CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Tropical AgriSciences

Department of Economics and Development

Farmers' Information Behaviour and Extension Workers' Job Satisfaction: Evidence from Sub-Saharan Africa

Dissertation Submitted for the Doctoral Degree

Awarded by the Faculty of Tropical AgriSciences

of the Czech University of Life Sciences Prague

Submitted by

Pius Nnahiwe

Supervisor: Ing., Dr. sc. agr., Dr. sc. habil. Miroslava Bavorová

Prague, 2023

Declaration

This declaration confirms that the dissertation thesis titled: “Farmers’ Information Behaviour and Extension Workers’ Job Satisfaction: Evidence from Sub-Saharan Africa” is the result of my investigation and has not been submitted elsewhere for any other degree or professional qualification.

Acknowledgements

Sincere gratitude to the thesis supervisor Ing., Dr. sc. agr., Dr. sc. habil. Miroslava Bavorová, who provided relevant guidance and direction during the study programme.

Thanks to the beautiful minds at the Department of Economics and Development for their intellectual contribution and the Internal Grant Agency of the Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, for financially supporting the research survey in Kenya (Project Number: IGA number 20175012) and Nigeria (Project Number: IGA number 20223113).

A special thanks to the implementers of V4 European Union project “enhancement of livelihoods in the Kenyan Coastal Region by supporting Organic and Fair Trade certification of smallholders” implemented in accordance with the intervention programme "conflict prevention, peace and economic opportunities for the youth" (EUTF05-HoA-KE-18) for data collection in Kenya. Also, I sincerely appreciate the following organizations I collaborated with for the successful data collection in Nigeria; the University of Ibadan, Cocoa Research Institute of Nigeria, National Institute of Social and Economic Research, Institute of Agricultural Research and Training, Forestry Research Institute of Nigeria, National Horticultural Research Institute and the Oyo State Agricultural Development Programme.

Abstract

As the agricultural sector modernises, the efficient flow of relevant information has become a crucial factor in its overall performance. The increasing importance of information in agriculture can no longer be ignored. To ensure the industry's success, access to credible and precise information must be emphasized. There is a widening knowledge gap between extension service providers and farmers, hindering the efficient flow of relevant information. This widened knowledge gap between extension service providers and farmers, especially in SSA agricultural sector, poses a significant challenge for both African policymakers and the international development community at large. Bridging this gap is highly instrumental in effecting a positive change in the overall performance of the agricultural sector in the region. This thesis sought to investigate the effect of different information sources available to smallholder farmers on the adoption of modern agricultural technologies, the impact of adopting these modern agricultural technologies on smallholder farmers' economic performance, and to determine the effects of extrinsic rewards on agricultural extension workers' job satisfaction. The thesis relied on two case studies by drawing empirical evidence from cashew farmers in Kenya and public extension workers in Nigeria. For the first case study, Logit regression and multiple linear regression models were used to analyse a sample of 372 smallholder cashew farmers in Kenya. The findings demonstrate that the availability of extension services and membership in farmer groups significantly impact the adoption of contemporary agricultural practices, particularly in regard to the utilization of fertilizers and pesticides and the implementation of optimal planting densities. It is noteworthy that the application of fertilizers had a negative effect on economic outcomes, whereas the utilization of pesticides did not exhibit a significant impact. On the other hand, an increase in planting density was found to have a positive effect. The second case study examined how extrinsic rewards impact public sector agricultural extension workers' job satisfaction drawing empirical evidence from 170 agricultural extension workers in Oyo State, Nigeria. The binary logit regression, Partial Least Squares Structural Equation Model and ordered logit model along four dimensions (strongly dissatisfied, dissatisfied, satisfied, and strongly satisfied) empirically make a compelling case for social exchange theory as higher perceptions of organizational (promotion and job security), social (respect from coworkers) and convenience (safety on the field) extrinsic rewards increases the probability of a public sector extension worker reporting higher levels of job satisfaction. Conclusively, other extrinsic rewards beyond

financial motivations are significant job satisfaction predictors regardless of the category. The thesis profers some policy recommendations for policymakers to emphasize the significance of the efficient flow of relevant information – as an important production factor – in the agricultural sector. By providing systems and structures that facilitate easy collaboration among major stakeholders such as private firms, NGOs and international development practitioners in delivering affordable relevant information to farmers. Public management policies should focus on facilitating extrinsic rewards that motivate extension workers to further engage with farmer groups, especially advocating for more active participation of female farmers in existing farmer groups and forming new ones. Emphasis should be placed on disseminating information regarding modern agricultural technologies to facilitate the adoption of these technologies to improve the economic performance of farmers, among other benefits. High-level forums among policymakers should focus on resolving social tensions and regular dialogues at the grassroots to mitigate rural farmer-pastoralist conflicts and transhumance-related violence so that the safety conditions of extension workers on the field are improved for the effective dissemination of relevant agricultural information.

Keywords: Extension; farmer groups; adoption; extrinsic rewards; Kenya; Nigeria

Table of Contents

List of abbreviations

ADP	Agricultural Development Programme
CAADP	Comprehensive Africa Agricultural Development
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
ITU	International Telecommunication Union
LGA	Local Government Area
KES	Kenyan Shilling
NGO	Non-Governmental Organization
OLS	Ordinary Least Squares
OYSADEP	Oyo State Agricultural Development Programme
PLS SEM	Partial Least Squares Structural Equation Model
SSA	Sub-Saharan Africa
USD	United Sates Dollars

List of figures

List of tables

1. Introduction

In sub-Saharan Africa (SSA), a significant proportion of the active population is engaged in agricultural pursuits. It is estimated that approximately 60 percent of the active population in this region is involved in some form of agricultural activity (Djoumessi, 2022), such as crop cultivation and livestock rearing. This high engagement in agriculture is driven by several factors, including the region's relatively low industrialization, high population growth, and dependence on natural resources for livelihoods. Additionally, it is notable that this high level of engagement in agriculture in SSA is often characterized by smallholder farming. More often than not, other terms such as 'peasant farmer', 'small-scale' and 'resource poor' are often used to describe the limited resource state – as regards capital, inputs, labour, and especially lack of knowledge – of smallholder farming observed in the region (Senyolo et al., 2021). Most farmers work on relatively small plots, estimated at around 0.5 to 2 hectares of land (Senyolo et al., 2021), and use traditional production methods mainly for subsistence agriculture. Smallholder farmers are among the vulnerable agrarian population that are often adversely affected by information asymmetry (Ullah et al., 2020) and uncertainty when they lack access to relevant information about agro-allied inputs, weather, modern technologies and high-value markets (Baiyegunhi et al., 2019). Conversely, it's been observed that farmers who access and utilize relevant information have a higher chance of mitigating production and market risks (Baiyegunhi et al., 2019) and can innovate (Balogun et al., 2018; Liverpool and Winter-Nelson, 2010; Singh et al., 2016) compared to their counterparts.

The importance of information in agriculture cannot be overstated, as it plays a vital role in promoting agricultural growth and improving production (Ullah et al., 2020). So far as observed from SSA, recent development efforts evidenced by the increased investments in agricultural research, promotion and adoption of modern technologies have facilitated certain growth in the agricultural sector (Djoumessi, 2022), which might be connected to formal (such as agricultural extension) and informal (such as farmer groups) sources of information in the region. The adoption of agricultural technology – an indicator for efficient use of information by farmers – is generally predicated on the information behaviour of farmers. According to Wilson (1999), "information behaviour" refers to the various actions and processes undertaken by an individual to identify their needs for information, and possible information needs, locate relevant sources in any way and utilize or disseminate the said information. This

thesis broadly focuses on the impact of relevant information sources on farmers and their potential to boost their economic performance. Several studies have asserted the contribution of farmer groups in facilitating information flow among farmers (Abebaw and Haile, 2013; Denkyirah et al., 2016; Hunecke et al., 2017; Liverpool and Winter-Nelson, 2010; Makokha et al., 2001; Martey et al., 2014; saint Ville et al., 2016; Sanyang et al., 2009; Sebhatu et al., 2021; Turner et al., 2014; Wossen et al., 2017) however there still a dearth of evidence in the literature that points to the effect of farmer groups in adopting modern agricultural technologies. Also, other formal sources of information, such as agricultural extension, which refers to the various mechanisms and strategies utilized to disseminate current and relevant information to farmers, with the goal of improving their knowledge, skills, and decision-making capabilities by facilitating information exchange and building capacities for group actions (Ullah et al., 2020). Furthermore, agricultural extension services enhance the resilience of small-scale farmers by bridging the knowledge gap between farmers and extension agents, providing advisory services and information, and promoting technology adoption through awareness creation, information dissemination, and training, resulting in increased agricultural productivity (Baiyegunhi et al., 2019).

As observed in many developing economies in SSA, the public sector is instrumental in delivering agricultural extension services which are often criticised for their ineffectiveness generally due to: inadequate financial and human capital (FAO and ITU, 2022), poor delivery of necessary information, not responsive to farmers' needs, poor farmer outreach, and skill gap (Kassem et al., 2021), applying outdated approaches (Baiyegunhi et al., 2019) to probably contemporary emerging challenges. Among this rising criticism, the main concern has often been directed at the rising level of low job satisfaction among extension workers (Anang and Ayambila, 2020a; Anderson and Feder, 2004; Baloch and Thapa, 2019; Bruce and Costa, 2019; Kassem et al., 2021; Suvedi et al., 2017; Sylla et al., 2019). One of the major root causes for the knowledge gap between extension agents and smallholder farmers in SSA stems from the low job satisfaction of extension workers, amongst other myriad factors. The Green Report on Agriculture and the Food Industry (2018) highlights the significance of employment in agriculture on a global scale, noting that it constitutes more than 30 percent of total employment worldwide (Jankelová et al., 2020). Jankelová et al. (2020) highlighted a decreasing employment trend in the sector in recent years which is connected to the low job satisfaction observed. It is worth noting that the role of technical agricultural employees in

the SSA context is crucial for the economic prosperity of the countries in the region, as without their expertise in the dissemination and promotion of modern technology adoption, the agricultural sector is hindered, ultimately impacting overall economic growth (Mulinge and Mueller, 1998). The agricultural sector is of critical importance, yet it has received limited attention from scholars with regard to the job satisfaction of its employees (Maican et al., 2021). This research gap is particularly significant in the context of global agriculture, as it remains unclear which underlying motivational factors drive employee performance and job satisfaction (Jankelová et al., 2020). Due to the importance of the agricultural sector in SSA, it is essential to adopt a comprehensive perspective when seeking to revitalize the sector as regards facilitating an efficient flow of information – which is a requisite factor of production. This perspective should encompass not only infrastructure improvements but also the cultivation of human capabilities, such as agricultural extension workers who function on the supply side of the whole information behaviour framework.

This thesis seeks to address the following research questions: how effective are the available information sources influencing modern agricultural technology adoption in SSA? Consequently, what is the effect of modern agricultural technology adoption on economic performance in the region? Lastly, what are the determinants of agricultural extension workers' job satisfaction in SSA? This thesis attempts to bridge the knowledge gap in the existing body of knowledge on the information behaviour of smallholder farmers in SSA, drawing on the first case study on the "implications of Kenyan cashew farmers' information sourcing behaviour on economic performance". Furthermore, this body of work explores the factors affecting the job satisfaction of extension workers in SSA, drawing on the second case study, "extrinsic rewards as job satisfaction predictors among extension workers in Nigeria". Moreover, this dissertation is structured around five distinct chapters, commencing with an introduction (Chapter 1), followed by a literature review (Chapter 2), two case studies (Chapter 3 and Chapter 4), and culminating with general conclusions, remarks and limitations of the study (Chapter 5).

Chapter 1 serves as a gateway to the thematic areas, objectives, relevance, and geographical regions of the research and provides a summary of the case studies. Moving on to Chapter 2, the reader is introduced to the overarching concept of information behaviour, which is supported by a conceptual diagram incorporating current literature and empirical

evidence. Additionally, this chapter focuses on the utilization of different information sources in relation to technology adoption and the exchange of information between actors on both the supply and demand sides of the agricultural sector, viewed through the lens of social exchange theory. The chapter concludes with a theoretical review of job satisfaction among extension workers and a brief overview of the Sub-Saharan African context, with Kenya and Nigeria as exemplary cases.

In-depth analyses of the two case studies are presented in Chapters 3 and 4, respectively, before the dissertation is brought to a close with Chapter 5, which offers a brief discussion of the general conclusions, summarized policy implications and limitations of the study as well as recommendations for future studies.

1.2 Objectives of the study

This thesis contributes to the existing body of knowledge on the information behaviour of smallholder farmers (as core information seekers) and furnishes empirical evidence to the growing behavioural economics literature by examining job satisfaction of extension workers (as core information providers) within the sub-Saharan African context. The specific objectives are to:

1. Examine the effect of different information sources available to smallholder farmers on adoption of modern agricultural technologies.
2. Investigate the impact of adopting modern agricultural technologies on smallholder farmers' economic performance.
3. Describe the perceived importance of core competencies among extension workers.
4. Determine the effects of extrinsic rewards on agricultural extension workers' job satisfaction.

Two case studies were relied upon to explore the listed broad objectives by drawing empirical evidence from cashew farmers in Kenya. The first case study on the "implications of Kenyan cashew farmers' information behaviour on economic performance" was carried out. Furthermore, empirical evidence was drawn from Nigeria for the second case study on "extrinsic rewards as job satisfaction predictors among extension workers in Nigeria".

1.3 Relevance of the study

As the agricultural sector continues to evolve and modernize, it is becoming increasingly apparent that information plays a crucial role in the production process (Prasad

et al., 2017; Radhakrishnan et al., 2016; Saha and Devi, 2016). The growing body of evidence supporting this view can no longer be ignored. Within the field of agriculture, the significance of information must be emphasized, and access to credible and precise information is vital for the progression of the industry. This access empowers farmers to make informed decisions and execute effective production methods, which directly impact their prosperity and sustenance. The empirical data from both developed and developing nations underscores the substantial impact of farmers' access to pertinent information on improving agricultural productivity (Läpple et al., 2015; Liverpool and Winter-Nelson, 2010; Ullah and Khan, 2019; Yaseen et al., 2018) through technology adoption. Agricultural technology is one of the most dynamic and influential domains within contemporary technology, motivated by the basic requirement for sustenance and the increasing demand for food to nourish the rapidly expanding human population (Zegeye et al., 2022). There has been an increased focus on utilizing farmer-led extension as a complement to traditional technology transfer approaches such as agricultural extension services. This approach positions farmers as the primary agents of change within their communities and empowers them to play an active role in the dissemination of new technologies to other farmers (Meijer et al., 2015).

Drawing empirical evidence from the Kenyan cashew sector, the first case study examined in this thesis focused on the impact of relevant information sources on farmers adopting modern agricultural technologies and their inherent potential to boost farmers' economic performance. The Kenyan government and international donors have taken an interest in revitalizing the cashew sector due to its potential as a profitable cash crop for farmers in the study region. To date, there has been a lack of empirical research exploring the factors that impact the adoption of modern agricultural technologies and their effect on the economic performance of farmers in the cashew sector. Therefore, a compelling rationale for sourcing empirical data from Kenya arises, as this research endeavours to bridge this void by presenting evidence that farmers who receive extension services and belong to groups exhibit a higher propensity to adopt contemporary technologies. However, in regions with extensive agriculture, such as the one under examination, the use of fertilizers may not be cost-effective.

The second case study investigated extrinsic rewards as job satisfaction predictors among public sector employees in Sub-Saharan Africa, taking Nigeria as an exemplary case. Using social exchange theory as a theoretical background, the binary logit, ordered logit along

four dimensions (strongly dissatisfied, dissatisfied, satisfied, and strongly satisfied), and structural equation models revealed that; higher perceptions of organizational (promotion and job security), social (respect from coworkers) and convenience (safety on the field) extrinsic rewards increases the probability of a public sector extension worker reporting higher levels of job satisfaction. We conclude that, regardless of the category, other extrinsic rewards beyond financial motivations are important job satisfaction predictors premised on the fact that a public management policy of creating job satisfaction is imperative for boosting public sector performance.

1.4 Abstracts of the case studies

Table 1 below provides a basic classification of the two case studies highlighting the specific objectives, keywords and survey methods used.

