amount of revenue and income farmers

get from planting quality declared seeds, and it had six (6) items including rice farmer's attitude on yield of quality declared seeds; higher sales value; longer storage life; benefit to many farmers in the community; high germination rate; and shorter maturity duration.

Factor 3 was related to attitude of rice farmers on the ease of getting quality declared seeds, and it had three (3) items including rice farmer's attitude on affordability, availability and accessibility of quality declared rice seeds.

4.3 Factors affecting smallholder farmers' demand for quality declared rice seeds

To determine factors associated with smallholder farmers' demand for quality declared rice seeds, a binary logistics regression was performed with the demand for quality declared rice seeds in the previous season as the dependent variable and socio-economic, marketing, attitudes and distributional factors as the independent variables. The summary statistics revealed that the logistics regression was significant in predicting the likelihood of demanding (using) quality declared rice seeds among rice farmers in northern Uganda with Chi-square (13) =75.366, -2 Log likelihood =158.99, and Nagelkerke R Square =0.441 implying that the independent variables explained about 44.1% of the variance in the dependent variable.

The study revealed that district was a significant predictor of the likelihood of rice farmers to demand (use) quality declared rice seeds with rice farmers in Nwoya district being 2.08 times more likely to use quality declared rice seeds as compared to rice farmers in Gulu district.

The use of communal labour in the production of rice in Northern Uganda also had a significant influence on the demand (use) of quality declared rice seeds with farmers that do not use communal labour up to 65.5% less likely to demand (use) quality declared rice seeds as compared to rice farmers who used communal labour.

Participation of farmers in on-farm rice seed demonstrations/trials significantly predicted the

likelihood of farmers to plant quality declared rice seeds with farmers who participated in on-farm rice seeds demonstrations/trials being 3.48 times more likely to plant the quality declared rice seeds as compared to farmers who never participated in such on-farm demonstrations. This is mainly because during these trials, farmers get exposed to the quality declared rice seeds as well as the requirements for planting the seeds which put them at the upper hand of using the seeds the next time since they will have gained enough experience with the seeds.

Access to agricultural extension services by farmers had a significant role in the predicting the likelihood of farmers to plant quality declared rice seeds with farmers who had access to agricultural extension services being 3.11 times more likely to plant quality declared rice seeds as compared to farmers who do not have access to agricultural extension services. It is normally through this extension visits that more information about the quality declared rice seed are given to farmer by agronomic professionals including how to plant and manage them thereby putting farmers with access to such services in a better position to use such seeds.

Additionally, attitude of farmers on the ease of getting the quality declared rice seed significantly influenced their decision to use the quality declared rice seeds with farmers who have a positive attitude that getting the seed was easy (in terms of availability, accessibility and affordability) being 1.41 times more likely to actually plant the quality declared rice seeds as compared to farmers who regarded that getting the quality declared rice seeds to them was not easy (see Table 4.3).

Table 4.3: Binary logistics regression of predictors of demand for quality declared rice seeds

Predictors	B	S.E.	Wald	df	Exp(B)
District	0.735*	0.409	3.236	1	2.086
Gender	-0.646	0.474	1.852	1	0.524
Education level	0.045	0.063	0.504	1	1.046
Use of communal labour	-1.064**	0.475	5.024	1	0.345
Use of family labour	0.873	0.627	1.941	1	2.394
Engagement in off-farm activity	0.519	0.434	1.430	1	1.681
Participation in rice seeds demonstration/trials	1.248*	0.666	3.506	1	3.482
Access to credit	1.093	0.739	2.186	1	2.984
Belong to farmer group	0.428	0.828	0.267	1	1.534
Access to extension services	1.134**	0.544	4.345	1	3.108
Attitude on adaptability	0.24	0.223	1.156	1	1.271
Attitude on revenue and income	0.18	0.225	0.641	1	1.197
Attitude on ease of getting	0.341*	0.200	2.903	1	1.406
Constant	-4.749***	1.046	20.611	1	0.009
Summary Statistics			**Value**	**df**	
Chi-square			75.366***	13	
-2 Log likelihood			158.99		
Nagelkerke R Square			0.441		
Cox & Snell R Square			0.288		

Source: Field research, 2020. Note: In case of dummies; ***, **, & * implies significance at $p<0.01$, $p<0.05$ & $p<0.1$ respectively. SE means standard errors Exp (B) is the odds ratios

4.4 Distribution channels for quality declared rice seeds in Northern Uganda

4.4.1 Distribution channels of rice seeds

The study revealed that rice farmers in northern Uganda access quality declared rice seeds via formal and informal channels with more than three quarter of farmers (86.5%) accessing the seeds through informal channels in both Nwoya and Gulu districts while less than one quarter of the participants (12.2%) accessed the rice seeds through formal channels in both districts. Intermediate/semi-formal seed channel was also used by about 4.1% of the smallholder rice farmers to access rice seeds. The study also found that farmers that accessed rice seeds through both formal and informal channels constituted only 1.4% overall in both Nwoya and Gulu districts.

Table 4.4: Distribution channels of quality declared rice seeds

Distribution channels	Overall (%)	Nwoya (%)	Gulu (%)
Formal seed sources	12.2	21.1	6.1
Intermediate/Semi-formal seed sources	4.1	7.8	1.5
Informal seed sources	86.5	77.8	92.4
Both formal and informal seed sources	1.4	1.1	1.5

Source: Field data, 2020

4.4.2 Rice seed sources among smallholder farmers

The study also found that the most common formal source of rice seeds to farmers in northern Uganda were from institutions like NARO and Universities such as Gulu University used by 9.5% of smallholder farmers to access rice seeds overall. Agro-input dealers as well as seed companies supplied 3.2% and 1.8% of the smallholder rice farmers in both Nwoya and Gulu districts respectively.

The study also revealed that farmers who planted rice seeds obtained from local seed businesses in both Nwoya and Gulu districts constituted only 4.1%.

Among the informal seed sources identified among farmers in both Nwoya and Gulu districts; about half of the farmers planted rice seeds got through their own saved seeds of the previous season. About one third of the smallholder rice farmers in Nwoya and Gulu districts planted seeds received through family & fellow community farmers. About 28% of the smallholder rice farmers used informally got rice seeds bought from open-air markets e.g. stockist or local traders (see Table 4.5).

Table 5: Rice seed sources

Rice seed sources	Overall (%)	Nwoya (%)	Gulu (%)
Seed company	1.8	3.3	0.8
Agro-input dealers	3.2	4.4	2.3
Institutions e.g. NARO, University	9.5	15.6	5.3
Local seed business	4.1	7.8	1.5
Better farmer-saved seed	46.8	41.1	50.8
Family and community farmers e.g. Bartered	32.9	27.8	36.4
Open-air market	27.9	25.6	29.5
Nearest seed out-let			
Fellow farmers	78.4	60.0	90.9
Agro-input shop	2.3	2.2	2.3
Local seed business	16.7	33.3	5.3
Institutions	2.3	4.4	0.8
Seed companies	0.5	0.0	0.8