Table 1: Basic classification of the two case studies

Case study	Objectives	Keywords	Methods
Implications of Kenyan cashew farmers information sourcing behaviour on economic performance	1. Determine the effects of cashew farmers' information sources (group membership status and extension services) on adoption of modern agricultural technologies (the use of fertilizers, chemicals and appropriate plant density), and 2. Investigate the impact of the adoption of modern farm technologies (the use of fertilizers, chemicals and appropriate plant density) on cashew farmers' economic performance (income per acre).	Fertilizer use; chemical spraying; planting density; income; Kenya.	• **Instrument:** quantitative and qualitative survey instruments • **Sampling:** Multistage; stratified sampling to select 3 main cashew areas then quota and snow-ball sampling • **Analysis:** Logit and Multiple Linear regression models
Extrinsic rewards as job satisfaction predictors among extension workers in Nigeria	1. Describe the perceived importance of core competencies among extension workers and 2. Determine the effects of organizational, social and convenience extrinsic rewards on extension workers' job satisfaction.	Extrinsic rewards; Ordered Logit; social exchange theory; Nigeria.	• **Instrument:** quantitative and qualitative survey instruments • **Sampling:** Multistage; Purposive sampling to select 3 ADP zones and simple random sampling to select 16 LGAs, random sampling of 6 institutes and purposive sampling of 5 departments • **Analysis:** Binary Logit regression, Ordered Logit and Partial Least Squares Structural Equation Models

Abstract – Case Study 1

This study seeks to explore the factors that influence the adoption of modern agricultural technologies by farmers in the coastal regions of Kenya, with a focus on the role of farmers' group participation and access to agricultural extension services. The study specifically evaluates the use of fertilizers, chemicals, and appropriate plant density and its impact on farmers' economic performance, measured in terms of income. The aim is to contribute to the existing literature on the adoption of technology theory, particularly in the context of Sub-Saharan Africa, where despite the potential benefits of modern agricultural technology, adoption rates remain low. Logit regression and multiple linear regression models were used to analyse a sample of 372 smallholder cashew farmers in the Coastal Province of Kenya in 2018. The results show that access to extension services and group membership have statistically significant effects on adopting modern agricultural technologies, namely on fertilizer and pesticide usage and appropriate planting densities. However, fertilizer usage had a negative effect on economic performance while pesticide application showed no effect, and higher planting density had a positive effect. The research suggests that the policy should prioritize extension programs that utilize local channels, such as farmer groups, to disseminate relevant agricultural information and cost-effective technologies. Specifically, the implementation of appropriate cashew planting density, as demonstrated in the study, has been found to lead to more profitable agribusiness outcomes.
Keywords: Fertilizer use; chemical spraying; planting density; income; Kenya

Abstract – Case Study 2

The public sector – regarding agricultural extension – has attracted substantial human capital and monetary investments in the last few decades due to its inherent potential to drive productivity in developing economies. However, there is a disparity in the literature regarding the sector's effectiveness in achieving this potential. In Sub-Saharan Africa, the sector's ineffectiveness is often associated with observed low morale of public sector extension workers despite their humanitarian motivations. Some scholars argue that this altruistic motivation is often stifled by public sector workers' demand for extrinsic rewards. There is still a dearth of evidence as regards predictors of job satisfaction, especially amongst public sector workers in the agricultural sector. The case study examines how extrinsic rewards impact public sector workers' job satisfaction drawing empirical evidence from 170 agricultural extension workers in Oyo State, Nigeria. Social exchange theory established organizational,

social and convenience extrinsic rewards as predictors of job satisfaction. The ordered logit model along four dimensions (strongly dissatisfied, dissatisfied, satisfied, and strongly satisfied) empirically makes a compelling case for social exchange theory as higher perceptions of organizational (promotion and job security), social (respect from coworkers) and convenience (safety on the field) extrinsic rewards increases the probability of a public sector extension worker reporting higher levels of job satisfaction. Conclusively, other extrinsic rewards beyond financial motivations are significant job satisfaction predictors regardless of the category. Hence, public management policies should be formulated to boost public sector performance by improving non-financial extrinsic rewards to drive employee job satisfaction.

Keywords: Extrinsic rewards; Ordered Logit; social exchange theory; Nigeria

2. Literature review

As a major driving force behind the economies of many sub-Saharan African countries, agriculture is widely considered to be a priority sector. This is reflected in the fact that it accounts for a significant proportion of the region's gross domestic product (GDP), with estimates ranging from 30 to 40 percent and agriculture remains a significant source of employment in the region, with more than half of the working population being engaged in the agricultural sector (FAO and ITU, 2022). Apart from a few crude oil-producing countries where other economically viable alternatives can help boost economic performance, such as Nigeria, the Gulf of Guinea, Cameroon, South Africa or Ivory Coast (Djoumessi, 2022). This high economic and employment importance highlights agriculture’s crucial role in the region’s development and stability. Agriculture is not only the main source for the production of food and other relevant goods but also for providing income and employment opportunities for a large portion of the population. According to the most recent estimates published by the Food and Agriculture Organization (FAO) in 2022, the rural population in Africa was estimated to be 728 million in 2018, with the projected population for the following year, 2019, believed to be far underestimated at 740 million (Djoumessi, 2022). Given that smallholder farmers are predominantly rural residents, it is a reasonable inference to suggest that they constitute a significant portion of the underestimated population forecast. Consequently, the population of smallholder farmers in SSA may present a significant challenge in terms of the available food resources, as they represent a substantial consumer base (on the demand side), or

conversely, serve as a powerful force if strategically leveraged to produce the necessary quantity of food (on the supply side) – which is the main focus of this thesis. This rapid population growth is a great opportunity for the region's agricultural sector if its food demand can be met, as it holds significant potential for driving economic growth and transforming the sector (FAO and ITU, 2022). As the population of SSA increases, there is a growing demand for food, which presents opportunities for the agriculture sector to expand and become more productive. This can have a positive impact on the overall economy, as agriculture is often a significant contributor to most countries' GDP in the region. With the burgeoning (approximately 60 percent) youthful population largest world's vast arable but still fallow land mass, high capital investments and recent technological advancement, the continent is poised to triple its present agricultural production to alleviate more than 400 million people living on USD 1.9 or less a day out of extreme poverty (FAO and ITU, 2022).

Despite the importance of agriculture in the region and the fact that it has harnessed the potential of the available labour force over the last 30 years (Djoumessi, 2022), the aim of increasing the sector's overall performance has often been impeded. As approximately 250 million smallholder farmers and pastoralists in the region (FAO and ITU, 2022) face a wide range of challenges that hamper their ability to increase their incomes and improve their livelihoods. The rising food prices negatively impact various facets of different countries in the region, such as food security, social cooperation, and growth (World Bank, 2023a). The recent World Bank report stated that approximately 60 percent of individuals living in extreme poverty worldwide, a significant proportion of whom allocate a substantial portion of their income towards food expenses, reside in SSA (World Bank, 2023a). This represents a substantial population of individuals, especially those living in agrarian communities, who are struggling to meet their basic needs, and highlights the region as a particularly vulnerable area in terms of economic insecurity. Additionally, poverty still is a widespread challenge in the region, further exacerbating smallholder farmers' vulnerability to any slight distortion in the fragile economy. As adduced in recent studies from the region, there is a decrease in the overall agricultural sector's performance (Djoumessi, 2022), possibly leading to the rise in food prices, which has significantly contributed to the overall inflation rate, accounting for over half of the total inflation and pushing the average inflation rate in SSA to 13 percent (World Bank, 2023a). These challenges reflect a certain level of inefficiencies in sub-Saharan Africa's agricultural sector. The underperformance of the agricultural sector or the inability of the

sector to fully harness the inherent potentials might also be linked to the concerning trend of increasing levels of hunger observed in almost all subregions where the prevalence of undernourishment has reached alarmingly high levels of 22.8 percent (FAO/IFAD/UNICEF/WFP/WHO, 2019). Hence, resolving the inefficiencies within the agricultural sector in SSA is crucial to smallholder farmers' livelihoods, achieving sustainable development, reducing poverty and other factors that have serious consequences for the region's social cohesion.

Among many other challenges that plague the agricultural sector in the region, constraints within the agribusiness environment, inadequate entrepreneurial skills linked with possible knowledge gaps (FAO and ITU, 2022) can place smallholder farmers in a disadvantaged position. Also, the use of improper land management practices, high transaction costs for inputs and products in rural areas, resulting from poor rural infrastructure, limited access to production resources and tools needed, such as access to credit and information (Baiyegunhi et al., 2019), can aggravate smallholder farmers working conditions in an expanding global economy. More often than not, efforts in addressing these inefficiencies within the agricultural sector of SSA have been directed at resolving challenges surrounding mainstream factors of production like land, labour and capital. However, due to the recent technological advancements – although most countries in SSA are presently at different levels of digital evolution (FAO and ITU, 2022) – and the availability of information, it is becoming harder to ignore the mounting evidence of the value of information as a crucial factor of production within the agricultural sector (Prasad et al., 2017; Radhakrishnan et al., 2016; Saha and Devi, 2016). In agriculture, the importance of information should be foregrounded, and access to trustworthy and accurate information is crucial for the advancement of agriculture as it enables farmers to make informed decisions and implement successful production strategies that have a direct impact on their well-being and livelihoods. The empirical evidence from both industrialized and developing countries highlights the significant impact of farmers' access to relevant information on the enhancement of agricultural productivity and reduction of production costs (Läpple et al., 2015; Liverpool and Winter-Nelson, 2010; Ullah and Khan, 2019; Yaseen et al., 2018). These findings emphasize the importance of providing adequate information support to farmers, particularly in developing countries where improved overall agricultural sector performance is critical to ensuring food security and reducing poverty. Timely and relevant information access has a

critical impact on enhancing farmers' economic performance and augmenting their financial returns on investments (Yaseen et al., 2018). As highlighted by Van den Ban (1998) farmers require a variety of information for different facets of their farm establishment (Glendenning et al., 2010) at different stages of crop production or livestock rearing to support vast production practices. This relevant information assists farmers in maximizing output through better resource use, implementation of effective production schematics, upkeep and soil fertility improvement (Yaseen et al., 2018).

Before determining the necessary information, farmers engage in the process of source selection, choosing from a diverse range of available sources, including both formal and informal sources (Glendenning et al., 2010; Yaseen et al., 2018). The formal means, as seen in most developing countries; information on good agricultural practices is typically delivered by public extension services via training, meetings, the Internet, push notifications to mobile phones, and mass media, including television, radio, and newspapers (Yaseen et al., 2018). In addition to public sector involvement, there has been a growing trend of private sector engagement in providing agricultural extension services and information. These private entities are employing strategies similar to those utilized by public extension programs to effectively address the informational requirements of farming communities (Anderson and Feder, 2004). In addition to utilizing formal channels, farmers also obtain information through informal means, including social networks comprised of individuals such as fellow farmers, acquaintances, familial connections, and providers of agricultural inputs (Yaseen et al., 2018) and the management of informal knowledge systems is crucial for smallholder farmers operating in developing regions (saint Ville et al., 2016). The process of accessing available information from different sources is an integral component of information-sourcing behaviour which is further part of the broader information behaviour concept. As adduced by Savolainen (2013), Wilson defined information behaviour as “the totality of human behaviour in relation to sources and channels, including both active and passive information seeking and information use.” Thus, within the SSA agricultural context, information behaviour comprises actors on both the demand (smallholder farmers) and supply (extension workers) side. This broad concept ties together the nuances involved in acquiring and synthesizing new information by extension service providers before it is tailored to farmers’ needs with the hope of utilizing the acquired information to improve farmers’ productivity. The question that comes to mind begging to be considered is: how do these various – both

formal and informal sources – contribute to the efficient use of relevant information by smallholder farmers? The adoption of modern agricultural technologies has often been suggested as an indicator of the efficient use of information by academic scholars.

The growing evidence from SSA attesting to the importance and impact of adopting modern technologies on the economies of different countries in SSA is overwhelming (Abebaw and Haile, 2013; Martey et al., 2014; Ouma et al., 2002; Sanyang et al., 2009; Zegeye et al., 2022). Most studies that have investigated the effect of the adoption of technological innovations in agriculture have traditionally centred around the theory of diffusion, as represented by the S-shaped diffusion curve (Tarde, 1903). This model illustrates a gradual initiation phase in which only a few farmers adopt the innovation, followed by accelerated adoption and ultimately slowing as the proportion of adopters reaches saturation. Since the diffusion of innovation process occurs as a result of individuals independently making decisions to adopt new technology – based on the availability of information regarding the said innovation – the sources of this information influence the rate of adoption. Both the individual's independent decision to adopt and the various information sources available to the individual fall within the concept of information behaviour. Hence, both the decision to adopt and information sources within a given context are contributing factors to the rate of diffusion of innovation highlighted by the theory of diffusion. However, for the efficient flow of information within the SSA's agricultural landscape, the sector can leverage recent advancements in technology, allowing for more efficient and effective decision-making, which can lead to improved resource management, increased productivity, and increased access to markets and financial services for smallholder farmers (FAO and ITU, 2022). Although to attain an efficient flow of relevant information within the agricultural sector in SSA by harnessing the high potential for digital transformation (FAO and ITU, 2022), certain challenges inhibiting smallholder farmers' access to timely and relevant information must be surmounted.

2.1 Information behaviour and technology adoption in agriculture

This chapter of the thesis is arranged in the following thematic order for clarity: the importance of technology transfer within the agricultural context, the role of information within technology transfer from both the supply and demand sides and finally, how these two sub-themes sit under the broad concept of information behaviour as highlighted in the conceptual diagram (Figure 1) below. The diagram presents a basic classification of

information sources in the agricultural sector, encompassing both the supply and demand sides. As illustrated in the diagram, farmers acquire pertinent information from both formal and informal sources. Additionally, extension workers play a crucial role as a formal information source, particularly in SSA. It follows that the level of job satisfaction experienced by extension workers can have a direct impact on the quality of information that farmers receive. Ultimately, the quality of the information received by farmers can influence their decision to adopt agricultural technologies. The first case study (on the demand side of the conceptual diagram) provides insights into the adoption of technology theory by investigating the effect of farmers' formal and informal sources of information on the adoption of modern agricultural technologies. While the second case study (on the supply side of the conceptual diagram), social exchange theory was utilized as a valuable framework to explain the extrinsic incentives that impact extension workers' job satisfaction. This has significant implications for the agricultural sector, especially with regard to information exchange between farmers (demand side) and extension workers (supply side).

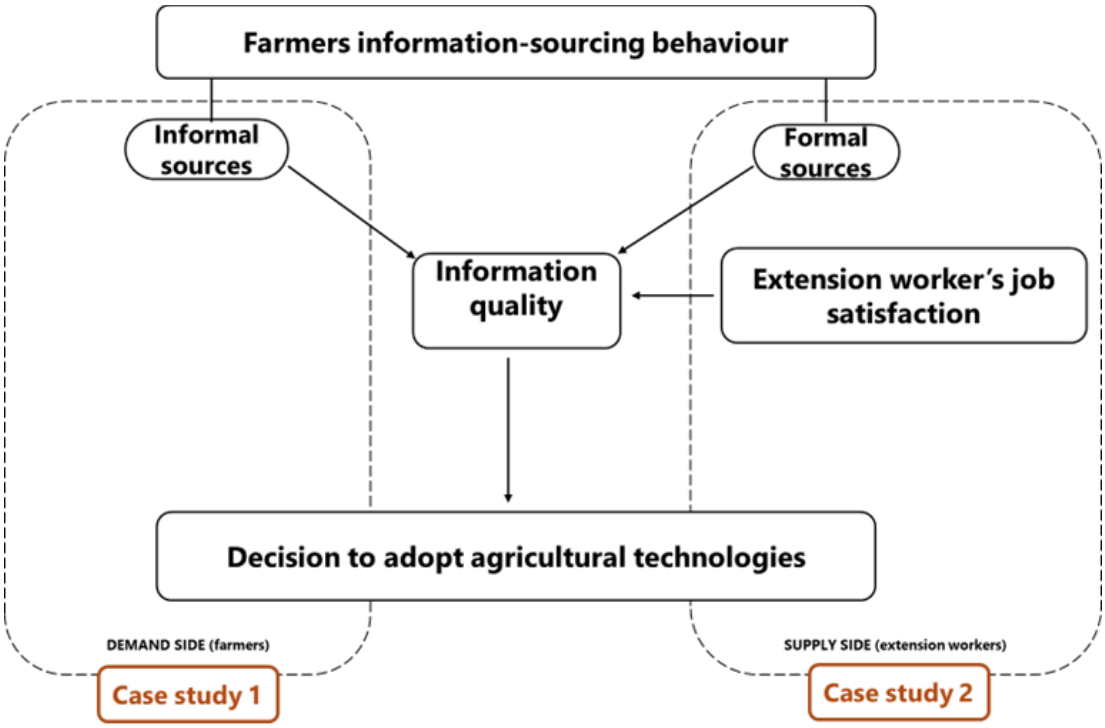


Figure 1: Conceptual diagram based on the existing literature and generated empirical evidence

One route to poverty reduction in agrarian communities can be through increasing the awareness and adoption of modern agricultural technologies so that farmers can improve productivity, increase their income and ultimately reduce food insecurity (Ullah et al., 2022).

However, farmer's information behaviour is essential to sourcing relevant information related to modern agricultural technologies before they can consider adopting them. The twenty-first-century smallholder farmer in SSA faces certain technological challenges that are arguably more complex than in previous years. Factors such as limited land and water resources – and poor access to relevant information – have made productivity gains crucial for growth in the agricultural sector, as they are essential for meeting the rising demand for food and other agricultural products (World Bank, 2008). Furthermore, according to the aforementioned World Bank report recommendation, increasing globalization and evolving supply chains, farmers and countries must continually innovate to keep pace with changing market demands and maintain competitiveness – with emphasis placed on sustainable technologies in regions characterized by heterogeneous and risky rainfed systems, such as SSA. Implementing modern technologies appropriate for the scale of operations is crucial for promoting agricultural growth (Mottaleb, 2018) in the region and adopting these technologies is contingent upon the information behaviour of actors – both on the demand and supply sides – of the agricultural sector. Hence it is getting increasingly difficult to neglect the mounting evidence that has also affirmed the importance of using relevant technologies – sourced from both formal and informal information sources – to raise inhabitants in rural Africa above the poverty line (Liverpool and Winter-Nelson, 2010). It is common knowledge that the significant effect of adopting technologies in the agricultural sector has been instrumental in many countries in the global north. This is not assuming that the agricultural industry in the global north countries is not facing numerous challenges as a result of the conflicting demands of economic growth and environmental sustainability, but the implementation of innovative practices and technologies in the global north's agricultural sector has undoubtedly contributed to enhancing productivity while concurrently preserving natural resources (Läpple et al., 2015). Thus, promoting an efficient flow of relevant information that facilitates agricultural innovation is crucial for the long-term viability of the food production industry, as farmers require innovative solutions that will improve efficiency and enhance their competitiveness. However, this success story is yet to be documented for countries in SSA, even though some forms of modern agricultural technologies – such as improved seeds, fertilizer, and agrochemicals – have been adopted at a staggering rate (Abate et al., 2016) probably due to lack of in-depth understanding of farmers information behaviour as regards how they source for relevant information relating to agricultural technologies.

The low agricultural productivity in SSA poses a significant development challenge for both African policymakers and the international development community (Abebaw and Haile, 2013), as most countries in the region struggle to meet the food demands of their populations despite the region's potential for agricultural production. This poor performance of SSA's agricultural sector, now a growing concern for development and donor agencies, can be likened to the low and slow adoption of modern agricultural technologies (Yigezu et al., 2018), which is associated with an inefficient flow of relevant information from the supply (extension agents) to the demand (smallholder farmers) side within the context of information-sourcing behaviour. This concern leads to the enactment of the Comprehensive Africa Agricultural Development Programme (CAADP) by African Governments to encourage technology dissemination and adoption to alleviate poverty and food insecurity in Africa (Abebaw and Haile, 2013). The growing evidence from SSA attesting to the importance and impact of adopting modern technologies on the economies of different countries in SSA is overwhelming (Abebaw and Haile, 2013; Martey et al., 2014; Ouma et al., 2002; Sanyang et al., 2009; Zegeye et al., 2022). The adoption of agricultural technologies – a crucial factor in promoting economic growth in developing nations – is predicated on the availability of pertinent information relating to those techsnologies as supplied by extension workers and how smallholder farmers seek out this relevant information. By increasing farm income and consumption expenditure, modern agricultural technology adoption can lead to a significant improvement in the welfare of farming households (Zegeye et al., 2022) if efficient information flow is facilitated. Feder et al. (1985) opined that the adoption of new technologies within agricultural systems is typically viewed as a process of maximizing expected economic gains, which are determined by traditional factors such as land allocation, the efficiency of the technology in question, and the costs associated with inputs and revenues generated by outputs (Zegeye et al., 2022). However, information relevant to agricultural technologies is emerging as a critical factor that equally determines if farmers will adopt these technologies – as the innovative products cannot be fully utilized without the accompanied knowledge component (Sanyang et al., 2009).

The early empirical research into the adoption of agricultural innovations came to the limelight during the Green Revolution, as scholars sought to comprehend the diffusion of divisible agricultural innovations originating from research institutions and universities among farmers (saint Ville et al., 2016). Since the term "technology transfer" was introduced into

scholarly literature, the term has caught scholarly attention; however, there is still no consensus on the definition. As adduced by one of the early definitions of the concept in 1994, Roessner and Bean defined technology transfer as the ‘‘movement of know-how, technical knowledge, or technology from one organization setting to another’’ (Sanyang et al., 2009). Sanyang et al. (2009) further highlighted that once a “finger can be placed” on what the term technology means, defining the adoption or use of technology seems less challenging. A prominent theorist, Sahal (1981), conceptualizes “technology” as a "configuration," emphasizing the importance of considering the subjectively determined processes and products that underlie the transfer of technology (Sanyang et al., 2009). Sanyang et al. (2009) opined that though approach emphasizes the interdependence of technology and knowledge transfer, which addresses a significant analytical challenge – by recognizing that the diffusion of a technological product is inherently linked to the diffusion of the knowledge that informs its composition. In contrast to perspectives that focus solely on the product, Sahal's framework highlights the need to consider the broader context of technology transfer and diffusion – as the technological product cannot be fully utilized without the knowledge component. Another study refers to adoption as “a learning process that occurs through the collection of information and the acquisition of practical skills” Pannell et al. (2006) as cited by (Hunecke et al., 2017). However, the impact of technology adoption in agriculture is contingent upon the willingness of farmers to adopt new technologies and the rate at which they adopt them. One major indicator for this is the time frame in which a certain percentage of farmers adopt a particular innovation within a particular population – such that, as highlighted by Rogers (2010), innovations that are perceived as having a higher relative advantage, compatibility, ease of use, divisibility, and observability are more likely to be adopted at a faster rate (Zegeye et al., 2022). Most studies of the uptake of technological innovations in agriculture have traditionally centred around the theory of diffusion, as represented by the S-shaped diffusion curve (Tarde, 1903). This model illustrates a gradual initiation phase in which only a few farmers adopt the innovation, followed by accelerated adoption, and ultimately slowing as the proportion of adopters reaches saturation. This framework was initially examined by rural sociologists and later incorporated into economics by Griliches in 1957, as reported by (Toma et al., 2018). The diffusion of the innovation process occurs as a result of individuals independently making decisions to adopt new technology – based on a comparison of the perceived benefits and costs associated with the innovation,

taking into account the uncertainty surrounding both. Farmers engage in a decision-making process when considering the adoption of a specific technology by assessing the potential impacts of the innovation on various aspects of their operations, including economic, social, and technical feasibility based on incremental benefits that may be gained through the use of the new technology (Zegeye et al., 2022). It is common knowledge that widely diffused and appropriately applied technologies contribute to economic growth regardless of the type of innovation involved.

Agricultural innovations is often an umbrella term referring to a vast array of new technologies, farm practices, and organizational and management techniques which points to the fact that these innovations are novel to the farm rather than being entirely new developments in the marketplace of ideas (Läpple et al., 2015). These innovations can take various forms, such as, but not limited to the following:

- the adoption of soil conservation or soil-improving practices (Nata et al., 2014);
- the adoption of new seed varieties, diversification of farm operations, the use of specialized farm accounting software or the implementation of forward contracting (Läpple et al., 2015);
- the adoption of high-yielding improved varieties (Abdoulaye et al., 2018);
- new disease-resistant and climate-adjusted seeds, modern management practices, and conservation of resources using scale-appropriate new agricultural machinery (Mottaleb, 2018) and;
- the genetic improvements of seeds, climate-smart technologies, fertilizers, and integrated pest management strategies (Ullah et al., 2022).

Ceteris paribus, when implemented correctly, the above technologies have the potential to enhance productivity and generate additional income for smallholder farmers. The literature on the adoption of agricultural technology displays a wide range of findings that vary based on the specific study context, the type of technology examined, and other relevant factors taken into consideration (Nata et al., 2014). In SSA, there is a renewed interest in foregrounding technological innovations in the agricultural sector through the dissemination and adoption of high-yielding enhanced seed varieties. As observed, a few samples of smallholder farmers that adopted improved maize varieties benefited from increased yields (Abdoulaye et al., 2018). However, empirical evidence documented from most developing

countries shows that the adoption of agricultural technologies has been at a staggering rate (Ullah et al., 2022), and other scholars have reported a discouraging rate and perhaps a tough challenge in identifying the main barriers of adoption in SSA (Wossen et al., 2017). Probably the uptake of these technologies among smallholder farmers in SSA appears to be slow as the process of technology adoption is complex and multifaceted, involving not only the implementation of new technologies but also the integration of these innovations with existing practices and systems (Meijer et al., 2015). In addition, the dwindling investment in innovation, particularly in SSA countries with an agriculture-based economy, since the 1960s has resulted in limited success in implementing scientific plant breeding techniques, specifically the green revolution, which aimed to develop improved crop varieties suited for smallholder farmers in subtropical and tropical regions (World Bank, 2008). The same World Bank report highlighted that the limited adoption of these techniques in SSA could be attributed to a variety of factors, such as the diverse range of crops grown in the region, the complex and heterogeneous agroecological conditions, the lack of necessary infrastructure, markets, and supporting institutions, gender-based differences in labour responsibilities and access to resources. However, there has been a shift observed in SSA in terms of the impact of improved crop varieties on food staples, such as the implementation of improved maize varieties and hybrids, disease-resistant strains of cassava, beans with multiple stress resistances, and improved rice varieties have demonstrated potential in addressing food insecurity in the region (World Bank, 2008). Although as highlighted by Pannell et al. (2006), the implementation of any novel innovation carries inherent risks and opportunities as farmers are more inclined to adopt new technologies that present a lower level of risk and offer a higher potential for benefits in comparison to existing methods – even though the decision to adopt these new technologies becomes even more complex when they require a significant initial investment (Yigezu et al., 2018). Aside from the initial investment cost involved, the adoption of technology remains a significant challenge for many due to a variety of barriers that impede the uptake and integration of technology, such as:

- Farmers' socio-economic characteristics; gender, farming experience, level of formal education, household size or income, to represent human capital, characteristics of the farm like plot size, land ownership, soil quality, machinery, crops or livestock as indicators for physical capital (Hunecke et al., 2017).

- Regulatory framework, the influence of other farmers, attitudes towards innovation, risk perceptions, access to information regarding the technology in question and knowledge transfer (Toma et al., 2018).
- Lack of human resources, inadequate institutional capacity, insufficient information and education (Senyolo et al., 2021).
- Current circumstances of the farmer, the qualities of the new practice and its comparative advantage over old practices and the willingness of the farmer to try the new model with an expectation that the new practice will help them achieve their economic, social, and environmental goals (Abdollahzadeh et al., 2016; Mottaleb, 2018).
- Institutional access, agricultural context and farmer-related variables (Ullah et al., 2022).

Understanding smallholder farmers' decisions regarding technology adoption have been a major area of agricultural research for several decades, and factors determining the adoption or non-adoption of modern agricultural technologies continue to draw scholarly attention (Hunecke et al., 2017). Meijer et al. (2015) proposed a comprehensive framework for understanding the adoption and adaptation of agricultural innovations, considering the complex and nonlinear nature of technology uptake. This framework considers extrinsic and intrinsic factors that influence the adoption of new technologies in the agricultural sector (Meijer et al., 2015). Additionally, Hunecke et al. (2017) and other scholars have highlighted the importance of social and institutional variables, particularly social capital, alongside human and physical capital, in understanding technology adoption in agriculture. However, the role of information as a critical factor within the scope of technology transfer from the demand side to the supply side is often overlooked.

Information viewed as a production factor, just like the land, labour, and capital (Prasad et al., 2017; Saha and Devi, 2016), must be retrieved, sorted, managed, organized, stored, analyzed and acted upon (Radhakrishnan et al., 2016). The availability of reliable information is fundamental to agricultural development, as it empowers farmers to make critical choices and implement effective production schematics that impact their livelihoods. Empirical evidence from both industrialized and developing countries demonstrates that farmers' procurement of relevant information has led to augmented agricultural output and a decrease in production expenses (Läpple et al., 2015; Liverpool and Winter-Nelson, 2010; Ullah and

Khan, 2019; Yaseen et al., 2018). Access to timely and relevant information can be crucial in improving farmers' productivity and augmenting financial gains from their investments (Yaseen et al., 2018). As highlighted by Van den Ban (1998), farmers need a wide range of information for various aspects of their farm enterprises (Glendenning et al., 2010) at different stages of crop production or livestock rearing to support myriad production practices. This information assists farmers in maximizing output through more judicious utilization of resources, implementation of effective production schematics, and upkeep and amelioration of soil fertility (Yaseen et al., 2018). As adduced by Glendenning et al. (2010) and Yaseen et al. (2018), the list below shows that farmers need relevant information related to:

- Most appropriate modern technologies and management of these technologies, including optimal use of inputs
- Changing farm system mix (mixed farming and diversification, animal husbandry, fisheries)
- Scouting for reputable input suppliers
- Collective action with other farmers in working groups
- Consumer and market demands for products
- Quality specifications for farm produce to meet the demand from high-value markets
- Off-farm income-generation opportunities
- Implications of changing policies (input subsidies, trade liberalization)
- Access to credit and loans
- Realtime market data relating to availability, quality and prices of inputs and selling produce
- Sustainable natural resource management and coping with climate change
- Postharvest aspects, including processing, marketing, storage, and handling
- Weather forecasts
- Recommended sustainable practices such as soil fertility management practices, best water-saving irrigation methods, and integrated pest management

However, the perceived need for this information will differ according to the groups of farmers depending on the cultural context, agroclimatic zones (Glendenning et al., 2010) and farmers' socioeconomic characteristics (Yaseen et al., 2018). Although Glendenning et al. (2010) further opined that the "process of contextualizing information through awareness so

that it becomes situation specific" referred to knowledge and the following factors can influence information flow from information providers and use by farmers:

- Content: The credibility, pertinence, practicality, and promptness of the information are imperative. Information should not be one-sided but comprehensive, endeavors should be undertaken to enhance the content to incorporate industry intelligence, regulatory insights, and farmers' knowledge, as well as incorporating the information to establish connections with support services and resources.
- Processes: The method by which the information is disseminated can have a significant impact on its utility and application. By prioritizing information requirements in collaboration with end-users, enhancing the value of the collected information, evaluating how farmers utilize the information, and adjusting the distribution strategy by segmenting and identifying specific recipients, the effectiveness of the information dissemination methodology can be improved.
- Human capacity: The capability of those charged with distributing information to interact and elicit feedback from farmers, as well as to gather both global and local information to share with farmers, plays a role in how farmers utilize the provided information. Human capability can also encompass both the quality and quantity of extension staff. Their capacity to acquire and synthesize new information and knowledge and to tailor it to the farmers in the operational area impacts the usage and influence of this knowledge on farmer productivity and revenue. Furthermore, assisting farmers in digesting and integrating information from various sources is crucial.
- Technology: Enhancing the utilization of technology can improve the quality and speed of delivering information. The optimal and long-term utilization of technology is contingent on the technology's suitability for the end user and the information conveyed via this technology. In this regard, information sharing can occur at varying levels, such as at the exchange between extension agents and farmers, inside the extension organization and inter-organizations.

Although before deciding on the type of information required, farmers make a decision about which source or combination of sources they will use from a group of available information sources, both formal and informal (Glendenning et al., 2010; Yaseen et al., 2018). Farmers obtain information through a variety of formal means, as seen in most developing

countries; information on good agricultural practices is typically delivered by public extension services via training, meetings, the Internet, push notifications to mobile phones, and mass media, including television, radio, and newspapers (Yaseen et al., 2018). Asides from the public sector, the private sector is becoming more involved in the provision of agricultural extension services and information through methods similar to the public extension to meet the information needs of farming communities (Anderson and Feder, 2004). In addition to utilizing formal channels, farmers also obtain information through informal means, including social networks comprised of individuals such as fellow farmers, acquaintances, familial connections, and providers of agricultural inputs (Yaseen et al., 2018). It has been observed that social capital plays a significant role in facilitating the flow of information among individuals (Hunecke et al., 2017), and the management of informal knowledge systems is crucial for smallholder farmers operating in developing regions (saint Ville et al., 2016). However, scholars have begun to differentiate between social learning and other forms of network effects and investigate the mechanisms and conditions under which informal information channels, such as networks, facilitate the dissemination of information (Liverpool and Winter-Nelson, 2010), especially modern technologies. Such technologies have the potential to enhance the productivity, stability, and resilience of agricultural production systems, evidenced in the rapidly transforming capability of technological investments made in developing countries in accelerating growth and reducing poverty (World Bank, 2008).