Source: Field data, 2020

4.4.2 Flow diagram showing distribution channels of rice seeds in northern Uganda

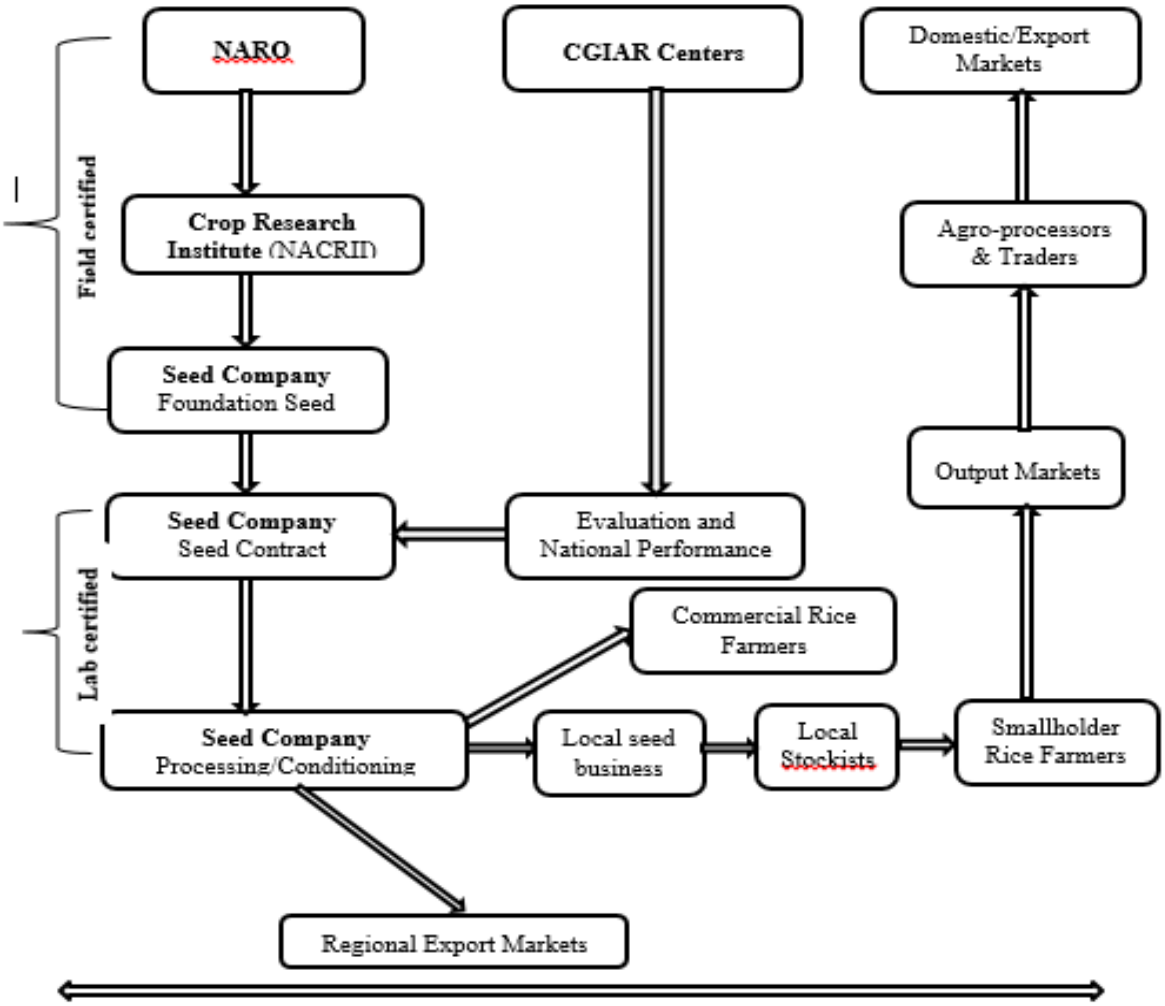


Figure 4. 1: Quality declared rice seed marketing and distribution channels

Among the different rice seed outlets identified in northern Uganda, more than three quarters of the smallholder rice farmers stayed close to fellow farmers that they can assess rice seeds while 16.7% of the farmers stayed near local seed businesses and very few farmers stayed near Agro-input shops that they can access rice seeds from. A limited number of smallholder rice farmers in northern Uganda stayed nearest to institutions and seeds companies.

The flow diagram above shows the distribution channels of rice seeds in northern Uganda. Normally, seeds approved by national agricultural research organization (NARO) are taken to crop research institute (NACRII) and thereafter taken to foundation seed farms who then supply seed contract growers. These seed are then taken for evaluation and national performance trials before distributing to farmers countrywide. After the trials have passed, the seed are then given to factories to process and thereafter supplied to either commercial rice farmers or local seed businesses who then supply either directly to local smallholder famers or supply local traders (stockist) who then supply smallholder rice farmers. After farmers have grown the seeds for the first time, they then begin to sell the seeds in output markets which are often dominated by agro-processors, traders and their fellow farmers who buy the seeds to plant in their own gardens in the next season. The agro-processors & Traders supply the seeds in both domestic and export markets for purposes of making profits.

CHAPTER FIVE: DISCUSSION OF RESULTS

5.1 Attitude of smallholder farmers towards quality declared rice seeds (QDRS)

The study revealed that the attitude of smallholder farmers towards quality declared rice seeds was relatively positive in northern Uganda. Majority of farmers had positive attitude on the germination rates, yields, sales value, maturity duration, resistance to disease, benefit to fellow farmers, better performance, storage life and ease of managing of QDRS as compared to the local rice seeds. The positive attitude exhibited by the farmers however did not significantly influence them to demand the seeds for themselves or to plant the quality declared rice seeds mainly. This is because the farmers noted that the quality declared rice seeds was expensive to buy, was not easily available, and they had limited access to the QDRS in their local environments. This finding was supported by Nora (2021) in Tanzania on gendered relations in quality declared rice seeds and found that majority of farmers had positive attitudes and perception on the effectiveness of QDRS. Therefore, it is concluded that there is a viable opportunity to enhance farmers' produce by using QDRS through appropriate information dissemination and provision of support and training needed by the farmers to maximize their produce and use of rice QDRS.

The study also identified three attitudinal factors with Eigen values greater than one (1) with the first factor related to the attitude of rice farmers on the adaptability of quality declared seeds to local environment, and it had five (5) items including rice farmer's attitude on ease of managing quality declared rice seeds; are resistant to pest and diseases; performs better than local seeds; are highly resistant to drought; and maintaining in the field is less costly. Factor 2 was related to attitude of rice farmers on the amount of revenue and income farmers get from planting quality declared rice seeds, and it had six (6) items including rice farmer's attitude on quality declared seeds yield; has higher sales value; has longer storage life; has benefited many farmers in the community; has high germination rate; and has shorter

maturity duration. Factor 3 was related to attitude of rice farmers on the ease of getting quality declared rice seeds, and it had three (3) items including rice farmer's attitude on affordability of quality declared rice seeds; are available; and are accessible.

The attitudinal factor centered on the adaptability of QDRS to the local environment, emphasizes crucial aspects influencing farmers' perspectives on these seeds. The study's findings indicate that farmers' positive attitude on QDRS's adaptability could positively impact their adoption decisions. Farmers' recognition of QDRS as resistant to pests, diseases, drought, and cost-effective for maintenance can bolster their confidence in adopting these seeds. This aligns with the findings of Smith et al. (2018), who observed that farmers' attitude on seed performance under local conditions significantly influenced their adoption decisions.

The correlation between farmers' attitudes toward the revenue and income generated from QDRS cultivation was identified as a factor. Farmers who possess a positive attitude towards QDRS higher sales value, longer storage life, possession of favorable germination and maturity rates might be more inclined to adopt these seeds. This resonates with research by Rahman et al. (2017), who emphasized the economic benefits as influential factors in farmers' adoption decisions.

Additionally, farmers' attitudes toward the ease of obtaining QDRS can significantly impact their adoption choices. Positive attitude on QDRS affordability, availability, and accessibility could mitigate barriers to adoption. These findings align with the work of Asfaw et al. (2017), who noted that farmers' access to improved seeds was a critical determinant of adoption.

5.2 Factors affecting smallholder farmers' demand for quality declared rice seeds

District significantly predicted the likelihood of rice farmers to demand (use) quality declared rice seeds with rice farmers in Nwoya district being more than twice as likely to use quality declared rice seeds as compared to rice farmers in Gulu district. This is mainly because of

easy access to the quality declared rice seeds in Nwoya district as compared to Gulu district. Nwoya district has several large-scale commercial farmers engaging in rice production with the use of modern agricultural equipment and tools including use of quality declared rice seeds. According to a report by Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) , (2021), Nwoya district has a farmer group called " TIC RYEMO CAN FARMERS' Group which is a quality declared rice seed producer group registered in Nwoya district supported by the Rice CARP+, Integrated Seed Sector Development (ISSD), National Agriculture Research Organization (NARO), the National Agricultural Advisory Services (NAADs)/Operation wealth Creation (OWC) and Nwoya district Local Government. Through this partnership, the group has been certified to produce and trade quality declared seeds (QDS), has acquired a tractor, a rice cleaner, and a bulking store. The group now boasts of increased acreage under rice production (overall acreage is about 460 acres), and increased revenue from sale of QDS-rice seed to the tune of 22,500,000 Uganda Shillings (USD 6,000). This therefore supports the higher likelihood of use of quality declared rice seeds among smallholder rice farmers in Nwoya district as compared to Gulu district.