The gamut of a nexus of actions and/or inactions involved with the entire human relations to the source and information itself has been described as information behaviour as it covers a broad area (Savolainen, 2013). Information behaviour refers to the various actions and processes undertaken by an individual to identify their needs for information, and possible information needs, locate relevant sources in any way and utilize or disseminate the said information (Wilson, 1999). The broad concept of information behaviour is applied to both actors on the demand (farmers) and supply (extension workers) sides. The effectiveness of information dissemination to farmers and how they utilize the provided information depends on the aptitude and willingness of the responsible extension agents to engage in interactive communication and solicit feedback from farmers, as well as to collect pertinent information for dissemination to farmers. Furthermore, the transfer of information from extension agents to farmers depends on the capacity of extension workers to acquire and synthesize new information before tailoring it to the farmer’s needs. In the literature of

information studies, an early example of research conducted to explore the concepts of information behaviour can be traced back to the mid-1960s when Wilson Tom D. carried out a study on the document and library use of scientists and technologists discussed at the 1948 Royal Society Scientific Conference (Savolainen, 2013). As adduced by Savolainen (2013), Wilson defined information behaviour as "the totality of human behaviour in relation to sources and channels, including both active and passive information seeking and information use." Thus, information behaviour encompasses both active and passive modes of information acquisition, including interpersonal communication and passive reception, without intending to take action on the information received. Another close mention of the term in 1965 was in R. W. Trueswell and colleagues' study of the information-seeking behaviour of X-ray crystallographers which was the launching pad for the model of "information-seeking behaviour" introduced by James Krikelas – who expatiated the more details on the framework (Savolainen, 2013). Krikelas defined information-seeking behaviour as "any activity of an individual that is undertaken to identify a message that satisfies a perceived need", and information was defined as "any stimulus that reduces uncertainty" (Savolainen, 2013). Savolainen (2013) commented on Krikelas' framework that the following; information-seeking, information-searching and information-use behaviour were conceptualized as components of information behaviour. In broad terms, information behaviour may be described as "how people need, seek, manage, give and use information in different contexts" (Savolainen, 2013) and these can be observed on both – the demand and supply – sides of information as well as the interaction between actors from both sides within the agricultural context. The movement of technical information from extension service providers to farmers is an example of information sharing from the supply to the demand side. Conversely, farmers can share feedback with extension workers and this information is further shared within extension organizations to further improve their processes for effectiveness. Furthermore, the information received by farmers from extension workers can be disseminated to other farmers. In the agricultural sector, different farmers, such as rural and farm women, small and marginal subsistence farmers, medium-scale farmers and rural youth mostly found in agrarian communities, will have different information search behaviours as well as factors such as educational level or access to resources that largely affect their information needs, searching behaviour, access, and use (Glendenning et al., 2010).

2.2 Social capital and farmer groups as information sources in technology adoption

Facilitating information flow through social networks is the primary benefit of social capital within farmer groups. In this sub-chapter, shreds of theoretical and empirical evidence were presented that highlight the significance of social capital in enabling the efficient flow of information among farmer groups, which are viewed as work groups and exhibit distinctive dynamics, as noted by (Hall et al., 2010). The concept of social capital, first proposed by Lyda Hanifan in 1916, has gained significant attention in the field of development and economic growth in recent decades as it's relationship with development has been extensively studied, and this knowledge has been used to inform the development of new strategies aimed at promoting economic growth (Hunecke et al., 2017). Although Hunecke et al. (2017) hinted that scholars are yet to agree on the precise definition of social capital, it is commonly understood as comprising networks, norms, and trust within social interactions, which serve to enhance cooperation and coordination among individuals in pursuit of shared objectives and mutual gain. The achievement of shared objectives within groups necessitates that relevant information pertaining to mutual gains is shared. Ostrom (2000) defined social capital as a means of understanding the persistent connections, mutual aid, and established customs among a community of individuals and might serve as a framework for analyzing the impact of interactions – or exchange of information – among actors within small-scale agricultural contexts on the emergence of new ideas and practices (saint Ville et al., 2016). Hence it is seen to be constituted within social structures and relationships among such actors or relationships that promote collaboration and probably information transfer within such groups to achieve a common goal (Hunecke et al., 2017). Social capital, often conceptualized in myriad forms within the academic literature, is widely regarded as a valuable resource, especially in facilitating information flow among farmers and extension workers emerging as an indirect consequence of social interactions. The concept of social capital is characterized by a high degree of ambiguity, which is further exacerbated by the absence of consensus regarding appropriate methods of measurement. This is due to the fact that key components of social capital, such as social ties, trust, and norms, are not directly observable hence; as a result, the use of indirect indicators for measurement has been widely advocated as a means of assessing social capital (Hunecke et al., 2017). In the agricultural sector, most studies investigating the effect of social capital on the adoption – which is often a proxy for efficient use of information – of modern technologies have often focused on smallholder farmers or producer groups with

members organized into formal or informal settings and, more often than not, acquire legal forms like associations, cooperatives and societies (World Bank, 2008). The World Bank report in 2008 further grouped producer groups into three categories, that play a major role informal information sources for famers especially based on their broad functions:

- Commodity-specific organizations often with an economic focus and taking care of their members' interests in particular agricultural commodity trade, such as cocoa, coffee, cashew or cotton.
- Advocacy organizations often represent members' interests, such as national producers' unions.
- Multipurpose organizations often take care of the members' diverse needs ranging from economic to social needs, such as savings associations. These groups stand in the gap for members residing within a locality where ineffective public services abound.

According to Liverpool and Winter-Nelson (2010), within various social contexts, including associations, cooperatives, and farmer groups, technology adoption is often related to social learning – a common phenomenon that occurs through observation of peers, imitation of associates, and modelling by friends. Social learning is predicated on information transfer between two actors in a social group and shapes farmer's information behaviour to a certain extent. The impact of social networks on the diffusion of technology has been well-established (Liverpool and Winter-Nelson, 2010) as social learning occurs within networks and promotes information sharing, which is an integral part of information behaviour. Notwithstanding the lack of consensus on the definition of social capital, several studies have asserted its main contribution in facilitating information flow among farmers and conversely affects the adoption of innovations (Abebaw and Haile, 2013; Denkyirah et al., 2016; Hunecke et al., 2017; Liverpool and Winter-Nelson, 2010; Makokha et al., 2001; Martey et al., 2014; saint Ville et al., 2016; Sanyang et al., 2009; Sebhatu et al., 2021; Turner et al., 2014; Wossen et al., 2017).

Among other factors exacerbating the challenges surrounding the uptake of agricultural technologies amongst smallholder farmers, the technical incapability to cope with modern technologies can be overcome when organized into farmer groups (Mojo et al., 2017). As farmer groups are an essential informal source of information and contact points for extension workers to disseminate pertinent information relating to modern technologies. Furthermore, in some parts of SSA, some farmer groups have emerged in response to market or financial

inefficiencies in rural communities (Wossen et al., 2017). Wossen et al. (2017) cited an example of cocoa farmers in Nigeria forming small unions to sell their products and to respond to the local credit market shortcomings. These trends have also been observed in other developing contexts, such as in the Caribbean, where farmer groups or farmers' social networks have played a crucial part in making up for ineffective or weak institutions (saint Ville et al., 2016) probably through the facilitation of information exchange.

It is widely acknowledged that farmer groups, such as agricultural cooperatives, play a crucial role in promoting socioeconomic development as they are seen as a critical focal point for extension workers to reach farmers and also facilitate information flow within the network. These farmer organizations act as information sources for farmers, serve to reduce transaction costs, enhance the bargaining power and technical efficiency of their members, and improve access to productive inputs and services (Mojo et al., 2017). Mojo et al. (2017) further recognized agricultural cooperatives as an effective means of addressing poverty in rural areas, where a disproportionate number of the poor reside (estimated at over 70%). Social capital observed in the context of farmer groups is often utilized to evaluate the challenges and possibilities for collaborative action among rural communities. Additionally, the examination of social capital within farmer groups has provided insight into the processes of agricultural innovation in small-scale farming systems and farmer groups, as an information source, have been instrumental in the development of more comprehensive and decentralized policy frameworks, as well as the promotion of collaborative governance through the strengthening of supportive community institutions (saint Ville et al., 2016). In broad terms, the advantages of farmer groups are manifold as they; foster collective action, diminish transaction costs and enhance transaction capability as robust network connections result in more productive and efficient labour, as well as a practical means of managing risk (Hunecke et al., 2017). However, these highlighted advantages will only be achieved by farmers if there is a willingness to exchange, process and evaluate vital information. Research has demonstrated that owing to the decrease in transaction costs, social capital facilitates farmers' ability to mitigate risk; in which social capital can be understood as a form of mutual insurance as trust facilitates information exchange and accountability among individuals to safeguard against risks and shocks (Hunecke et al., 2017). The findings of recent research indicate that membership in other forms of farmer groups, such as cooperatives, can have a positive impact on both technology adoption and food security, particularly for rural women,

as it was adduced to assist households in diversifying their livelihoods, reducing transactional costs, increasing market bargaining power, and promoting gender equity (Wossen et al., 2017). Overall, cooperatives are widely recognized as a vital institutional innovation for addressing the challenges faced by smallholder farmers in accessing markets (Wossen et al., 2017), probably due to the fact that they are one of the effective information sources readily available to smallholder farmers. In SSA and other developing regions, farmer groups have become a prevalent feature and information source of the agricultural landscape. It is estimated that approximately 250 million farmers belong to such groups, which engage in a variety of activities, including participation in trade negotiations and domestic agricultural policy-making, efforts to improve access to output and input markets, promotion of technological innovations and diversification into new activities, and contributions to natural resource management (World Bank, 2008). In line with the World Bank report (2008), farmer groups act as a fundamental component of agriculture-for-development agendas, actively involved in participatory governance, particularly in the context of decentralization and community-driven development approaches. The participatory nature of governance highlighted by the World Bank report arises from the exchange of information observed across the demand and supply sides. As extension agents and policymakers tend to receive quality feedback from farmers as well as farmers themselves receiving relevant advisory services which make up the whole gamut of information behaviour. Despite the rapid expansion of farmer groups in these regions, it is important to note that their mere existence does not guarantee effectiveness in achieving their stated goals and objectives (World Bank, 2008).

As adduced by Wossen et al. (2017), farmer groups such as cooperatives have the potential to impact the adoption and utilization of technology, as well as overall welfare, through a variety of mechanisms highlighted below:

- cooperatives can promote technology adoption by alleviating the liquidity constraints faced by farmers through the provision of credit;
- cooperatives can perhaps be an effective information source for farmers thereby influencing their information-sourcing behaviour, influencing technology adoption and welfare by disseminating market information, and potentially offering improved market prices for agricultural products;

- cooperatives can achieve economies of scale by pooling resources such as credit, information, and labour among members, ultimately leading to improved welfare outcomes.

Traces of evidence are been documented to further highlight the role information plays in adopting agricultural technologies. Hunecke et al. (2017) reported that adopters of new agricultural practices could be differentiated from non-adopters by their tendency to not only possess more information but also actively seek additional information. The authors further cited research by Foster and Rosenzweig (2010) that suggested farmers' primary sources of information be their peers and extension agents. While extension agents are often considered the primary source of information, Foster and Rosenzweig (2010) posit that farmers also gain knowledge through social interactions with other farmers, even in the absence of extension agent intervention, as adduced by (Hunecke et al., 2017).

The facilitation of information flow through networks and trust is the primary benefit of social capital within farmer groups. Fisher (2013), as cited by Hunecke et al. (2017), asserts that trust serves as a catalyst for transforming information into actionable knowledge. Networks, on the other hand, provide a platform for the exchange of information and bridge the gap between the availability of new technologies and the farms that may adopt them Micheels and Nolan, (2016) as cited by (Hunecke et al., 2017). Hunecke et al. (2017) further opined that the presence of networks increases not only the quantity and accessibility of information but also filters, concentrates, and legitimizes the information within the network. Furthermore, the authors' findings demonstrated that membership in farmer groups has a positive impact on farmers' adoption decisions (Hunecke et al., 2017). The importance of interpersonal relationships and social learning, such as found amongst farmer groups as a crucial information source, in the diffusion of technology is gaining recognition in academic literature. This recognition highlights the potential to design development strategies that utilize social learning observed amidst farmer groups to enhance the effectiveness of technology diffusion efforts (Liverpool and Winter-Nelson, 2010). Hence, elements of social capital are crucial factors in the decision-making process for technology adoption. Hunecke et al. (2017) supported this assertion by highlighting a few studies demonstrating a positive correlation between the number of adopted technologies and the social capital of farmers. Some of these studies identified trust and social networks as the primary drivers of this dynamic (Hunecke et al., 2017).

Multiple studies conducted in developing nations have demonstrated the significant impact of agricultural cooperatives, as effective information sources, on the adoption of technology in situations where transaction costs are high, and bargaining power is low. A research investigation to evaluate the influence of cooperative membership on farmers' utilization of advancements revealed that cooperative membership has a direct effect on the implementation of innovations Kolade and Harpha (2014) as cited by (Wossen et al., 2017). An area of significant scholarly inquiry in SSA pertains to the impact of rural producer organizations and agricultural cooperatives on technology adoption and the well-being of households (Wossen et al., 2017). Numerous scholarly investigations into the dynamics of cooperatives in Africa have highlighted the potential for membership to result in a host of beneficial outcomes for farmers, including increased income, improved productivity, and greater utilization of modern inputs (Sebhatu et al., 2021). As adduced by Mojo et al, (2017), a study conducted in Ethiopia by Abebaw and Haile (2013) revealed a significantly positive impact of cooperative membership on the adoption of agricultural technologies like fertilizer which can be viewed as a proxy for efficient information flow (Mojo et al., 2017).

While the uptake of new technology in agricultural settings can yield positive outcomes, it is imperative to acknowledge that there can also be negative consequences. One such example, as observed by Hunecke et al. (2017), is when the ineffective utilization of technology by certain farmers leads to a widespread rejection of the technology within the community which further asserts the existence of a certain information behaviour among farmers. Additionally, research by Adrianzen (2009), as cited by Hunecke et al. (2017), suggests that rural households tend to exhibit a heightened level of rejection in response to poor performance of new technology in comparison to their acceptance of technology that performs well (Hunecke et al., 2017). The surmounting evidence asserting the importance of farmer groups as an efficient information source for farmers adopting agricultural technologies can not be ignored. However, adoption decisions strongly rely on the type of technology and the relevant resources required to get access to it (Wossen et al., 2017) and other farmer group characteristics that promote information flow.

The socioeconomic characteristics of group members (Wossen et al., 2017) and the level of homogeneity within a farmer group may have an impact on the collective adoption of agricultural technology (Liverpool and Winter-Nelson, 2010). Also, a study on gendered social

networks, agricultural innovations, and farm productivity in Ethiopia was conducted to examine the dynamics and communication patterns within a network. The findings indicated that individuals with familial ties with other network members were more likely to establish informational connections with them (Mekonnen et al., 2018).

Also, the relationship between agricultural technology adoption and group size has been studied. Liverpool and Winter-Nelson (2010) hypothesized that larger networks would have a greater likelihood of facilitating the adoption of new technologies compared to smaller networks due to the ability to spread fixed costs among a larger membership. The concept of risk sharing within a network, as well as the potentially prohibitive cost of technology for individual farmers, could lead to a reduction in cost per member through collective action, resulting in correlated adoption within the group (Liverpool and Winter-Nelson, 2010). This is so since there is a higher probability that a larger network may indicate greater access to information pertaining to the technology in question, potentially encouraging adoption as an increased number of members implies a higher flow of information within the network. However, Liverpool and Winter-Nelson (2010) also noted that the acquisition of information from personal experience might come at a cost, and the experience of others may serve as a substitute for it. Hence the authors posited that a larger network might also lead to a delay in adoption and a reliance on the experiences of other members within the network.

Lastly, in their study, Mekonnen et al. (2018) discovered a positive correlation between the frequency of meetings with group members and the formation of an information link with a network member – this ultimately increases the likelihood of information flow and technology adoption within the group.