The study also found that the use of communal labour in the production of rice among rice farmers in Northern Uganda significantly influenced demand (use) of quality declared rice seeds among farmers with farmers that do not use communal labour less likely to demand (use) quality declared rice seeds as compared to rice farmers who used communal labour. Working with groups in the agricultural sector often come with several advantages including increasing access to knowledge of modern production and marketing models, increasing access to credit services among others. This goes along way equipping smallholder farmers who engages communal labour during the course of their production of rice with knowledge on the quality declared rice seeds as well as access to credit for buying the quality declared rice seeds hence the higher demand of quality declared rice seeds among rice farmers who use communal labour as compared to those who do not use communal labour (McGuire &

Sperling, 2016).

Participation of farmers in on-farm rice seed demonstrations/trials also significantly predicted the likelihood of farmers to plant quality declared rice seeds with farmers who participated in on-farm rice seeds demonstrations/trials almost three and half times more likely to plant the quality declared rice seeds as compared to farmers who never participated in such on-farm demonstrations/trials. The researcher contents that it is during these trials where farmers get exposed to the quality declared rice seeds as well as the requirements for planting the seeds which put them at the upper hand of using the seeds the next time since they will have gained enough experience with the seeds (Pranesh, 2016).

Having access to agricultural extension services by farmers had a significant role in predicting the likelihood of farmers to plant certified rice seeds with farmers who had access to agricultural extension services more than three times as likely to plant quality declared rice seeds as farmers who do not have access to agricultural extension services.

It is normally through this extension visits that more information about the quality declared rice seeds are given to farmer by agronomic professionals including how to plant and manage them thereby putting farmers with access to such services in a better position to use such seeds. This finding was also supported by Sarkar et al., (2022) in their study on determinants of adoption of exotic rice cultivars whose research finding revealed a significant role of household characteristics, access to institutions & infrastructure, and varietal characteristics in adoption (demand) decisions. Similarly, the findings of the Tobit censored regression indicate that access to training is a significant factor in determining the intensity of adoption of Bangladesh Rice Research Institute varieties in the '*Aus'* season comparatively starting around March or April and extending into July in Ugandan context (Shajedur et al., 2020).

Attitude of farmers on the ease of getting the quality declared rice seeds significantly

influenced their decision to use the QDRS with farmers who had a positive attitude towards getting the seed (in terms of availability, accessibility, and affordability) was easy almost twice as likely to plant the quality declared rice seeds as compared to farmers who regarded that getting the quality declared rice seeds to them was not easy. The positive attitudes of the smallholder farmers on the quality declared rice seeds drives their desires to plant the QDRS and desires backed by ability to afford the quality declared rice seeds is therefore referred to as real demand in economics. This therefore implies that farmers who have a positive attitude towards QDRS and also have the financial ability to afford the QDRS have more chances of planting the QDRS seeds as compared to those who do not have the ability to afford the QDRS.

This study did not find any supporting evidence that socio-economic factors like gender, age, gender, education level, use of family labour, engaging in off-farm activities, having access to credit, belonging to a farmer group, attitude on adaptability of quality declared rice seeds and attitude on the level of revenue & income derived from planting certified rice seeds were not significant predictors of the likelihood of demanding (usage) of quality declared rice seeds. This contradicts some studies like Manan et al (2018) who found that majority of rice farmers were influenced by their land sizes, education level, market availability, extension activities, as well as seed sources and costs. Kangile et al (2018) performed both descriptive statistics and multinomial logit regression analysis methods in examining socio-economics characteristics of smallholder rice farmers. They found that socio-economic factors that influence choice of rice type to plant among smallholder rice farmers mainly included gender, level of education, age, family type, and land ownership status.

5.3 Distribution channels for Quality declared rice seeds

The study revealed that rice farmers in northern Uganda accessed quality declared rice seeds via both formal and informal sources with majority of farmers accessing the seeds through

informal sources.

The most common formal source of quality declared rice seeds to smallholder farmers in northern Uganda was from institutions like NARO and Universities. Other formal sources of quality declared rice seeds in northern Uganda included local seed businesses, agro-input dealers, and seed companies. Informal seed sources identified among farmers in northern Uganda included own farmer saved seeds of the previous season, through family & community farmers, and open-air markets (from stockist or local traders).

Among the different rice seed outlets identified in northern Uganda, majority of the smallholder rice farmers stayed close to fellow farmers who can supply them with rice seeds followed by farmers who stayed near local seed businesses and near Agro-input shops. The remaining rice farmers stayed nearest to institutions and seeds companies.

The distribution channel of quality declared rice seeds in northern Uganda identified in this study is comparable to findings in MAAIF, (2017) annual report which cited that presently the rice seeds are produced and distributed through both formal- and informal systems. Under formal systems, the nucleus seeds of rice cultivars are either sourced from international organizations such as Africa Rice and/or from National Agriculture Research Organization. Breeder- and foundation seeds are produced from the nucleus seeds at National Crops Resources Research Institute and supplied to private seed companies who then produce quality declared rice seeds on a commercial scale and sell to farmers. Informal seed systems, through which rice seeds are predominantly produced in Uganda, are carried out by either saving a portion of their harvest by individual farmers themselves or by progressive/entrepreneurial farmers for a given community. Community based seed production is often organized by development projects and non-governmental organizations. Such seeds however are often not certified; but declared as quality seeds on a mutual basis.

The development of a robust seed system provides the foundation for Uganda's food security especially with regards to rice production. An efficient seed distribution channel ensures good quality rice seeds of superior varieties with better yield potential and tolerance to abiotic and biotic stresses (Okot, 2011). The seed distribution channel consists of research and variety development initiatives such as National Agricultural Research Organization (NARO), National Crops Resources Research Institute (NACRRI), CGIAR research centers, and seed production/multiplication companies to produce commercial volumes from breeder seed to quality declared rice seed including processing, distribution, and marketing in retail level to smallholder rice farmers. Rice seed certification is an important mechanism for ensuring seed quality and is understood by growers, buyers and rice farmers and this includes the field and laboratory certification (Fiala, 2018).

Several rice seed classes exist; these classes provide the distributor or buyer information about the history and quality of rice seed lot. They include breeder seed, foundation seed, registered seed and quality declared rice seeds. Rice seeds are to pass through field inspection and laboratory analysis before they can be tagged as quality declared rice seeds (Fiala, 2018).

CHAPTER SIX: SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Summary of key findings

The study revealed that smallholder rice farmers in northern Uganda do have a positive attitude on the quality declared rice seeds especially on its adaptation to the local environment and attitude on the amount of income/revenue they expect to get when they plant quality declared rice seeds. However, the study also noted that the smallholder rice farmers in northern Uganda found it hard to access the quality declared rice seeds especially in terms its unavailability, unaffordability, and inaccessibility. The limited ease of access to the quality declared rice seeds significantly influenced the level of demand for the quality declared rice seeds among smallholder farmers in northern Uganda.

According to this research, the demand for quality declared rice seeds varies across different districts in northern Uganda with smallholder farmers in Nwoya district having more than twice chances of demanding quality declared rice seeds as compared to smallholder farmers in Gulu district. This was mainly because farmers in Nwoya district has more access to agricultural institutions and large scale commercial farmers who often use the quality declared rice seeds in their farms and therefore taking the seeds nearer to farmers in Nwoya district.

The study also revealed that the use of communal labour in the production of rice in northern Uganda influenced the demand of quality declared rice seeds among smallholder rice farmers with the farmers who used communal labour more likely to demand quality declared rice seeds as compared to farmer who do not use communal labour in their rice farms. The study also found that participation in on-farm rice seeds demonstrations/trials significantly influenced the demand for quality declared rice seeds with farmers who have participated in the demonstrations in the past having more chances to demand the quality declared rice seeds

as compared to farmers who never participated the such demonstrations. The study also revealed that access to agricultural extension services influenced the ability of smallholder rice farmers to demand quality declared rice seeds with farmers who receive agricultural extension services having a higher probability of demanding quality declared rice seeds as compared to farmers who have no access to agricultural extension service. The study also found that farmers who had a positive attitude on ease of getting quality declared seeds demanded and used the quality declared rice seeds as compared to those who had a negative attitude on the ease of getting quality declared rice seeds.

The study found that quality declared rice seeds are produced and distributed through both formal and informal systems in northern Uganda. Under formal systems, the nucleus seeds of rice cultivars are sourced from National Agriculture Research Organization. Breeder and foundation seeds are produced from the nucleus seeds at National Crops Resources Research Institute and supplied to private seed companies who then produce quality declared rice seeds on a commercial scale and sell to farmers. Informal seed systems through which rice seeds are predominantly produced in northern Uganda, are carried out by either saving a portion of their harvest by individual farmers themselves or by progressive/entrepreneurial farmers for a given community. Community based seed production is often organized by development projects and non-governmental organizations.

Such seeds however are often not certified; but declared as quality seeds on a mutual basis.

6.2 Conclusions

Driven by the goal of exploring the determinants of demand for Quality Declared Rice Seeds (QDRS) in northern Uganda, this study utilized a cross-sectional design to survey smallholder rice farmers in Nwoya and Gulu districts. A multi-stage sampling technique targeted 196 farmers who answered questionnaires probing their attitudes and demand for QDRS. Employing SPSS for data analysis, the study investigated the role of various factors,

including access to credit, distance to markets, and farmer attitudes, in influencing QDRS demand.

The study concludes that the introduction of quality declared and certified rice seeds in rice production as a means of facilitating access to affordable quality rice seeds is taking root in Northern Uganda. This is because smallholder rice farmers are beginning to realize the comparative benefits of planting quality declared rice seeds as compared to the local/indigenous rice seeds. This is mainly in terms of its adoptability to the local environment (disease resistance, drought resistance, duration for maturity) and level of income/revenue (better yield, better price, and better quality) derived from planting the quality declared rice seeds. It is also worth noting that majority of smallholder farmers in northern Uganda still face accessibility gaps in terms of lack of availability and high seed prices.

The study concluded that several socio-economic factors influenced the demand for quality declared rice seeds among smallholder rice farmers in northern Uganda including district of rice farms, the use of communal labour during the production of rice, participation in on-farm demonstrations/trials, access to agricultural extension services and attitudes of smallholder farmers towards ease of getting the quality declared rice seeds.

The study concludes that in northern Uganda, the distribution of quality declared rice seeds flows through both formal and informal channels. The formal channels include seeds sourced from international organizations such as Africa rice and national organization such as NARO who produce foundation seeds and supply to private business-oriented seed companies who then produce quality declared rice seeds on a commercial scale for sale to both commercial farmers and smallholder farmers. Informal sources of quality declared rice seeds were the most common source of rice seeds in northern Uganda and involved the flow of rice seeds from either farmer saved seeds or from entrepreneurs in the community who often stock the seeds hoping to sell in the next season to smallholder farmers.

6.3 Recommendations

6.3.1 Policy recommendations

The study highlighted access to credit as a pivotal factor influencing the demand for QDRS among smallholder rice farmers. Considering this, it is recommended that the government collaborates with financial institutions to provide targeted credit facilities or subsidies for purchasing QDRS. By easing the financial burden, farmers can be empowered to invest in higher-quality seeds, ultimately amplifying their production capacity.

In order to address the critical issue of seed accessibility, it is recommended that either governmental bodies or commercial organizations establish a network of quality declared rice seed outlets throughout the region. This can be done through encouraging local seed businesses to operate in the villages to increase accessibility of the quality declared rice seeds. This physical presence will ensure convenient access to QDRS, mitigating logistical challenges faced by farmers and fostering higher adoption rates.

To bolster adoption, policymakers and private sector entities can collaborate to lower the cost of QDRS or enhance their production efficiency. Strategies could encompass incentivizing research and development initiatives, supporting the creation of QDRS varieties suited for direct seeding, and promoting seed-saving sowing methods such as rice trans-planters. These measures can directly address economic concerns and technical constraints voiced by farmers.

Institutions involved in QDRS distribution such as local seed businesses can play a vital role in boosting demand by initiating widespread awareness campaigns. Community dialogues, radio broadcasts, trade shows, and agricultural extension visits can serve as effective platforms for educating farmers about the advantages of QDRS over local varieties.

These initiatives should be designed to resonate with local contexts and highlight QDRS's ability to enhance yield, resilience, and overall profitability.

6.3.2 Recommendations for further research

Like any academic research, this survey presented some limitations that are worth mentioning. First, the study used a cross sectional design to analyze the determinants of smallholder famers' demand for quality declared rice seeds in two neighboring districts (Nwoya and Gulu) districts, Northern Uganda. It is therefore imperative to test the validity of the results through comparative studies of the determinants of smallholder famers' demand for quality declared rice seeds in other regions in Uganda because the results might be peculiar to certain regions depending on several factors.

Secondly, the study was done during off season where rice cultivation was scarcely done. It is therefore recommended that validity of the results be tested during the planting season since there might be variation across regions and seasons in terms of determinants of smallholder famers' demand for quality declared rice seeds. Further, research can also be done on the role of quality declared rice seeds in the improvement of household incomes among smallholder farmers in northern Uganda.

REFERENCES

Adhikari, R. K. (2011). Economics of organic rice production. *Journal of Agriculture and Environment, 12*, 97–103.

Akongo, G. O., Gombya-Ssembajjwe, W., Buyinza, M., & Bua, A. (2016). Farm-Level Adaptive Capacity to Climate Variability in Rice Production, Northern Uganda. *Research on Humanities and Social Sciences*, *6*(14), 27–36.

Apind, B. O., Lagat, J. K., Bett, H. K., & Kirui, J. K. (2015). Determinants of Small-holder Farmers Extent of Market Participation; Case of Rice Marketing in Ahero Irrigation Scheme, Kenya. *Journal of Economics and Sustainable Development*, *6*(2), 154–160.

Ariga, J., Mabaya, E., Waithaka, M., & Wanzala-Mlobela, M. (2019). Can improved agricultural technologies spur a green revolution in Africa? A multicountry analysis of seed and fertilizer delivery systems. *Agricultural Economics*, *50*(S1), 63–74. https://doi.org/10.1111/agec.12533

Atera, E. A., Onyancha, F. N., & Majiwa, E. B. O. (2018). Production and marketing of rice in Kenya: Challenges and opportunities. *Journal of Development and Agricultural Economics*, *10*(3), 64–70.

Awan, M. I., van Oort, P. A. J., Ahmad, R., Bastiaans, L., & Meinke, H. (2015). Farmers' views on the future prospects of aerobic rice culture in Pakistan. *Land Use Policy*, *42*, 517–526. https://doi.org/10.1016/j.landusepol.2014.09.006

Bandumula, N. (2018). Rice production in Asia: Key to global food security. *Proceedings of the National Academy of Sciences, India Section B: Biological Sciences*, *88*(4), 1323–1328.

Barungi, M., & Odokonyero, T. (2016). *Understanding the rice value chain in Uganda-opportunities and challenges to increased production*.

Bidyasagar, T., & Nicra, S. R. F. (2017). Marketing channel and marketing efficiency analysis for rice in Nalbari district of Assam (India). *IJCS*, *5*(5), 1285–1289.

Boateng, K. K., Obeng, G. Y., & Mensah, E. (2019). Agricultural Greenhouse Gases from Sub-Saharan Africa. In *Greenhouse Gas Emissions* (pp. 73–85). Springer.

Chandio, A. A., & Yuansheng, J. (2018). Determinants of adoption of improved rice varieties in northern Sindh, Pakistan. *Rice Science*, *25*(2), 103–110.

Chauhan, J. S. (2017). *Seed Systems and Supply Chain of Rice in review article Seed Systems and Supply Chain of Rice in India Mile stones in the development of seed sector in India*. *October*.

Chidi, I., Anozie, R. O., & Priscilia, N. C. (2015). Analysis of Socio-Economic Factors and Profitability of Rice Production among Smallscale Farmers in Ebonyi State. *Journal of Agriculture and Veterinary Science*, *8*(2), 20–27.