Although farmer groups serve as a good source of information, especially as regards new agricultural technologies, certain internal and external challenges often beset such groups (World Bank, 2008). According to the World Bank report (2008), groups such as producer or farmer organizations at a point in their existence might be pressed to address any of the following issues:

- Resolving conflicts between efficiency and equity: Farmer groups or producer organizations operate within the framework of rural communities, where they are bound by the principles of social inclusion and solidarity. However, this can be challenging when these organizations are required to function as professional,

business-oriented entities, as they must aid their members in competing in the marketplace. The emphasis on inclusion can make it difficult for these organizations to exclude members who do not fulfil their obligations, and the emphasis on solidarity can lead to cross-subsidization of lower-performing members at the expense of higher-performing members, which can ultimately weaken the incentives for efficiency and innovation.

- Dealing with a heterogeneous membership: As producer organizations continue to expand their membership base, they are faced with the significant challenge of effectively representing the diverse interests of this expanding population. Traditional leadership structures within these organizations, characterized by an older males, larger-scale farmers, and members of the rural elite, may not adequately address the needs and concerns of smallholder farmers, women, and young producers. To address this issue, it is crucial for producer organizations to implement transparent decision-making mechanisms and robust information and communication systems utilizing media and technology. These measures can empower newer and weaker members, improve organizational governance, and hold leaders accountable to their membership.
- Developing managerial capacity for high-value chains: The current globalized and interconnected nature of supply chains presents significant challenges for the managers of producer organizations. These managers must navigate increasingly complex national and international supply chain networks, which are characterized by ever-changing and demanding requirements. To effectively manage these supply chains, managers must be able to effectively coordinate the resources and capabilities of their members to meet the requirements of these value chains. This includes ensuring that supplies are delivered on time and at the appropriate scale, that they meet relevant standards and specifications, and that they are tailored to meet the specific requirements of agro-processors, exporters, and supermarkets.
- Participating in high-level negotiations: Producer organizations involved in advanced technical discourse, such as international trade negotiations, require the acquisition of specialized technical and communication abilities. Furthermore, representatives of these organizations must effectively balance the needs and interests of their national

and local members, a complex task for apex organizations with a diverse range of concerns.

- Dealing with unfavourable external environment: Despite their internal effectiveness in addressing the aforementioned challenges, producer organizations are unable to effectively advocate for the interests of smallholders without a supportive legal, regulatory, and policy framework that guarantees their autonomy. This necessitates a shift in the perspective of policymakers and government agency staff regarding the role of these organizations. Producer organizations must be recognized as autonomous entities rather than as mere instruments for policies created and implemented without their input or as conduits for donor agendas.

2.3 Extension services as an information source in technology adoption

Traditionally, the concept of extension in agriculture and rural development has focused on the transfer of scientific research as the primary means of driving innovation. This linear or technology transfer model posits that new knowledge and technology developed through research can be easily transferred and adapted to different contexts (Suvedi et al., 2017). Christoplos, as cited by Emmanuel et al. (2016), proposed a comprehensive understanding of an efficient agricultural extension service, encompassing all the various components that deliver the necessary and requested information and advisory services to farmers and other stakeholders within the agri-food systems and rural development spheres (Emmanuel et al., 2016). The introduction of agricultural extension services on a global scale is recognized as a crucial institutional input for the modernization of agriculture and the advancement of rural development. These services are defined as a comprehensive set of organizations that provide support and assistance to individuals engaged in agricultural activities, enabling them to address problems and acquire information, skills, and technologies to enhance their livelihoods and overall well-being (Kassem et al., 2021). However, the traditional concept of extension has undergone a transformation since the implementation of the training and visit program, which emphasized the transfer of technology as a means to enhance productivity, particularly for subsistence food crops (Glendenning et al., 2010). Even though the concept of agricultural extension has evolved to encompass a broader scope of responsibilities beyond simply transferring technology, Swanson (2008), as cited by Glendenning et al. (2010), asserts that agricultural extension now includes the development

of human and social capital, the provision of training and education in production and processing techniques, the facilitation of market access and trade opportunities, the organization of farmers and producer groups, and the promotion of sustainable natural resource management practices among farmers. In light of this recent evolution and expanded role, the scope of information that agricultural extension can provide and facilitate access to has significantly increased as it is particularly crucial since the agricultural landscape has become increasingly complex, underscoring the importance of farmers' access to reliable and relevant sources of information (Glendenning et al., 2010). Furthermore, when farmers have access to extension services, there is a higher likelihood of improving their welfare as the gap between potential and actual yields is reduced (Wossen et al., 2017).

Despite the evolved focus and wide scope covered by agricultural extension, several scholarly investigations have identified access to agricultural extension as still a potent determinant in farmers' adoption decisions regarding innovations (Ullah et al., 2020). Ullah et al. (2020) argued that agricultural extension services, which aim to enhance information exchange and collective action in order to improve farmland utilization, rural livelihoods, and overall well-being, serve as a primary means of providing farmers with current information – that might influence the probability of adopting relevant agricultural technologies. The availability of extension services plays a crucial role in promoting the adoption of advanced agricultural technologies among farmers. This is due to the fact that extension services help to alleviate supply-side barriers that are caused by informational market failures since extension services can provide farmers with opportunities to learn about new technologies and to gain knowledge about optimal farming and management techniques (Wossen et al., 2017). This, in turn, promotes the adoption of these technologies and practices among farmers since the adoption rate of agricultural innovations among farmers is significantly influenced by the level of awareness and education provided by extension agents through sensitization, mentoring, and practical demonstration (Fadare et al., 2014). Also, the enhancement of agricultural extension serves to augment the ability of farmers to implement novel methods and techniques through the provision of access to knowledge and information. Furthermore, farmers assert that the development of the agricultural sector is contingent upon the availability of modern technologies and relevant information (Emmanuel et al., 2016). Conversely, by conducting a focused analysis on the provision and access of information, agricultural extension agents can gain a deeper understanding of the challenges

and constraints present in current methods and approaches – this can ultimately lead to the refinement and improvement of said methods and approaches (Glendenning et al., 2010).

There is a growing consensus among scholars that an effective extension system plays a crucial role in disseminating information and facilitating the adoption of new farming technologies among rural farmers who may otherwise lack access to such knowledge and resources. Suvedi et al. (2017) suggested that through extension activities, rural farmers are exposed to new technologies and educated on alternative practices, thereby mitigating the information asymmetry that is commonly associated with the introduction of new technologies. The provision of high-quality extension services can significantly enhance adoption rates and lead to improvements in agricultural productivity and farm income (Suvedi et al., 2017). Furthermore, research has demonstrated that the institutional structures and public investment that enhance agricultural extension services play a crucial role in facilitating the transfer of technology to rural, low-income farmers (Wossen et al., 2017). However, contemporary perspectives on technology adoption acknowledge that innovation is a complex and interactive process involving multiple actors with varying types of knowledge operating within specific social and institutional contexts. As a result, Suvedi et al. (2017), further emphasized the importance of understanding and addressing the broader systems and factors that shape innovation – an approach which is commonly referred to as the "innovation systems" perspective. Due to the complex nature of the innovation adoption process, the conventional method by which public research institutions produce technologies and distribute them through primarily public extension systems to farmers has been found to be less effective in addressing the rapidly evolving market demands of the present-day – even though it was proven successful in certain situations, particularly during the green revolution (World Bank, 2008). The World Bank (2008) report asserted that this traditional approach is not well-suited to more diverse contexts, such as the rainfed regions of SSA, where more comprehensive strategies are required to ensure the development and adoption of technological innovations.

In the context of SSA, the impact of extension access on technology transfer and household welfare has received substantial attention. Despite the availability of various agricultural activities and information, it is important to note that not all farmers have access to such resources. A significant proportion of smallholder farmers, particularly in developing

countries in SSA, rely on extension services provided by the public sector and non-governmental organizations (NGOs) (Suvedi et al., 2017). However, extension access provided by such sources may impede adoption if extension workers fail to reach the most marginalized farmers or if they lack both the incentives and accountability mechanisms to provide accurate and timely information to smallholder farmers (Wossen et al., 2017). Also, it is widely acknowledged that national agricultural research institutions, such as those found in SSA, often face challenges in terms of inadequate financial – since there is a significant reliance on external funding – and human resources to support agricultural innovation (FAO and ITU, 2022). While extension outfits are often cited as the primary means through which researchers and policymakers promote novel and modern agricultural technologies, the evidence for their effectiveness in facilitating adoption and improving welfare outcomes is mixed (Wossen et al., 2017). Suvedi et al. (2017) stressed that extension services provided by the public sector in developing countries have often received strong criticism for their indifference to tailoring services to smallholder farmers' needs. Furthermore, the authors attributed the inefficiencies observed in the public sector extension scheme due to: a significant decrease in staff morale or job satisfaction, which is further exacerbated by factors such as the frequent transfer of extension staff members from extension units to farms or technical directorates, lack of motivation and incentives for improvement among extension staff members can be linked to the current compensation schemes (Suvedi et al., 2017).

2.4 Information behaviour, social exchange theory and job satisfaction: a nexus

From the literature, some scholars based most job satisfaction studies on three – social exchange, neoclassical economic and sociological – broad theoretical perspectives (Mulinge and Mueller, 1998). While other authors refer to these broad perspectives as content and process theories of motivation (Maican et al., 2021; Sahito and Vaisanen, 2017). Albeit, this study relies on the social exchange theoretical approach, which can be traced to George Homans in 1958 and later extended by (Blau, 1964) to provide a plausible explanation for social transactions in organizations (Mulinge and Mueller, 1998).

The exchange theory in social psychology finds its roots in the works of George Homans (1958), who first introduced the concept and applied it to social relationships within small groups. Homans argued that social interactions are similar to exchanging goods, each carrying its own value (Mulinge and Mueller, 1998). Building upon Homans' work, Blau (1964)

expanded the exchange theory model to encompass the complexities of large organizations. He introduced a supply and demand model, which integrated the broader social structure into forming individual reference standards. Blau posits that the principles underlying social behaviour in both simple and complex groups follow the same general principles as those articulated by Homans (Blau, 1964). The Social Exchange Theory posits that individuals participate in social relationships with the expectation of receiving rewards or benefits in exchange for their contributions (Blau, 1964). These rewards may be intrinsic and extrinsic, while the inputs or investments include efforts, status, skills, education, experience, seniority, and productivity. When applied to work organizations, the theory suggests that individuals engage in work activities and contribute to the organization in exchange for certain incentives or rewards (Mulinge and Mueller, 1998). Mulinge and Mueller (1998) further highlighted that the theory holds that individuals enter organizations with specific needs and goals and agree to provide their skills and efforts in exchange for resources from the organization that can fulfil these needs and goals. Furthermore, the authors stated that those resources provided by the organization as rewards might be intrinsic or extrinsic in nature – which is also in tandem with Herzberg's argument. According to Huang et al. (2016), the reciprocity norm in social exchange theory, individuals are obligated to reciprocate favourable treatment received from others. In other words, when one party provides a benefit, the recipient is expected to respond with similar treatment. Conversely, negative treatment elicits a corresponding negative response and contrary to economic exchanges where tangible benefits or commodities are received, the provision of benefits in social exchanges is subject to individual discretion (Huang et al., 2016). The social exchange theory is predicated on the possible social transactions that happen between entities that are dependent on each other. Or, as recently expressed; in an interdependent relationship, the provision of treatment – either positive or negative – by one entity necessitates an equivalent exchange in return from the recipient (Huang et al., 2016). Aryee et al. (2002) opined that when employment relationships are regarded as discretionary benefit exchange, they may be defined as a series of social and/or economic transactions (Gould-Williams and Davies, 2005; Huang et al., 2016).

Mulinge and Mueller provided a shred of empirical evidence for determinants of job satisfaction by applying the social exchange theory (Mulinge and Mueller, 1998). Later, a study on public sector workers, using social exchange theory, established the relationship between employees' intention to remain with an organization and rewards, among other

variables (Gould-Williams and Davies, 2005). Another study used the social exchange theory to establish employee perceptions of safety as a significant determinant of job satisfaction (Huang et al., 2016). Theoretically and in line with the literature, this study assumes that public sector extension workers will reciprocate satisfaction with the job when they perceive a safe working environment, especially while on the field. Although certain concerns about the inconsiderate application of this theoretical framework to different cultural contexts have been raised and addressed see (Mulinge and Mueller, 1998), in line with the authors' recommendation, this study further draws evidence from a developing country to affirm theoretical consistency.

Several studies have explored the relationship between social exchange theory and information-sharing (Hall et al., 2010). Some of these studies have even suggested that social exchange theory could be a useful framework for explaining why actors are willing to share information in knowledge markets. For example, Hall et al. (2010) conducted a study examining online information-sharing behaviours in a blogging environment and used social exchange theory as a lens for analysis. The application of social exchange theory as a valuable paradigm for elucidating the reasons behind actors' willingness to partake in knowledge sharing within knowledge markets carries significant implications in the agricultural domain, particularly in relation to the exchange of information between the demand side, i.e., farmers, and the supply side, i.e., extension workers. Since social exchange theory requires that "resources," such as information, are exchanged through a process of "buying" and "selling," but the reciprocal obligations of those involved in the "trade" are not clearly defined (Hall et al., 2010). Any exchange that takes place is not necessarily bound by contractual obligations, nor are the "resources," such as information, necessarily exchanged for monetary compensation – even though the value of the "resources" exchanged may be considered greater than their actual market cost (Hall et al., 2010). A social exchange relationship is distinguishable from a transactional one by virtue of the shared social connections, elevated degrees of reciprocal confidence, and sustained interdependence among the involved parties (Hall et al., 2010). Such dynamics are discernible in the context of SSA agriculture. Social exchange theory can be relied upon to gain deeper insights into the information behaviour of actors operating within the agricultural landscape of SSA, including the core information seekers (farmers) and providers (extension workers). The success of information dissemination and utilization by farmers heavily relies on the abilities and proficiency of

extension workers responsible for communicating and interacting with them. Conversely, extension workers solicit feedback from farmers to enhance the effectiveness of agricultural extension services.

2.5 Job satisfaction among extension workers

The Green Report on Agriculture and the Food Industry (2018) highlights the significance of employment in agriculture on a global scale, noting that it constitutes more than 30 percent of total employment worldwide (Jankelová et al., 2020). Despite a trend of decreasing employment in the sector in recent years (Jankelová et al., 2020), the role of technical agricultural employees in developing context is crucial for the economic prosperity of the countries in the region as without their expertise in the dissemination and promotion of modern technology adoption, the agricultural sector is hindered, ultimately impacting overall economic growth (Mulinge and Mueller, 1998). Mulinge and Mueller (1998) further opined that attempts to enhance the impact of the agricultural sector on economic development in developing nations should not solely focus on the technical aspects of the industry, and the rationale for their stance is rooted in the assertion that the organizational and operational aspects of the sector play a significant role in shaping the perceptions and attitudes of workers towards their employment. There is a significant body of research in the field of motivation and job satisfaction; however, much of it does not specifically examine the agricultural sector. Maican et al. (2021) suggested that this might be due to the unique nature of the work in agriculture, which requires a specific focus on the employees and their working conditions, which are vastly different from those of employees in other sectors. Despite the importance of the agricultural sector, there is a lack of research on the job satisfaction of employees working in this field, as it has been largely overlooked by scholars (Maican et al., 2021). This represents a crucial area of inquiry in the global context, as the field of agriculture has a significant research gap in examining the underlying motivational factors that influence employee performance and job satisfaction (Jankelová et al., 2020). It is crucial to adopt a holistic perspective when addressing the revitalization of the agricultural sector in SSA. This approach should involve not only the improvement of infrastructures but also the development of human capacities. Mulinge and Mueller (1998) argue that development efforts should be expanded to include an understanding of the work structures of key personnel who play a vital role in the sector's success, specifically the technically trained agricultural personnel responsible for extension work. Maican et al. (2021) also acknowledged

that a competent and motivated agricultural workforce, both within the supply chain and on farms, plays a crucial role in improving the overall performance of the agricultural sector.