Dalipagic, I., & Elepu, G. (2014). Agricultural value chain analysis in Northern Uganda: Maize, Rice, Groundnut, Siunflower and Sesame. *ACF-International*, *March*, 1–74.

Dawe, D., Pandey, S., & Nelson, A. (2010). Emerging trends and spatial patterns of rice production. *Rice in the Global Economy: Strategic Research and Policy Issues for Food Security. Los Banos, Philippines: International Rice Research Institute (IRRI)*.

Demont, M., & Ndour, M. (2015). Upgrading rice value chains: Experimental evidence from 11 African markets. *Global Food Security*, *5*, 70–76.

Fahad, S., Adnan, M., Noor, M., Arif, M., Alam, M., Khan, I. A., Ullah, H., Wahid, F., Mian, I. A., Jamal, Y., & others. (2019). Major constraints for global rice production. In *Advances in rice research for abiotic stress tolerance* (pp. 1–22). Elsevier.

FAO. (2014). *Understanding smallholder farmer attitudes to commercialization*.

Fiala, N. (2018). *The supply chain for seed in Uganda: Where does it all go wrong?*

Gadal, N., Shrestha, J., Poudel, M. N., & Pokharel, B. (2019a). A review on production status and growing environments of rice in Nepal and in the world. *Archives of Agriculture and Environmental Science*, *4*(1), 83–87.

https://doi.org/10.26832/24566632.2019.0401013

Gadal, N., Shrestha, J., Poudel, M. N., & Pokharel, B. (2019b). A review on production status and growing environments of rice in Nepal and in the world. *Archives of Agriculture and Environmental Science*, *4*(1), 83–87.

Gaffney, A., Slakie, E., Anderson, C. L., & Gugerty, M. K. (2019). Why attitudes matter: Measuring farmer attitudes in agricultural development. *Gates Open Res*, *3*(740), 740.

Ghose, B. (2014). Food security and food self-sufficiency in China: from past to 2050. *Food and Energy Security*, *3*(2), 86–95. https://doi.org/10.1002/fes3.48

Gitleman, L., & Kleberger, J. (2014). Improved rice variety adoption and its effects on farmers' output in ghana. *Paper Knowledge . Toward a Media History of Documents*.

Haneishi, Y. (2014). Rice in Uganda: Production Structure and Contribution to Household Income Generation and Stability. *Graduate School of Horticulture, Chiba University*.

Josephine Okot. (2011). *Seed Supply: The Role of Financial Services in Ensuring that the Required Varieties, Quality and Volume are Produced for Sale in the Ugandan Market*.

Joshi, G., & Bauer, S. (2006). Farmers' choice of the modern rice varieties in the rainfed ecosystem of Nepal. *Journal of Agriculture and Rural Development in the Tropics and Subtropics (JARTS)*, *107*(2), 120–138.

Kangile, R. J., Gebeyehu, S., & Mollel, H. (2018). Improved rice seed use and drivers of source choice for rice farmers in Tanzania. *Journal of Crop Improvement*, *32*(5), 622–634.

Kansiime, M. K., & Mastenbroek, A. (2016). Enhancing resilience of farmer seed system to climate-induced stresses: Insights from a case study in West Nile region, Uganda. *Journal of Rural Studies*, *47*, 220–230.

Karami, E., & Mansoorabadi, A. (2008). Sustainable agricultural attitudes and behaviors: a gender analysis of Iranian farmers. *Environment, Development and Sustainability*, *10*(6), 883–898.

Karim, M. R., Rahman, M. S., Jamil, H., & Noman, M. R. F. (2014). Farmer's attitude

towards aromatic rice cultivation as an indigenous practice. *Journal of Science and Technology*, *81*, 84.

Khanal, N. P., & Maharjan, K. L. (2014). Factors influencing farmers' behavior in rice seed selling in the market: a case study in the Tarai region of Nepald. *Agricultural and Food Economics*, *2*(1), 1–11.

Kijima, Y. (2019). Farmers' risk preferences and rice production: Experimental and panel data evidence from Uganda. *PloS One*, *14*(7), e0219202.

Kikuchi, M., Haneishi, Y., Tokida, K., Maruyama, A., Asea, G., & Tsuboi, T. (2016). The structure of indigenous food crop markets in sub-Saharan Africa: The rice market in Uganda. *The Journal of Development Studies*, *52*(5), 646–664.

Krejcie, R. V, & Morgan, D. W. (1970). Determining Sample Size for Research Activities Robert. *Educational and Psychological Measurement*, *38*(1), 607–610. https://doi.org/10.1177/001316447003000308

Leliveld, A. H. M., Dietz, A. J., Foeken, D. W. J., Klaver, W., Akinyoade, A., Smits, H. J., Soeters, S. R., & van't Wout, M. L. (2013). Agricultural dynamics and food security trends in Uganda. *Agricultural Dynamics and Food Security Trends in Uganda*, *2*.

MAAIF Performance Report. (2017). *The Republic of Uganda Ministry of Agriculture , Animal Industries and Fisherise: Performance Review Report*. 150.

Makosa, D. (2015). Constraints and opportunities to upgrading Ugandas rice markets: A value chain approach. *Journal of Development and Agricultural Economics*, *7*(12), 386–399.

Manan, J., Sharma, M., & Jaidka, M. (2018). Factors affecting the adoption of paddy varieties in Kapurthala district of Punjab, India. *Int J Curr Microbiol App Sci*, *7*(9), 3014–3020.

Mangeni, B. (2019). The Role of Public-Private Partnerships (PPP) in Ensuring Technology Access for Farmers in sub-Saharan Africa. *African Journal of Food, Agriculture,*

Nutrition and Development, *19*(01), 14137–14155.

https://doi.org/10.18697/ajfand.84.BLFB1018

Mango, N., Lundy, M., Makate, C., Jager, M., & Francesconi, N. (2018). Determinants of market participation and marketing channels in smallholder groundnut farming: A case of Mudzi district, Zimbabwe. *African Journal of Science, Technology, Innovation and Development*, *10*(3), 311–321.

Matsane, S. H., & Oyekale, A. S. (2014). Factors affecting marketing of vegetable among small-scale farmers in Mahikeng Local Municipality, North West Province, South Africa. *Mediterranean Journal of Social Sciences*, *5*(20), 390.

McGuire, S., & Sperling, L. (2016). Seed systems smallholder farmers use. *Food Security*, *8*(1), 179–195. https://doi.org/10.1007/s12571-015-0528-8

Milovanovic, V., & Smutka, L. (2017). Asian Countries in the Global Rice Market. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, *65*(2), 679–688. https://doi.org/10.11118/actaun201765020679

Mogga, M., Sibiya, J., Shimelis, H., Lamo, J., & Ochanda, N. (2019). Appraisal of major determinants of rice production and farmers'choice of rice ideotypes in south sudan: implications for breeding and policy interventions. *Experimental Agriculture*, *55*(1), 143–156.

Nandi, J. A., Haruna, S. K., & Abudu, S. (2012). Analysis of socio-economic factors influencing farmers'adoption of rice varieties with high yielding and weed suppressing abilities in kano river irrigation project (krip). *Journal of Agriculture, Forestry and the Social Sciences (JOAFSS)*, *10*(1).

Nangoti, N., Kayobyo, G., & Rees, D. J. (2004). Seed demand and supply in eastern and northern Uganda-implications for government and non-government interventions. *Uganda Journal of Agricultural Sciences*, *9*(1), 778–784.

Niang, A., Becker, M., Ewert, F., Dieng, I., Gaiser, T., Tanaka, A., Senthilkumar, K.,

Rodenburg, J., Johnson, J.-M., Akakpo, C., & others. (2017). Variability and determinants of yields in rice production systems of West Africa. *Field Crops Research*, *207*, 1–12.

Nora, Elisamia, L. (2021). *Gender relations in rice quality declared rice seed (QDRS) in tanzania: a case of kilombero district, morogoro, tanzania* (Issue March).

Ntakyo, P. R., & van den Berg, M. (2019). Effect of market production on rural household food consumption: evidence from Uganda. *Food Security*, *11*(5), 1051–1070. https://doi.org/10.1007/s12571-019-00959-2

Ojiewo, C., Rubyogo, J. C., Wesonga, J., Bishaw, Z., Abang, M., & Gelalcha, S. (2019). Mainstreaming Efficient Legume Seed Systems in Eastern Africa. In *Mainstreaming Efficient Legume Seed Systems in Eastern Africa*. https://doi.org/10.18356/ce824af1-en

Oyejide, T. A., Alaba, O., Abidemi, A., & Balakrishnan, U. (2019). Agricultural pricing and public procurement in sub-Saharan Africa. *Gates Open Res*, *3*(677), 677.

Palladium. (2020). *Enhancing Rice Productivity in Northern Uganda* (Issue January).

Pranesh, K. N. (2016). *Agricultural Extension Services : Effectiveness of Krishi Vigyan Kendra ' s in Karnataka*. *December*.

Prasad, R., Shivay, Y. S., & Kumar, D. (2017). Current status, challenges, and opportunities in rice production. In *Rice production worldwide* (pp. 1–32). Springer.

Rabbi, F., Ahamad, R., Ali, S., Chandio, A. A., Ahmad, W., Ilyas, A., Din, I. U., & others. (2019). Determinants of commercialization and its impact on the welfare of smallholder rice farmers by using Heckman's two-stage approach. *Journal of the Saudi Society of Agricultural Sciences*, *18*(2), 224–233.

Ruforum. (2021). *Convergence of the Action Research Program and producer groups' business models: the case of two rice producer groups in Nwoya and Amuru districts*.

Sarkar, M. A. R., Rahman, M. C., Rahaman, M. S., Sarker, M. R., Islam, M. A., Balie, J., & Kabir, M. S. (2022). Adoption Determinants of Exotic Rice Cultivars in Bangladesh.

Frontiers in Sustainable Food Systems, *6*. https://doi.org/10.3389/fsufs.2022.813933

Schneider, P., & Asch, F. (2020). Rice production and food security in Asian Mega deltas—A review on characteristics, vulnerabilities and agricultural adaptation options to cope with climate change. *Journal of Agronomy and Crop Science*, *206*(4), 491–503. https://doi.org/10.1111/jac.12415

Shajedur Rahaman, M., Jahangir Kabir, M., Abdur Rouf Sarkar, M., Ariful Islam, M., Chhiddikur Rahman, M., & Abu Bakr Siddique, M. (2020). Factors Affecting Adoption of BRRI Released Aus Rice Varieties in Mymensingh District. *International Journal of Agricultural Economics*, *5*(5), 210. https://doi.org/10.11648/j.ijae.20200505.18

Shrestha, R. B. (2012). Factors affecting price spread of rice in Nepal. *Journal of Agriculture and Environment*, *13*, 47–52.

Singh, G., Gupta, M. K., Chaurasiya, S., Sharma, V. S., & Pimenov, D. Y. (2021). Rice straw burning: a review on its global prevalence and the sustainable alternatives for its effective mitigation. *Environmental Science and Pollution Research*, *28*(25), 32125–32155. https://doi.org/10.1007/s11356-021-14163-3

Spengler, R. N., Stark, S., Zhou, X., Fuks, D., Tang, L., Mir-Makhamad, B., Bjørn, R., Jiang, H., Olivieri, L. M., Begmatov, A., & Boivin, N. (2021). A Journey to the West: The Ancient Dispersal of Rice Out of East Asia. *Rice*, *14*(1), 83. https://doi.org/10.1186/s12284-021-00518-4

Ssebuliba, R. N. (2010). *Baseline survey of the seed sector in Uganda in relation to regional harmonization of seed legislation*. A report by the Uganda Seed Trade Association, Kampala, Uganda.

Teeken, B., Olaosebikan, O., Haleegoah, J., Oladejo, E., Madu, T., Bello, A., Parkes, E., Egesi, C., Kulakow, P., Kirscht, H., & others. (2018). Cassava trait preferences of men and women farmers in Nigeria: implications for breeding. *Economic Botany*, *72*(3), 263–277.

Uganda Bureau of Statistics (UBOS). (2017). Uganda bureau of statistics 2017 statistical abstract. *Uganda Bureau of Statistics*, 1–341.

Vernooy, R., Rana, J., Otieno, G., Mbozi, H., & Shrestha, P. (2022). Farmer-Led Seed Production: Community Seed Banks Enter the National Seed Market. *Seeds*, *1*(3), 164–180. https://doi.org/10.3390/seeds1030015

Wagan, S. A., Jingdong, L., Shuangxi, X., Noonari, S., Memon, I. N., Memon, Q. U. A., & Wagan, G. H. (2016). Economic Assessment of Rice Production in Sindh, Pakistan. *American Journal of Environmental and Resource Economics*, *1*(1), 37–42.

Waithaka, M., Mugoya, M., Mabaya, E., & Tihanyi, K. (2021). *Decentralized Seed Services in Africa: An Assessment of Tanzania and Uganda*.

Wimalasekera, R. (2015). Role of Seed Quality in Improving Crop Yields. In *Crop Production and Global Environmental Issues* (pp. 153–168). Springer International Publishing. https://doi.org/10.1007/978-3-319-23162-4_6

World Bank. (2007). *World Bank Assistance to Agriculture in Sub-Saharan Africa: An IEG Review*. The World Bank.

APPENDICES

Appendix I: Household Survey Questionnaire

DETERMINANTS OF SMALLHOLDER FAMERS' DEMAND FOR QUALITY DECLARED RICE SEEDS IN NORTHERN UGANDA

DEPARTMENT OF AGRIBUSINESS AND RURAL DEVELOPMENT GULU UNIVERSITY

Dear respondents,

This tool is designed for the purpose of gathering information regarding *Determinants of smallholder famers' demand for Quality declared rice seeds in northern Uganda*. The final paper that will be written based on information you provide is intended to be significant in a variety of ways. For doing so, the information you provide is quite essential. Therefore, you are kindly requested to provide accurate information as much as possible. The researcher confirms to you that all data will be treated confidentially and only aggregated and average information will be published.

General Information *(Write in the spaces provided)*

Questionnaire Number……Administered by…….

Name of the respondent……..…

Contact of respondent……

District……. Sub-county…….……

Parish…… Village…….

Section A: Socio-economic demographic characteristics

1. What is the sex of the respondent ? (A1)	2. What is the age of the respondent (in years)?	3. What is the highest level of education attained by the respondent(in Completed years.)?	4. What is the marital status of the respondent ? (A4)	5. For how long has the respondent been engaged in farming? (years)	6. Apart from farming, are thereof- farm activities the respondent is Engaged in? (A6)	7. If Yes, which of the following off-farm activities is the respondent engaged in? (*indicate the applicable codes as many as possible in the space provided*) (A12)	8.How much do you earn from the activity(ies) in the last 12 months	9. How many people are there in your household ?	10.How many members of your household do not provide labour in farm activities?
Sex (A1) 0=Female 1=Male					Off-farm activity(A6) 0=No 1= Yes	Off-farm activity(A7) 0=No 1= Yes			

Marital status (A4) 1= Married; 2= Single; 3= Widowed; 4= Divorced; 5=Separated

Off- farm activity (A7) 1=Salary earner; 2=Casual wage earner; 3=Farm laborer; 4=Transportation; 5=business ; 6=Mechanics; 7=Brewing business; 8=Brick making; 9=Butcher;10=Carpentry;11=Charcoalburning;12=Trading;13=Construction;14=Tailor;15=Schooling;16=others ( ) specify……

Section B: Quality declared seed distribution channel *(please fill the table below)*

Research Station

Seasons/Year 2019	Did you obtain rice seed from research station?	If yes, mention the name of the research station	If yes, what variety of rice seed did you obtain?	If yes, how much quantity did you acquire from the research station	If yes, at what price per kilogram	How many research stations do you know where you can access quality declared rice seed	List the names of research stations where you can access quality declared rice seed
Season A							
Season B							
	0= No 1= Yes						