In academic research, job satisfaction has garnered significant attention as a topic of study. The concept was initially introduced by American psychologist Hoppock in 1935, who defined it as a composite of an individual's emotional and physical well-being in relation to their work environment (Wen et al., 2019). Job satisfaction can be understood as a multifaceted construct encompassing psychological, physiological, and environmental factors that collectively contribute to an individual's internal sense of fulfilment and contentment in their work Hoppock (1935) cited by (Witt et al., 2020). As posited by Locke (1969), job satisfaction refers to an employee's level of contentment in their job, as well as the individual's subjective evaluation of various components of their job (Gazioglu and Tansel, 2006; Meyerding and Lehberger, 2018). Spector, in 1997, as adduced by Hansen and Stræte (2020), considered job satisfaction as both a global feeling about the job and a complex array of attitudes pertaining to various facets of the job. He further identified the following facets of job satisfaction: appreciation, communication, co-workers, fringe benefits, job conditions, nature of the work itself, the nature of the organization itself, organizational policies and procedures, pay, personal growth, promotion opportunities, recognition, security and supervision. Even though their study suggests that job satisfaction may be less influenced by objective working conditions and more affected by the individual's expectations and demands (Hansen and Stræte, 2020). Job satisfaction is widely acknowledged as a complex phenomenon that encompasses various elements such as remuneration, promotion prospects, interpersonal relations with colleagues, oversight, and the nature of the work itself (Yang et al., 2019). Standard economic theory posits that job satisfaction, as a measure of utility from work, is positively influenced by income and negatively influenced by the number of hours worked, as well as a variety of job-specific and worker-specific characteristics (Vila and García-Mora, 2005). Vila and García-Mora (2005) examined employees' educational level as an explanatory variable of interest for job satisfaction determinants. While other studies have examined other determinants of motivation and job satisfaction, such as power, job security, financial reward, and promotion (Sahito and Vaisanen, 2017). Izvercian et al. (2016), as cited by Wen et al. (2019), revealed that variables such as distraction, motivation, social interaction, employee characteristics, organizational environment characteristics, and organizational perception impacts job satisfaction (Wen et al., 2019). However, based on

some broad social psychological theories, job satisfaction predictors have been grouped into intrinsic and extrinsic rewards, especially as regards the agricultural sector (Maican et al., 2021; Mulinge and Mueller, 1998; Muri et al., 2020).

Most research conducted to investigate job satisfaction determinants have in the past used either one of or combined three broad theoretical frameworks: the social psychological approach, the neoclassical economic approach and the sociological approach (Mulinge and Mueller, 1998). Other scholars have further categorized most motivation theories into content and process theories of motivation. As adduced by Maican et al. (2021), the content theories attempt to answer the question “what?” while the process theories address the “how?” of motivation. According to Sahito and Vaisanen (2017), the most important early theories on which the content theories of motivation have been based is Maslow’s hierarchy of needs, Alderfer’s ERG theory, Herzberg’s two-factor theory, and McClelland’s theory of needs. While process theories of job satisfaction and motivation are based on Vroom’s expectancy theory, Adam’s equity theory, Locke’s goal-setting theory, and Skinner’s reinforcement theory (Sahito and Vaisanen, 2017).

One of the earliest and most used theories in the investigation of job satisfaction predictors is the hierarchy of needs by Abraham Maslow in 1954 as cited by (Pardee, 1990). Maslow's Need Hierarchy Theory is a widely acknowledged framework for categorising human motivations. The theory posits five broad levels of needs, physiological, safety, social, ego, and self-actualization, which are arranged hierarchically, with lower-level needs being addressed before higher-level ones (Sahito and Vaisanen, 2017). Pardee (1990) noted that two significant postulates could be derived from this theory. Firstly, a satisfied need does not serve as a stimulus for behaviour, and secondly, as lower-level needs are fulfilled, the next higher level of needs becomes the most dominant factor in determining behaviour. Another widely used theory in investigating determinants of job satisfaction is Herzberg's Motivation Hygiene or Two-Factor Theory of Motivation, which was a result of a study conducted by Herzberg, Mausner and Snyderman in 1959 (Pardee, 1990).

Herzberg et al. (1959) revealed a correlation between specific job characteristics and employee satisfaction. The authors found that certain aspects of the job elicited feelings of satisfaction while others provoked dissatisfaction (Pardee, 1990). Based on these findings, Herzberg et al. (1959) proposed that management could leverage the so-called "motivators"

to enhance employee satisfaction and, conversely, attempt to reduce factors that tend to increase dissatisfaction – "hygiene factors" (Sahito and Vaisanen, 2017). However, it is worthy of reiterating Herzberg here, as cited by Pardee (1990), that job satisfaction and dissatisfaction are not opposites rather, the direct opposite of job satisfaction is *no* job satisfaction. Also, "the opposite of job dissatisfaction is *no* job dissatisfaction, not satisfied with one's job" Herzberg (1976) as cited by (Pardee, 1990). Herzberg's two-factor theory is composed of intrinsic job content elements (referred to as job satisfiers or motivators) and extrinsic job context elements (referred to as dissatisfiers or hygiene factors) (Sahito and Vaisanen, 2017). Herzberg (1966) proposed that work motivation is related to six intrinsic factors: achievement, recognition, tasks, responsibility, advancement, and personal growth while on the other hand, job dissatisfaction is associated with seven extrinsic factors, which include policies and administration, supervision/managerial relationships, salary, working conditions, status, security, and coworker relationships (Sledge et al., 2008).

For the purpose of the second case study within the framework of this thesis, social exchange theory was used to investigate the job satisfaction predictors amongst agricultural extension workers in SSA, drawing empirical evidence from Nigeria.

2.6 Sub-Saharan African context: Kenya and Nigeria as exemplary cases

The SSA region comprises forty-eight countries situated below the Sahara desert. These nations are situated in various geographical locations within the region, including the central, eastern, southern, and western parts, as well as some island nations. The World Bank reported the total population, based on the counts of all residents regardless of legal status or citizenship, is 1.18 billion, with a forest area of 26.3 percent of the total land area as of 2020, gender parity index for gross enrollment ratio in primary and secondary education, i.e. the ratio of girls to boys enrolled at primary and secondary levels in public and private schools is 0.94 as at 2020 and the life expectancy at birth to be approximately 61 years as at 2020 (World Bank, 2023b). The modest life expectancy in Africa can be attributed to various factors, including inadequate access to healthcare services, substandard living conditions, and socio-political unrest. Despite the absence of any African nation among the developed countries, it is noteworthy that the continent exhibits a degree of economic disparity. According to the World Bank report, the poverty headcount ratio at 2.15 USD a day (the percentage of the population living on less than 2.15 USD a day at 2017 purchasing power adjusted prices) is 35.1

percent of the estimated total population in SSA and a current GDP of 1.9 trillion USD with 2.6 percent of this GDP value accounted as personal remittances (comprising of personal transfers and compensation of employees) as at 2021 estimates (World Bank, 2023b) Significant internal variation exists within nations, with urban centres, particularly capital cities, exhibiting higher levels of affluence compared to rural areas. Most African countries experience marked levels of inequality, with sub-Saharan Africa being the world's most impoverished region. This area continues to grapple with endemic corruption, inadequate economic policies, and inter-ethnic discord (World Bank, 2023b). A significant proportion of the world's least developed countries are found in this region.

Kenya is a prominent East African nation known for its breathtaking landscapes and expansive wildlife reserves. It is geographically bordered by South Sudan and Ethiopia to the north, Somalia and the Indian Ocean to the east, Tanzania to the south, and Lake Victoria and Uganda to the west. The country is characterized by a horizontal division by the Equator and a vertical division by the 38th meridian, which divides it into two distinct halves (Britannica, 2023a). The eastern half gently slopes towards the coral-backed seashore, while the western portion rises sharply through hills and plateaus to the Central Rift Valley. To the west of the Rift is a plateau that slopes westward, with Lake Victoria occupying the lowest part. Kenya comprises several geographic regions, including the Lake Victoria basin, the Rift Valley and its highlands, the eastern plateau forelands, the semiarid and arid regions in the north and south, and the coast (Britannica, 2023a). The coast boasts some of Africa's finest beaches, while inland, the populous highlands are renowned for their tea plantations and diverse wildlife. Forested lakes and rivers characterize Kenya's western provinces, while a small section of the north is covered by desert and semidesert. Kenya's spectacular wildlife and panoramic geography attract significant numbers of tourists from Europe and North America, making tourism a significant contributor to the country's economy (Britannica, 2023a). According to the World Bank report, the poverty headcount ratio at 2.15 USD a day (the percentage of the population living on less than 2.15 USD a day at 2017 purchasing power adjusted prices) is 29.4 percent of the estimated total population in Kenya and a current GDP of 110.35 billion USD with 3.4 percent of this GDP value accounted as personal remittances (comprising of personal transfers and compensation of employees) as at 2021 estimates (World Bank, 2023c). Kenya's primary sources of foreign revenue encompass a diverse array of agricultural and tourism sectors. The most significant agricultural exports include black tea, coffee, and horticultural

produce, such as green beans, onions, cabbages, snow peas, green grams, avocados, mangoes, and passion fruit, as well as ornamental flowers like roses, carnations, statice, alstroemeria, and lilies. Additionally, crops such as sugarcane, corn, wheat, rice, and cotton are important contributors to the country's economic growth. More than 80 percent of Kenya's populace resides in rural areas, where their livelihoods are primarily linked to the cashew sector, either directly or indirectly. The majority of smallholders cultivate corn and yield substantial amounts of Irish potatoes, beans, peas, sorghum, sweet potatoes, cassava, bananas, and oilseeds. Despite cashew's previous status as a principal export crop, both cashew and sesame play a marginal role in the country's current agricultural sector. Kenya has undertaken significant political and economic reforms resulting in a decade of continuous economic growth, social progress, and political stability (World Bank, 2022a). However, persistent issues such as poverty, inequality, youth unemployment, transparency, accountability, climate change, and the country's susceptibility to internal and external disruptions continue to pose significant developmental hurdles (World Bank, 2022a). The country's long-term development agenda, Vision 2030, endeavours to transform Kenya into a prosperous and competitive nation with an exceptional quality of life (World Bank, 2022a). The new government has prioritized the agricultural, healthcare, housing, and manufacturing sectors under a "bottom-up" economic model to align with this vision.

Nigeria, situated along the western coastline of Africa, is a country distinguished by its diverse geography. The nation features a range of climatic conditions, spanning from arid to humid equatorial regions. With abundant natural resources, particularly substantial petroleum and natural gas reserves, Nigeria is poised to thrive economically. Nigeria's climate is tropical, characterized by variable rainy and dry seasons contingent upon location. While the southeast experiences hot and wet conditions throughout the majority of the year, the southwest and farther inland regions are relatively dry (Britannica, 2023b). In the north and west, a savanna climate predominates, defined by distinct wet and dry seasons, while a steppe climate with little precipitation is prevalent in the far north (Britannica, 2023b). In 2021, the agriculture, forestry and fishery sectors in Nigeria constituted a significant portion of the country's GDP, amounting to 23.4 percent (World Bank, 2023d). These sectors also provided gainful employment to 35.1 percent of the Nigerian population, serving as a crucial source of livelihood for many individuals (World Bank, 2023d). Since Nigeria gained independence in 1960, agriculture has served as the bedrock of the country's economy. However, due to the

increased significance of oil as a primary contributor to GDP, the government has largely disregarded the agricultural sector. In the third quarter of 2014, the global decline in oil prices had a severe impact on the nation's revenue, precipitating a recession that further undermined the economy. To alleviate the effects of the recession and restore the economy, the government formulated an Economic Recovery and Growth Plan (ERGP), which designated agriculture as a critical sector. The plan aims to address the issues of food insecurity, employment creation, foreign exchange earnings, and industrialization by prioritizing agriculture (Inusa et al., 2018). Undoubtedly, agriculture has been a significant contributor to the consistent growth of Nigeria's GDP. Notably, the sector recorded a growth rate of 4.88 percent in the third quarter of 2016 and 13 percent in previous years, indicating a vast untapped potential (Federal Ministry of Budget & National Planning, 2017). Nigeria, as a nation, possesses a substantial land mass of 98.3 million hectares, of which 74 million hectares have been deemed suitable for agricultural purposes. Despite this abundant potential, nearly half of the country's cultivable land remains underutilized, leading to a significant shortfall in crop and livestock production (Mgbenka and Mbah, 2016), especially since agriculture is a major source of income among smallholder farmers.

3. Case study 1: Implications of Kenyan cashew farmers information sourcing behaviour on economic performance

3.1 Introduction

Despite numerous attempts at enhancing agricultural growth in Sub-Saharan Africa over the last few decades, small-scale farmers in the region continue to be at a disadvantage in the face of a rapidly expanding global economy. Consequently, the urgency of transforming the status quo through the introduction of cutting-edge value-adding technology cannot be ignored. This transformation is critical in ensuring that the livelihoods of vulnerable low-income farmers, who are exposed to heightened competition and risks, are improved (FAO, 2011). The utilization of contemporary technological advancements has been posited as a crucial factor in enhancing the economic productivity of farmers and ensuring the sustainability of the agricultural industry in the long run (Mottaleb, 2018). Despite the numerous benefits associated with the implementation of modern technologies in agriculture, a substantial number of farmers have yet to adopt these tools. This phenomenon can be attributed to various factors, including the perceived risks and uncertainties surrounding

proper utilization, the farmers' beliefs and expectations, as well as the compatibility and suitability of these technologies in the given agro-ecological setting (World Bank, 2008) and limited access to extension services and information (FAO, 2011). This study aims to contribute to the advancement of technology adoption theory by investigating the influence of farmers' group participation and access to agricultural extension services on the adoption of modern farm technologies (fertilizers, chemicals, and proper plant density) in coastal regions of Kenya. The study also assesses the effect of such adoption on farmers' economic performance, as reflected by their income per acre.

The efficacy of extension services in bridging the information and knowledge disparities among farmers, and promoting technological advancements and innovations, has frequently been the subject of intense criticism (Babu et al., 2016; FAO, 2017, 2011; Gautam, 2000; Kondylis et al., 2017). Additionally, the efficacy of extension services in enhancing the productivity of farmers is frequently subjected to critique due to the incapacity of extension personnel to address pressing issues, such as climate change, natural resource management, and food security (FAO, 2011), the traditional top-down content to which the farmers cannot relate (FAO, 2017) and inefficacy in reaching most farmers and providing relevant information (Kondylis et al., 2017), especially to the changes in demand for extension (FAO, 2011). Contrarily, the World Bank's publication underscores the significance of extension advisory services in fostering agricultural transformation, and initiatives are currently being implemented to re-establish their function in numerous developing nations (Babu et al., 2016). This assertion might be due to the perception of economic gains by farmers who seek extension services (Elias et al., 2016) and its inherent potential to facilitate information flow – especially as regards agricultural technology (Glendenning et al., 2010). It has frequently been the case that information has been marginalized or neglected as a key or contributing element to the economic outcomes of farmers. However, with the accumulation of evidence highlighting the significance of information as a valuable asset akin to land, labor, and capital, it is becoming more challenging to disregard its importance (Balogun et al., 2018; Birner and Anderson, 2007; Liverpool and Winter-Nelson, 2010; Radhakrishnan et al., 2016). Evidence have indicated a positive correlation between farmer's exposure to informational sources and their adoption of innovative agricultural technologies and best management practices. This suggests that access to information plays a crucial role in facilitating the adoption of new methods in farming (Singh et al., 2016).

The strong existence of interpersonal agricultural knowledge networks, including self-help groups, women's groups, and farmers' groups, beyond extension services, is crucial for the dissemination of relevant information to farmers and promoting the adoption of modern agricultural technologies. These networks are often considered to be more effective in this regard (Birner and Anderson, 2007; FAO, 2017; saint Ville et al., 2016). According to recent findings from Sub-Saharan Africa, the participation of farmer groups or cooperatives in agricultural practices may result in a positive impact on the utilization of agricultural inputs, as this conclusion is based on a comprehensive analysis of the economic performance of agricultural cooperatives in Ethiopia (Sebhatu et al., 2021). As adduced in another recent study conducted in Kenya, efficient farmer groups may economically and socially empower their members by providing various services (Ingutia and Sumelius, 2022) and access to knowledge on new agricultural technologies. Also, increased access to extension support significantly facilitates the adoption of chemical fertilizer and consequently exerts positive influences on food security (Emmanuel et al., 2016). However, in order to promote the success of smallholder farmers in this region, it is imperative to gather and analyze empirical data concerning the adoption of contemporary technologies for cultivating cash crops, including cotton, cocoa, tea, and cashew, among diverse cultural groups within the Sub-Saharan region.

The cashew nut plays a vital role in many developing countries. It is a rain-fed cash crop with occasional but beneficial support from irrigation, especially during dry seasons when the cashew is in flower and produces nuts. Intercropping is widely practiced in contemporary cashew plantations, yielding multiple advantages. This approach contributes to the food security of small-scale farmers through diversifying their diets, enhances revenue streams for their livelihoods, and optimizes soil resource utilization, particularly during the early stages of cashew tree growth before income generation can be achieved (Costa and Bocchi, 2017). Costa and Bocchi (2017) recommended that the application of fertilizers at varying rates, based on the age and yield of the cashew tree, is crucial for optimal growth and productivity. In addition to the use of fertilizers, it is highly recommended to mitigate the harmful effects of pests through the implementation of appropriate pesticides. In Africa, the mirid bug, coreid coconut bug, cashew stem girdler (which is a common but typically minor pest in the Coastal Province of Kenya) and powdery mildew (PMD) can have a significant impact on cashew crops and result in yield losses ranging from 60% to 100%. (Costa and Bocchi, 2017; Dendena and Corsi, 2014).

A recent review suggests that West and East Africa have high production potential, with countries like the Ivory Coast, Mozambique and Tanzania cited among the current major producers and processors (Rabany et al., 2015). However, for Kenya, the current under-utilized production and almost inexistent cashew industry and trade, stemming from the privatization and a ban on unprocessed cashew export in 90-ies, limit it only to local consumption. Despite different studies indicating the strong potential of cashew nut production for improving smallholder farmers' livelihood and enhancing poverty reduction, the sector still lacks proper stimulus (Dendena and Corsi, 2014). In Kenya, farmers value agricultural advice and are willing to share in its cost, even though some evidence suggests that the extension approach adopted in the past had no significant impact on farmer efficiency or crop productivity (Gautam, 2000). Kenya's Ministry of Agriculture provides extension services to farming communities, including cashew-growing districts but does not provide any extension services specifically on cashew production (Navarra et al., 2017). It is anticipated that the farmer groups will serve as a facilitator for the dissemination of knowledge among its members. However, there is a lack of empirical evidence to support this expectation. This study aims to evaluate the effect of agricultural extension support and farmer groups, among other identified factors, on the adoption of new technologies and their subsequent impact on the economic performance of cashew farming in the coastal regions of Kenya.

Specifically, this study (i.) determine the effects of cashew farmers' information sources (group membership status and extension services) on adoption of modern agricultural technologies (the use of fertilizers, chemicals and appropriate plant density), and (ii.) investigate the impact of the adoption of modern farm technologies (the use of fertilizers, chemicals and appropriate plant density) on cashew farmers' economic performance (income per acre).

The Kenyan government and international donors have shown a heightened interest in promoting the cashew sector as a viable cash crop for farmers in the study region. However, there is a lack of empirical research exploring the factors affecting the adoption of modern agricultural technologies and the impact of such adoption on the economic performance of farmers in the cashew sector. This paper contributes to the existing literature by providing evidence that farmers who receive extension services and are members of groups are more likely to adopt modern technologies. However, in areas with extensive agriculture, the cost of

fertilizers may not be economically feasible. Thus, extension services need to focus on disseminating economically viable technologies, such as appropriate cashew planting density, to aid farmers in achieving their economic goals.

3.2 Theoretical background

Agricultural technology and innovation adoption might be tracked to the early S-shaped diffusion curve (Tarde, 1903). Rural sociologists later expounded on this concept before its introduction to economics in 1957 by Griliches, as cited by (Toma et al., 2018). Due to different views on technology adoption, tracing its conceptual origin in the literature is quite challenging. Although, once a "finger can be placed" on what the term technology means, defining the adoption or use of technology seems less challenging, as opined by Sanyang et al. (2009). Adoption was defined as the ''movement of know-how, technical knowledge, or technology from one organization setting to another'' (Sanyang et al., 2009).

This study investigates the impact of the adoption of modern farm technologies (the use of fertilizers, chemicals and appropriate plant density) on cashew farmers' economic performance. Similar indicators have been used in other recent studies evaluating the adoption of agricultural technology (Emmanuel et al., 2016; Läpple et al., 2015; Martey et al., 2014; Meijer et al., 2015; Nata et al., 2014; Sanyang et al., 2009; Senyolo et al., 2018; Wheeler, 2009; Wossen et al., 2017). One of the recent studies conducted in Sub-Saharan Africa argued that smallholder farmers' inherent capacity to innovate (and possibly adopt new technologies) is strengthened by access to knowledge and information (Emmanuel et al., 2016).

Meijer et al. (2015) stated that the decision-making process for the adoption of agricultural innovations is influenced by a range of factors, which can be broadly categorized into extrinsic, intrinsic, and intervening factors. These factors can be traced back to various information sources, such as input dealers, radio and television broadcasts, newspaper articles, extension workers, primary cooperative societies, output buyers or food processors, government demonstrations, village fairs, training programs, para-technicians, private agencies or NGOs, farmers' study tours, and farmer information and advisory centers. (Balogun et al., 2018; Birner and Anderson, 2007; FAO, 2017; Glendenning et al., 2010; saint Ville et al., 2016).

One of the most commonly utilized sources for obtaining information about successful farming practices is through the exchange of information among farmers themselves,

particularly those perceived to be successful in their agricultural endeavors. Empirical studies conducted in rural parts of India reveal that the percentage of farm households accessing information on modern agricultural technology through other progressive farmers was the highest compared to other sources (Birner and Anderson, 2007; FAO, 2017; Glendenning et al., 2010). Also, evidence from rural communities of Saint Lucia in the Caribbean shows the vital role played by 'peer farmers' in disseminating new agricultural knowledge; facilitating farmer-to-farmer knowledge exchange; increasing farmer access to information and connecting farmers to sources of support (saint Ville et al., 2016) with supporting observations from recent reports from Ethiopia and Ghana (FAO, 2017). Furthermore, other studies reveal that farmers' interactions within their social networks can generate sources of new information that may have a positive influence on agricultural productivity, and this additional information is perceived to be more valuable compared to that offered by governmental extension agents (Balogun et al., 2018; Liverpool and Winter-Nelson, 2010; saint Ville et al., 2016).

The conceptual framework based on the above empirical studies is illustrated in figure 1. Based on the previous studies, we expect that group membership and extension services increase the probability of adopting innovative technologies and that this adoption affects economic performance.

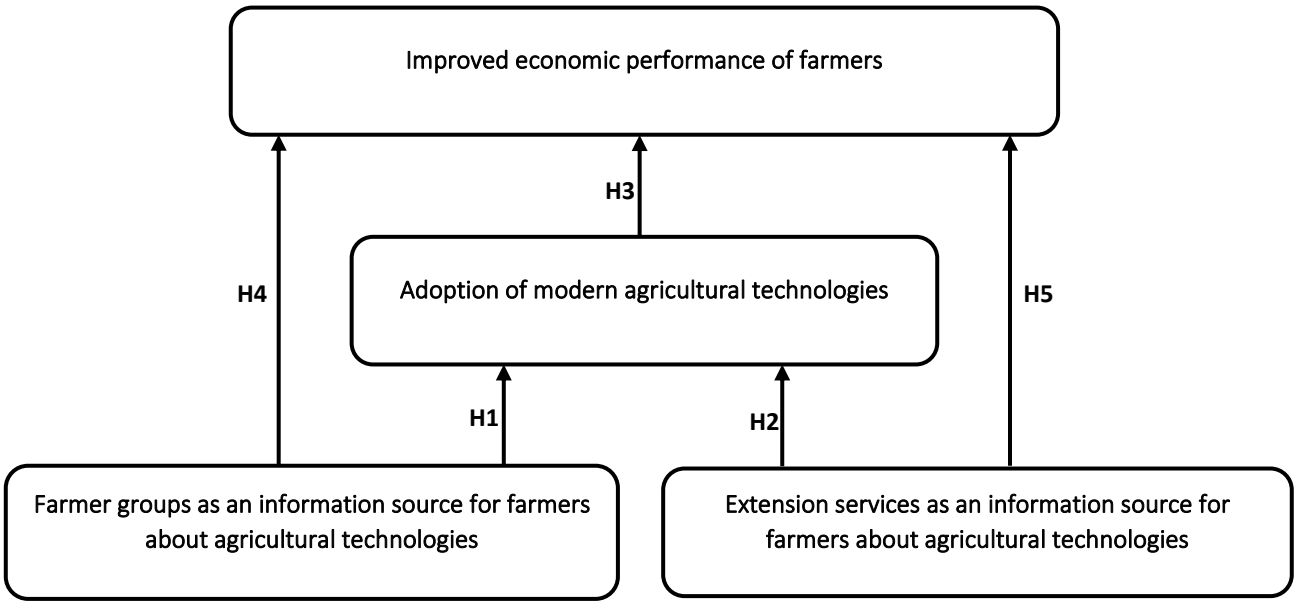


Figure 2: Conceptual framework for case study 1

3.2.1 Factors influencing adoption of agricultural technologies

Recently, research findings indicate that participation in farmer organizations, among other socio-economic determinants, has a positive impact on the dissemination of information regarding the implementation of agricultural technologies (Singh et al., 2016). Also, as established farmer groups facilitate technology acquisition and dissemination (Sanyang et al., 2009) as well as trust and social capital generated within farmers' networks, encouraging uptake of new agricultural knowledge (saint Ville et al., 2016; Turner et al., 2014). Other evidence from Africa shows that membership in farmer associations is a significant factor influencing fertilizer use (Abebaw and Haile, 2013; Martey et al., 2014) and the adoption of pesticides (Abebaw and Haile, 2013; Denkyirah et al., 2016). On the contrary, an empirical study on the determinants of fertilizer use in Kenya revealed that the probability of adopting fertilizer decreased for farmers who were members of an organization (Makokha et al., 2001). Farmer group membership status significantly positively affects technology adoption (Liverpool and Winter-Nelson, 2010).

Hypothesis 1: Farmers' group membership as an information source positively influences the adoption of modern agricultural technologies (the use of fertilizers, chemicals and appropriate plant density).

In Kenya, the rationale for providing extension services is still relevant. Nevertheless, the results of recent studies indicate that the extension method utilized during the past decade was deficient in terms of effectiveness, sustainability, and the ability to significantly enhance farmer proficiency or the yield of crops (Gautam, 2000). On the contrary, a study established a significant positive relationship between access to extension services and fertilizer usage in Kenya (Makokha et al., 2001). Findings from Sub-Saharan Africa revealed a positive effect of extension support on farmers' crop yields (Afful and Ayisi, 2016; Elias et al., 2013) which may be linked to the dissemination of new practices and technologies. Also, in Ethiopia, a study revealed that the frequency of extension contact enabled farmers to take up agricultural knowledge and innovations (Elias et al., 2016). Likewise, in Ghana, access to extension services significantly influenced the frequency of pesticide application (Denkyirah et al., 2016). A recent study shows that extension services are a primary driver of knowledge and technology in Kenya (Ingutia and Sumelius, 2022). Some studies affirmed the importance of extension services to significantly influence the adoption of novel technologies (Sanyang et

al., 2009; Toma et al., 2018), basal fertilizers (Ouma et al., 2002), pesticides and frequency of pesticide application (Denkyirah et al., 2016). Contrary to previous studies, Bruce et al. (2014) established that farmers who accessed extension services had a lower probability of adopting technologies.

Hypothesis 2: Agricultural extension services as an information source positively influence the adoption of modern agricultural technologies (fertilizers, chemicals and appropriate plant density).

Fertilizer use: In this investigation, this variable refers to the suggested utilization of either organic and/or inorganic fertilizers in the designated research region with the purpose of augmenting cashew yield. The most favored fertilizer types, if employed, are manure and DAP. Some prior research provides empirical data demonstrating the considerable and positive influence of fertilizer usage on agricultural output (Bruce et al., 2014), on household food security (Nata et al., 2014) and crop productivity (Emmanuel et al., 2016). Also, fertilizer adoption (both inorganic and manure) was positively influenced by access to extension, membership in an organization, hired labour and off-farm income (Makokha et al., 2001). Although, it was observed that participation in development projects may not always result in increased adoption and fertilizer use intensity (Martey et al., 2014).

Chemical spraying: In this study, the term "chemical spray" refers to the application of any agrochemical(s) to combat the damaging effects of pests. A pest infestation can lead to yield losses if pest infestations are not controlled (Costa and Bocchi, 2017; Dendena and Corsi, 2014). Amongst the known methods for pest control, the use of chemicals such as pesticides and insecticides has been reported to be the most widely adopted method for pest management by cashew farmers (Dendena and Corsi, 2014). Nata et al. (2014) showed that households that used insecticides – an indicator for pest attack – had a decreased production in Ghana.

Planting density: There has been an established relationship between cashew planting density and nut yield, which positively affects farmers' net incomes (Mangalassery et al., 2019). Mangalassery et al. (2019) further highlighted that a cashew farmer who adopts a high-density planting system might enjoy double-digit yield increases compared to their counterparts who use a relatively lower planting density system. This study defines planting density as the

number of cashew trees per acre. The observed span between the trees in the study area was usually 8-12 metres, with frequent gaps caused by dead trees.

Extension support: The extension variable expresses if farmers in the study area have access to extension services or not. Some studies have highlighted the relationship between access to extension services and technology adoption (Denkyirah et al., 2016; Ingutia and Sumelius, 2022; Ouma et al., 2002; Sanyang et al., 2009; Toma et al., 2018), while others explored the effect of extension services on crop yields (Afful and Ayisi, 2016; Emmanuel et al., 2016) and farm productivity (Elias et al., 2013).

Group membership: In this study, we define group membership as a farmer who is part of any form of farmer group(s) that support and coordinate members in reaching an agreed goal. This definition aligns with a recent study that highlights the importance of farmer groups in accessing relevant information and other advantages (Ingutia and Sumelius, 2022). Farmers in our target regions are group members such as producer, marketing, savings, social and/or services groups. These groups vary as regarding size and from informal to formal levels of the organization.

Age: Adoption of modern agricultural technologies is influenced by farmers' characteristics, such as the farmer's age (in years). Farmers' age has been shown to significantly influence the decision to use pesticides (Denkyirah et al., 2016) and determined productivity (Balogun et al., 2018). A study established that farmers from 40 years and above have a lower probability of adopting chemical fertilizer (Emmanuel et al., 2016). Other studies found that farmers' age was not significant to influence technology adoption (Nata et al., 2014) and had a negative effect on innovation (Läpple et al., 2015).

Education: This is defined as the number of famer's schooling years. This variable (education) has been empirically documented to have a significant positive influence on farmers' intentions to uptake new technologies (Toma et al., 2018), use pesticides (Denkyirah et al., 2016), adopt chemical fertilizer (Emmanuel et al., 2016) and innovate as they are adduced to process novel information quickly (Läpple et al., 2015). Although, a study showed a contrary result that education had an unexpected negative impact on fertilizer use (Ouma et al., 2002).

Household head gender: Regarding gender, some studies reported that male farmers are more likely to adopt chemical fertilizers (Emmanuel et al., 2016) and pesticides (Denkyirah et

al., 2016) compared to women in Ghana. Also, in Ghana, as regards factors affecting fertilizer use intensity, it was established that household heads that are income-earning males were significant influencing factors compared to their counterpart females – who were limited as regards resources hence using their income to meet the nutritional needs of the household (Martey et al., 2014).

Farm size: In this study, farm size was measured in acres. This variable positively impacted farmers' decisions to adopt chemical fertilizer in Ghana (Emmanuel et al., 2016). Other studies conducted in Ghana showed that the likelihood of farmers adopting fertilizer technology reduced as the farm size increased (Martey et al., 2014), and for farmers with relatively smaller farms, the likelihood of adopting an enhanced rice variety was high compared to their counterparts with larger farms (Bruce et al., 2014). In Nigeria, Balogun et al. (2018) established a significant positive relationship between farm size and productivity of cassava farmers.

Hired labour: This variable measured if a farmer employed the services of additional workers or not. It is well documented that different studies from the literature point to different directions regarding the effect of labour on adopting specific agricultural technologies (Toma et al., 2018). Toma et al. (2018) further observed that farms with more workers per hectare have a higher probability of adopting new technology and continue to use innovations that boost economic performance. Although, scarcity of labour tends to influence a farmer to adopt labour-saving technology (Toma et al., 2018). In Ghana, Bruce et al. (2014) showed that farm labour significantly impacted farm output. In Kenya, hiring of labour was established to be a statistically significant factor influencing the adoption of improved maize variety and the amount of fertilizers farmers use (Ouma et al., 2002).

Off-farm income: In this study, this variable measured whether or not the farmer takes part in any off-farm activity that generates additional income for the farmer. It has been highlighted that when farmers are engaged in any form of off-farm work, this may compete with the time spent on the farm, affecting technology adoption negatively (Toma et al., 2018). Although, Toma et al. (2018) further adduced that when farmers adopt some form of technology, this might free up some time required to carry out some farm activities manually, and this free time may be spent on some other off-farm jobs. A study in Ireland proved that off-farm work has a negative impact on farmers' innovativeness (Läpple et al., 2015).

Loans: This variable expressed if the farmer has access to credit. Access to credit has been shown to significantly influence farmers' innovation (Läpple et al., 2015), the decision to use pesticides, and frequency of pesticide application (Denkyirah et al., 2016). It was revealed that access to credit has a complementary relationship with extension services to reduce poverty and a mutual relationship with cooperative membership on technology adoption (Wossen et al., 2017).