Seed Company

Seasons/ Year 2019	Did you obtain rice seed from seed company?	If yes, mention the name of	If yes, what variety of rice seed	If yes, how much quantity did you	If yes, at what price per kilogram	How many seed companies do you	List the names of seed companies

		the seed company	did you obtain?	acquire from the seed company		know where you can access quality Declared rice seed	where you can access quality declared rice seed
Season A							
Season B							
	0=No 1=Yes						

Local Seed Business

Seasons/ Year 2019	Did you obtain rice seed from local seed business?	If yes, mention The name of the local Seed business	If yes, What variety of rice Seed Did You obtain?	If yes, How much quantity did you acquire from the local seed business	If yes, at what price per kilogram	How Many local seed businesses do you Know where you can access Quality assured rice seed	List the names of local seed businesses where you can access quality assured rice seed
Season A							
Season B							
	0= No 1= Yes						

Agro-Input Traders

Seasons/Year 2019	Did you obtain rice seed from agro-input traders?	If yes, mention the name of the agro-input traders	If yes, what variety of rice seed	If yes, how much quantity did you acquire	If yes, at what price per kilogram	How many agro-input traders do you	List the names of agro-input traders
			did you obtain?	from the agro-input traders		know where you can access quality declared rice seed	where you can access quality declared rice seed
Season A							
Season B							
	0= No1=Yes						

Farmer Groups

Seasons/ Year 2019	Did You obtain Rice Seed From Farmer group?	If yes, Mention the name of the Farmer Group	If yes, What variety of rice seed did You obtain?	If yes, how much quantity did you acquire from the farmer group	If yes, at what price per kilogram	How many farmer group do You know where you can access quality assured rice seed	List the names of farmer group where you can access quality assured rice seed
Season A							
Season B							
	0=No 1=Yes						

Section C: Rice Production

Land access

Seasons/ Year 2019	How big is the size of the land you owned (acres)?	Of this land, how much did you use for farming (acres)?	Did you grow rice in both seasons of 2019?	If yes, for how many years have you been growing rice?	Did you rent land for rice growing?	If yes, how big was the land you used for growing rice (acres)
Season A						
Season B						
			0= No 1= Yes		0= No 1= Yes	

Seed access

Seasons/Year 2019	Which type of variety of rice did you grow? (B.2.1)	How much seed (Kg) did you use in the rice land portion?	What was the price per Kg of seed of rice you planted?
Season A			
Season B			
	Type or variety of rice (B.2.1) 0=Local 1=Improved		

C. 3 Rice output information *(please fill the table below)*

Seasons/Year 2019	Quantity harvested (Kg)	Quantity Sold (Kg)	Price/Kg (Ushs)
Season A			
Season B			
Total			

Section D: Institutional Factors

1. Did you borrow money for rice farming in the last 12 months? (D1)	2. If yes, what was the source of the credit(D2)	3. Are you a member of any farmers group? (D3)	4. Have you ever been visited by any extension agent?(D4)	5. How many times in the last12 months? (*in number*)	6. If yes, what is the type of extension agent that visited you?(D6)	7. If yes, what is the purpose of the extension visit? (D7)	8.What is the distance from where you can access quality declared rice seed?
Creditaccess (D1) 0= No 1= Yes		Assoc. membership(D3) 0=No 1= Yes	Extension access (D4) 0= No 1=Yes				

Source of credit (D2) 1=Relatives 2=Friends 3 =VSLA 4=Money Lenders 5=Government 6=NGO/Church 7=Bank 8=SACCO 9=Others specify

Type of Extension (D6) 1= Government; 2= NGO; 3=Farmers associations; 4= Others (specify) Purpose of visit (D7); 1=Advice on rice crop management; 2 =Advice on marketing; 3=Advice on postharvest handling; 4 = policy implementation; 5 = other ( )

specify

Section E: Attitudes towards Quality declared rice seeds

The statements in this section relate to your attitudes on quality declared rice seeds. Answer the following questions by ticking a box that reflects your evaluation of each statement given below using a five point likert scale, 1= strongly disagree, 2= disagree, 3= neutral, 4= agree, 5=strongly agree

	Variable	Response				
		1 SD	2 D	3 N	4 A	5 SA
1	Quality declared rice seeds has high potential that can improve my rice yield					
2	Quality declared rice seeds are easily accessible					
3	Quality declared rice seeds are affordable					
4	I am will to buy Quality declared rice seeds					
5	Quality declared rice seeds yield better than local varieties					
6	I would allocate more acreage for Quality declared rice seeds					
7	I look for where to get Quality declared rice seeds					
8	I have no problem to plant Quality declared rice seeds					
9	I would plant Quality declared rice seeds because they are resistance to pests and diseases					
10	I am willing to learn more about Quality declared rice seeds					

Appendix II: Informed Consent Document (English Version)

INFORMED CONSENT DOCUMENT (ENGLISH VERSION): Version 2.0 dated 29.07.2020

Title of the study: DETERMINANTS OF SMALLHOLDER FARMERS' DEMAND FOR QUALITY ASSURED RICE SEEDS IN NORTHERN UGANDA.

Investigator(s): APIYO SCOVIA PERPHENCY, MUGONOLA BASIL AND AKITE IRINE

Institution(s): GULU UNIVERSITY

Introduction

My name is Apiyo scovia perphency a student of Gulu University, in the faculty of Agriculture and Environment pursuing a master's degree in Agri-Enterprises Development, I am carrying out a study on determinants of smallholder farmers' demand for quality assured rice seeds in Northern Uganda. This informed consent explains the study to you. After the study has been explained, any questions you may have are answered, and you have decided to participate in the study, you will be asked to sign a consent, which you will be given a copy to keep.

A brief description of the sponsors of the research project

The study is sponsored by Rice Community Action Research Programme Plus (Rice CARP^{+}) project which is promoting the growing of upland rice in Northern Uganda.

Purpose:

The study seeks to examine the determinants of smallholders' demand for quality assured rice seeds in Northern Uganda The study will generate information that will be useful to small scale and large scale rice farmers in addressing the impediments to the productivity level.

Procedures:

Your participation in this study will involve filling in a questionnaire together with the researcher. You have been chosen to participate in this study because you are a rice producer in Gulu and Nwoya. The interview will last for approximately (25 -30minutes) and 196 participants will take part in the study.

Who will participate in the study?

You have been chosen to participate in this study because you are a rice producer in this area. The interview will last for approximately 25 – 30 minutes and 196 rice producers will take part in this study.

Risks/discomforts:

There is no foreseeable risk of harm or discomfort that will arise from your participation in this study. The only risk or discomfort will be the inconvenience in terms of time spent during the interview.

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Benefits:

Benefits will prevail after the researchers have compiled a report of findings and concerned bodies react appropriately. The research participants will get feedback on findings and progress of the study and any new information that affects the study participants (including incidental findings) will be made available to research participants. Additionally the participant will get to know about the major determinants of the demand for quality assured rice seeds. Furthermore the study findings will guide policy makers in coming up with policies that may promote the intensification of using the quality assured rice seeds.

Confidentiality:

Your identity will not be revealed to any one as we shall only use codes to identify participants. Information obtained will only be accessible by the research team. Soft copies of the data will be protected by password and hard copy files will be kept under lock and key. Confidential information will only be accessed by the principal investigator.

Alternatives:

You do not have to participate in this study if you are not interested. You will not lose any benefit in case of no participation.

Cost:

There will not be any additional cost incurred as a result of participating in this study.

Questions:

If you have any questions related to the study, as a research participant, you can contact the principal investigator, Apiyo Scovia Perphency on telephone number 0781821730 or via email on apiyoscoviaperphency@gmail.com.

Statement of voluntariness:

Participation in the research study is voluntary and you may join on your own free will. You have a right to withdraw from the study at any time without penalty.

If you have any issues pertaining to your rights and participation in the study, please contact the Chairperson, Gulu University Research Ethics Committee, Dr. Gerald Obai Tel:No.,0772305621; email:lekobai@yahoo.com/lekobai@gmail.com; or the Uganda National Council for Science and Technology, on plot 6 Kimera road, Ntinda, Kampala on Tel 0414705500.

Statement of consent

..... has described to me what is going to be done, the risks, the benefits involved and my rights as a participant in this study. I understand that my decision to participate in this study will not affect me in any way. In the use of this information, my identity will be concealed. I am aware that I may withdraw at

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anytime. I understand that by signing this form, I do not waive any of my legal rights but merely indicate that I have been informedabouttheresearchstudyinwhichIamvoluntarilyagreeingtoparticipate.Acopyofthis form will be provided tome.

Name……Signature/thumbprint of participant……Date ……

Name……Signature/thumbprint of witness……Date……

Name……Signature of interviewer……Date……

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Appendix III: Informed Consent Document (Luo Version)

Wilok madito I kwed man: Kwed I lok kum ngo ma mio lupur ma tino mito kodi mucele maber I tung kumalu me Uganda.

Lakwed: Apiyo Scovia Perphency, Mugonola Basil kwede Akite Irine Gang pwonye: Gulu Univaciti

An nyingaApiyo Scovia Perphency latin kwan me Gulu Univaciti I rwom me digiri me macta I dongo kit me puru gami ma patpat.

A tye ka timo kwed I lok kum jami ma kwako kit me lupur mucele, cato kwede mucele gi, onyo lok I kum cuk me mucele. Waraga man tito it in lok kum kwed man, ka lapeny mo tye ki bot in ki bi gamo ne. Dong ka I moko tami me bedo I kwed man, ci I bi dwal cingi I waraga man dok bene waraga man acel bi dong boti.

Kwed man onongo kony me lim ki bot dul ma ki lwongo ni Rice CARP.

Kwed man tye me niang ngo ma weko lupur matino bedo ki miti I kom kodi mucele maber ki I dictrik me Gulu ki Nwoya. Adwogi me kwed man obi miyo kero bot lupur matino mengio lageng mokeken I kom medo kero pa mucele me cek ma dwong.

Katala ma megi ma lube ki kwed man tye me miyo ngec ma lube ki lapeny ma ki bi penyi ki I karatac man.

Ki yero in me bedo I kwed man pyen in lapur mucele ma aa ki Nwoya ki Gulu dictrik. Lapeny man twero cwalo dakika ma room pyera aryo wiabic me oo i pyera adek (25-30). Kwed man mite weldano 196 ma gi puru micelle.

Peko mo matwero kati ki I kom kwed man matpat ki cawa ni bi bedo pe.

Magi aye kony ma lagam lapeny bi nongo ne, gin aye nongo adwogi me kwed man, miyo tam boti ki lok manyen ka tye matwero gudu kum lagam lapeny I kwed man.

Lok kumi mokeken mabikato woko bibedo pe pien wa bitiyo ki nukta.Ngec mokeken ma

imiyo lakwed en aye bibedo ki kare me nongo ne.

Ngeni meno miyo tami I kwed man tye I miti ni, ka tyen lok mo tye ma weko pe I twero gamo lapeny magi pe obi weko I rwenyo gin mokeken.

Dok bene ngeni acara pe tye ma kwako miyo tami I kwed man, do kono cawa ni keken aye bibale I gamo lapeny magi.

Ka lapeny mo tye ma lube ki kwed man onyo twero ni I kwed man go cim bot Apiyo Scovia Perphency I namba man 0781821730 onyo cwali yamo internet – imail: apiyoscoviaperphency@gmail.com

Miyo tami I kom kwed man pe tye ki dic mokeken.Iromo aa giri onyo weko miyo tami.pwod mo pe iye.

ka lok mo tye ma lube ki twero ni I kum gamo lapeny man go cim bot won kom ma loyo dul me kwed I Gulu Univaciti, I lep munu dul man ki lwongo ni Gulu University Research Ethics Committee, nying won kom Dakta Gerald Obai namba cim mege tye 0772 305 621; imail: lekobai@yahoo/lekobai@gmail.com; onyo Uganda National Council for Science and Technology, ma tye I polot 6 iyoo Kimera, Ntinda, Kampala I namba cim man 0414705500.

Yeyoki bot lagam lok

.....Lacok lagam man owaca peki, ber ki

twero me gamo lok, dok aniang ni twero na ki tama pe bi guda kit mokeken. Lok kuma pe binen dok bene aromo kwero onyo weko mede ki gamu lapeny ma kwako kwed man cawa mokeken ka cwinya pe mito.Keto cinga ni nyutu ni abedo I kin lugam lok dok pira gira ki miti na.Karatac man acel bi dong bota.

Nyinglagamlok…….....Dwalcing/opanycing pa lagamlok…..…Nino dwe.....

Nyingcaden…….....Dwalcing/opanycing pa caden…… Nino dwe.....

Nyinglakwed....……...Dwalcing pa lakwed……..... Nino dwe.....

Appendix IV: Research Ethics Committee Approval

GULU UNIVERSITY

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RESEARCH ETHICS COMMITTEE

7th August 2020

APPROVAL NOTICE

Ms Apiyo Scovia Perphency
Gulu University
Uganda

Re: **Application No. GUREC-059-20**

Type of review:
[X] Initial review
[ ] Amendment
[ ] Continuing review
[ ] Termination of study
[ ] SAEs
[ ] Other, Specify:_____

Title of Proposal: **"DETERMINANTS OF SMALLHOLDER FAMERS' DEMAND FOR QUALITYASSURED RICE SEEDS IN NWOYA AND GULU DISTRICTS, NORTHERN UGANDA"**

I am pleased to inform you that the Gulu University Research Ethics Committee **(GUREC)** approved the above referenced application.

Approval of the research is for the period of **13th July 2020 to 12th July 2021**

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 addenda to the protocol or the consent form must be submitted to the **GUREC** for re-review and approval prior to the activation of the changes. The **GUREC** application number assigned to the research should be cited in any correspondence.

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3. Any unanticipated problems involving risks to participants must be promptly reported to the **GUREC**. New information that becomes available which could change the risk: benefit ratio must be submitted promptly for the **GUREC** review.

4. Only approved and stamped consent forms are to be used in the enrollment of participants. All consent forms signed by participants and/or witnesses should be retained on file. The **GUREC** 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 **GUREC** eight (**8**) weeks prior to the above expiration **date of 12th July 2021** in order to continue the study beyond the approved period. Failure to submit a continuing review application in a timely manner 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.

The following documents have been approved in this application by the **GUREC:**

	Document	**Language**	**Version**	**Version Date**
1	Protocol	English	Version 2.0	29th July 2020
2	Data Collection Tools	English	Version 2.0	29th July 2020
3	Informed consent Document	English/Luo	Version 2.0	29th July 2020

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Signed,

Mr. Robert Kiduma
For; Chairperson
Gulu University Research Ethics Committee

Appendix V: Plagiarism Check

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PLAGIARISM CHECK

Declaration for Originality Form

This form must be completed and signed for all scholarly work produced.

Name: _ SCOVIA PERPHENCY APIYO _____
Personal File No.(staff) Reg. (**student**).___ 18/U/2869/MAE _____
Faculty/Institute:___ AGRICULTURE & ENVIRONMENT_____
Department:____ RURAL DEVELOPMENT AND AGRIBUSINESS____
Title and bibliographic description of the work
DETERMINANTS OF DEMAND FOR QUALITY DECLARED RICESEEDS IN NWOYA AND GULU DISTRICTS, NORTHERN UGANDA

Declaration.

1. I understand what plagiarism is and I am aware of the University policy on this regard,
2. I declare that this …**Thesis**… (thesis, dissertation, essay, assignment, paper, report etc.) is my original work and has not been submitted elsewhere for examination, award of a degree or publication. Where other people's work or my work has been used, this has been properly acknowledged and referenced in accordance with Gulu University requirements,
3. I have not sought or used the services of any professional agency to produce this work,
4. I have not allowed, and shall not allow anyone to copy my work with the intention of passing it off as his/her own,
5. I understand that any false claim of this work shall result in disciplinary action in accordance with University Policy on Plagiarism.

Signature _____ Date 25-Hi/9/2023

Originality Report

The article/thesis/document titled above have been subjected to plagiarism check and the level was found to be……**20%** (percent) this is classified as:

- ✓ **Minor**
- ☐ Moderate
- ☐ Serious

Yours sincerely,

Dr. Ongaya Kizito (PhD)
Senior Librarian