Plant sesame: This variable was added to the model as a proxy for diversified agriculture. Sesame is cultivated in intercropping systems with cashew trees in the study area. Intercropping, a cultural practice in the tropics, especially on cashew farms, act as an environmentally sustainable weed management alternative, contributes to the management of soil resources and offers additional income to improve farmers' livelihood (Dendena and Corsi, 2014). Dendena and Corsi (2014) opined that the performance of intercropping on a cashew farm depends on the type of food crop integrated and recommended further investigations. Relevant studies have established the positive impact of planting viable intercrops alongside cashew on farmers' economic performance (Lawal and Uwagboe, 2017; Sajeev et al., 2014).

3.2.2 Impact of agricultural technologies adoption on economic performance

According to the findings of Ouma et al. (2002), the academic community widely acknowledges the significant impact of agricultural technology on both agricultural productivity and the overall economic performance of the sector. A Kenyan study has advocated for the utilization of certain technologies, such as optimized fertilizer usage and enhanced crop processing and storage methods, to enhance productivity (Makokha et al., 2001). Both extension access and cooperative membership showed a significant positive effect on the technology adoption of improved cassava varieties and a potential to improve agricultural productivity in Nigeria (Wossen et al., 2017). In the Gambia, a comparative study revealed that facilitating technology transfer can boost vegetable production (Sanyang et al., 2009). Sanyang et al. (2009) further highlighted strong evidence for adopting agricultural technologies in contributing to the economic performance of the rice sector when the Gambian government relied on farmers adopting rice irrigation technologies to improve primary production hence meeting local demand. In Ghana, it's observed that agricultural

productivity is limited due to inadequate mechanization and poor use of modern agricultural technologies such as fertilizers and relevant agro-inputs (Martey et al., 2014).

Hypothesis 3: The adoption of modern agricultural technologies fertilizers, chemicals and appropriate plant density influences farmers' economic performance.

A recent study highlighted that farmer groups positively impact crop yields resulting in increased food security through improved access to fertilizer, insecticides, herbicides and other relevant inputs (Ingutia and Sumelius, 2022). It's been observed that farmers who are part of a group stand a chance of improving their economic performance through increased disposable income as a result of improved farm productivity and better access to markets (FAO, 2017). Farmers' knowledge and information depend on the available information farmers are disposed to, the (social) costs of acquiring this information, and information sources, such as farmer groups or social networks or peer-farmer interaction, extension agents, and researchers (Sanyang et al., 2009; Wheeler, 2009). Furthermore, social capital variables such as meeting attendance, decision-making index and self-confidence have significantly influenced farmers' productivity (Balogun et al., 2018; Saha and Devi, 2016). Farmer group membership status has been shown to significantly affect farmers' productivity (Balogun et al., 2018) and household welfare (Wossen et al., 2017).

Hypothesis 4: Farmers' group membership as an information source positively influence farmers' economic performance.

Recent studies from Sub-Saharan Africa revealed that access to extension and advisory services had helped farmers learn new agricultural technologies and subsequently helped farmers switch to more commercial, market-oriented agriculture in Ethiopia (Buehren et al., 2017). Also, a study conducted in Ethiopia showed that extension participation increases farm productivity (Elias et al., 2013). In comparison, another study conducted in South Africa established a direct relationship between extension services received by farmers to farmers' crop yields (Afful and Ayisi, 2016). In Ghana, a study showed the significant positive effect of extension services on rice productivity (Emmanuel et al., 2016). Although, extension services were shown not to be significantly associated with the likelihood of increasing household food security position (Nata et al., 2014). Scholars have also argued for the possible positive impact of agricultural extension services – an indispensable policy instrument in developing countries – on farmers' productivity and household welfare (Wossen et al., 2017).

Hypothesis 5: Agricultural extension services as an information source positively influence farmers' economic performance.

3.3 Methodology

3.3.1 Study area

Agriculture is one of the pillars of the Kenyan economy. It contributes one-third of GDP, and this contribution has increased in the past eight years, from 2010 to 2018, by almost 10% and employs 75% of the national labour force (World Bank, 2018). Over 80% of the Kenyan population live in the areas and derive their livelihoods directly or indirectly from this sector. Kenya's foreign earnings come mainly from black tea, tourism, coffee, and horticultural exports, such as green beans, onions, cabbages, snow peas, green grams, avocados, mangoes, and passion fruit. Even though cashew used to be one of the leading export crops, nowadays, cashew and sesame play a marginal role in national agriculture.

The study was carried out in the main cashew growing areas - Kenya's Coastal Province, where six counties are named Kwale, Taita Taveta, Mombasa, Kilifi, Lamu and Tana River. The farming systems in the Coastal Province are divided into three cropping systems: annual, biannual and perennial crops and farming activity (calendar) is determined by the rainfall pattern, with cashew as a major perennial crop. Data were drawn from three high cashew density counties, namely: Kilifi County covers an area of 12,246 km2 with a population of 1,109,735 with seven constituencies and 35 wards; Kwale County is on the southern coast of Kenya, occupying a surface area of 8,270 km2 with a population of 649,931, 4 constituencies and 18 wards; Lamu County is located on the northern coast of Kenya and covers an area of 6,273 km2 with a population of 101,539 with two constituencies divided into ten wards. The areas of high cashew density guided the choice of sub-counties of focus; these are:

1. Kilifi County: Kilifi North, Kilifi South, Magharini and Ganze
2. Kwale County: Msambweni, Matuga and Lunga Lunga
3. Lamu County: Mpeketoni and Hindi

Figure 3: Map of Kenya showing Kilifi, Kwale and Lamu counties main cashew producing areas

3.3.2 Data collection

A quantitative structured questionnaire survey was used as the primary research instrument to collect the data. The data was collected by trained local field officers within the EU Trust Fund for Africa-funded project "Enhancement of livelihoods in the Kenyan coastal region by supporting Organic and Fair Trade certification of smallholders".

A multi-stage sampling approach was designed using stratified sampling as the first step to identify the main cashew growing areas across Kilifi, Kwale and Lamu counties. The target population was estimated at 15,000 local cashew farmers. With 95% level confidence

and a 5% margin error, the minimal representative quota sample was set at 375 respondents. Quota sampling was used to collect representative data and to capture also the youth and women components in the study area (the minimum target was 100 male farmers, 25 female farmers, and 25 youth farmers in each county). In addition to quota sampling, the snow-ball method was also used to reach respondents. A pilot survey with ten farmers was conducted, and the questionnaire was adopted according to the respondents' comments. In total, 417 questionnaires were filled in the field.

The questionnaire for data collection was programmed into an Open Data Kit (ODK) data collection tool and uploaded to the smart mobile/tablet of each of the 16 trained enumerators – project field officers - as the data collection was done electronically between 30th April and 5th May 2018.

The dataset was later cleaned for wrong or missing data to 390 entries. For most farming-related questions, the dataset was further limited to respondents who are owners or co-owners of the farm. Thus, we reached the final number of 372 data entries as the others were not decision-makers. The sample can be smaller for some figures since not all the respondents answered the respective question.

Additional qualitative data were collected with the support of the researchers from the local Pwani University to gain better insight into peer support, networking and peer farmers' interaction on access to information from cashew farmers in the study area. A semi-structured, unstructured in-depth interview and focus groups were used. Each interview took about thirty minutes to one hour. The qualitative data collected from key informants, farmers and other value chain stakeholders was relevant to reveal a target group's range of behaviour and the perceptions that drive it with reference to specific pre-designed topics or issues. As the insights received were used to triangulate some other key findings revealed by the quantitative data. However, the process of organizing these semi-structured, unstructured in-depth interviews and focus group discussions was heavily dependent on human and time resources. The focus group discussions and interviews followed a series of guided questions to gather insights that have been aptly described in the results section under the study area's farming system and cashew farmer's information-seeking behaviour. During these sessions (focus group discussions and interviews), dialogues and insights were recorded in the form of notes. The following are the main participants involved in the qualitative data collection:

- Interview with Kwale Agricultural Officer
- Interview with Kilifi Agricultural Officer
- Interview with Kilifi Cooperative Officer
- 15 unstructured interviews with female cashew farmers
- 31 unstructured interviews with male cashew farmers
- 2 unstructured interviews with sesame farmers
- Interview with 3 Ten Senses Africa and Farm Africa field officers
- Interview with 2 managers of Kwale and Kilifi Ten Senses Africa cashew nurseries
- Interview with a representative of Cooperative Union
- 2 focus groups discussion with local groups of cashew farmers
- Interview with a local broker (middlemen)

Additional secondary quantitative and qualitative data relied heavily on an examination of existing, accumulated research, combining official government data with studies conducted by local and international organizations such as the report of the cashew nut revival task force "The Revitalization of the Cashew Nut Industry in Kenya" from 2009.

3.3.3 Data analysis

The resurgence of international donors, non-governmental organizations, and government entities in the Kenyan cashew industry has led to the provision of extension services aimed at promoting agricultural technologies. This study predicts that farmer group membership and the availability of extension services will increase farmers' access to information regarding agricultural technologies. This, in turn, is expected to drive an increase in the adoption of new agricultural technologies, resulting in a positive impact on farmers' economic performance. In addition, farmer group membership status (Abebaw and Haile, 2013; Balogun et al., 2018; Denkyirah et al., 2016; Ingutia and Sumelius, 2022; Liverpool and Winter-Nelson, 2010; Sanyang et al., 2009; Wossen et al., 2017) and access to extension (Afful and Ayisi, 2016; Buehren et al., 2017; Elias et al., 2013; Emmanuel et al., 2016; Nata et al., 2014; Wossen et al., 2017) have been proven empirically to have a significant effect on agricultural economic performance.

Against this background, the study analysed the simultaneous effect of farmer group membership status and access to an extension service on farmers' adoption of agricultural technologies (proxied by fertilizer use, chemical spraying and appropriate plant density use)

and economic performance (proxied by income). We adopted the logistic regression (logit) model to analyse the use of fertilizers and chemical spraying due to the dichotomous nature of the dependent variables (1 = if a farmer uses fertilizer and chemical spraying; 0 = otherwise).

The logit model is expressed as follows (Gujarati and Porter, 2022).

$$\frac{prob(y_i=1)}{prob(y_i=0)} = \frac{\rho_i}{1-\rho_i} = e^{(\alpha_0+\alpha_1 X_{1i}+\alpha_2 X_{2i}+\cdots+\alpha_k X_{ki})}$$

$$=$$

$$L_i = \ln\left(\frac{\rho_i}{1-\rho_i}\right) = \alpha_0 + \alpha_1 X_{1i} + \alpha_2 X_{2i} + \cdots + \alpha_k X_{ki}$$

Where ρ_i represents the probability of a farmer adopting fertilizer and chemical spraying, $(y_i = 1)$; $1 - \rho_i$ is the probability of non-adoption, $(y_i = 0)$; X_i respresent the explanatory variables; α_0 is the intercept; $\alpha_1,\ \alpha_2, \ldots, \alpha_k$ are coefficients of the explanatory variables X.

Multiple linear regression was used as expressed in Equation 2 to analyse the use of plant density (the third proxy for the adoption of agricultural technologies) and as expressed in Equation 3 to analyse the effect of farmer group membership, access to extension services and agricultural technology adoption on the economic performance of farmers (income per acre). The multiple linear regression was used due to the continuous nature of the dependent variables. The multiple linear regression is specified as follows:

$$Y_i = \alpha + \sum_{i=1}^{n} \beta_i X_i + \varepsilon_i$$

Where Y_i is the dependent variable plant density (number of cashew trees per acre) or economic performance (income per acre), α is the intercept, the regression coefficients β_i explain factors affecting plant density or farmers' economic performance, while the parameters to be estimated (i = 1, 2, 3, 4…) is denoted by X_i, and the error term is represented by ε_i.

Data were coded, and the STATA software package was used to analyse the data set. Descriptive statistics, which show the frequency, mean, standard deviation and percentage of respondents, were used to describe the socio-economic characteristics of the sample.

For this study, the empirical logit model is specified as follows:

$$T_i = \ln\left(\frac{\rho_i}{1-\rho_i}\right) = \alpha + \beta_1 G_i + \beta_2 E_i + \beta_3 S_i + \beta_4 F_i + \varepsilon_i, \qquad i = 1, 2, 3, \ldots, N$$ Equation (1)

Where T_i is the probability of a farmer adopting the agricultural technologies (i.e., fertilizer and chemical spraying), G_i denotes farmer group membership status, E_i represents access to extension services, S_i is a vector of socio-economic characteristics of a farmer (i.e., the gender, age and years of education as well as farmer access to off-farm income), F_i represents a vector of farm characteristics (i.e., farm size, use of hired labour, access to loan, and cultivation of another cash crop – sesame). ε_i is the random error that assumes independence and standard logistic distribution. The coefficients ($\beta_1, \beta_2, \beta_3, \beta_4$) were estimated by the maximum likelihood method, whereas the magnitude of relations between the dependent and explanatory variables was estimated and explained by the average marginal effects of the parameters.

For this study, the multiple linear regression adopted is specified as:

$$P_i = \alpha + \beta_1 G_i + \beta_2 E_i + \beta_4 S_i + \beta_5 F_i + \varepsilon_i, \quad i = 1, 2, 3, \ldots, N$$ Equation (1)

$$Y_i = \alpha + \beta_1 G_i + \beta_2 E_i + \beta_3 T_i + \beta_4 P_i + \beta_5 S_i + \beta_6 F_i + \varepsilon_i, \quad i = 1, 2, 3, \ldots, N$$ Equation (3)

Where P_i represents the dependent variable plant density (Equation 2), the third proxy for a farmer adopting the agricultural technology. As seen in Equation 3, Y_i represent the dependent variable income, G_i denotes farmer group membership status, E_i represents access to extension services, T_i is a vector of technology adoption (fertilizer use and chemical spraying), P_i represents the vector of technology adoption plant density, S_i is a vector of socio-economic characteristics of a farmer, and F_i represents a vector of farm characteristics. ε_i is the random disturbance term. Unlike the logit model, which uses the estimated marginal effects to interpret the magnitude of the effects, coefficients of the linear regression model ($\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$) have direct interpretation (the direction of the relationship and the magnitude of the effect on the dependent variable).

Logit regression analysis was used to understand the effect of independent variables on the adoption of modern agricultural technologies – such as fertilizer use (4) and chemical spraying (5):

Equation 4;

$$Fertuse=\alpha 0+\alpha 1Age+\alpha 2Edu+\alpha 3Hhhead+\alpha 4Farmsize+\alpha 5Hlabour+\alpha 6Offfarm+\alpha 7Groupmem+\alpha 8Loans+\alpha 9Exten+\alpha 13Psesame+\mu$$

Equation 5;

$$Chemspray=\beta 0+\beta 1Age+\beta 2Edu+\beta 3Hhhead+\beta 4Farmsize+\beta 5Hlabour+\beta 6Offfarm+\beta 7Groupmem+\beta 8Loans+\beta 9Exten+\beta 13Psesame+\mu$$

While a linear regression model was used to investigate planting density and the consequent effect of the adoption of modern technologies on farmers' economic performance (income per ha). Empirically, the impact of the adoption of modern agricultural technologies on farmers' profit is specified as in (6) and (7):

Equation 6;

$$Plantden=\omega 0+\omega 1Age+\omega 2Edu+\omega 3Hhhead+\omega 4Farmsize+\omega 5Hlabour+\omega 6Offfarm+\omega 7Groupmem+\omega 8Loans+\omega 9Exten+\omega 13Psesame+\mu$$

Equation 7;

$$Pef=\varphi 0+\varphi 1Age+\varphi 2Edu+\varphi 3Hhhead+\varphi 4Farmsize+\varphi 5Hlabour+\varphi 6Offfarm+\varphi 7Groupmem+\varphi 8Loans+\varphi 9Exten+\varphi 10Plantden+\varphi 11Chemspray+\varphi 12Fertuse+\varphi 13Psesame+\mu$$

Where *Pef* denotes economic performance or relative income measured as gross farm income per acre; *Age* represents the age of farmer in years; *Edu* denotes number of years spent in school; *Hhhead* denotes the gender of household head (1 if the household head is a male and 0 otherwise); *Farmsize* denotes the size of farm in acres; *Hlabour* represents hired labour (1 if the farmer hires anyone and 0 otherwise); *Offfarm* denotes off farm income (1 if the farmer generates income outside farming related activities and 0 otherwise); *Groupmem* denotes group membership (1 if the farmer is part of at least one of any farmer group such as Savings and Credit Cooperative Societies or Village Savings and Loan Associations or production groups or cooperative associations where farmers exchange relevant information as regards know-how, besides the primary function of such groups, and 0 otherwise); *Loans* denotes loans (1 if the farmer have taken a loan and 0 otherwise); *Exten* denotes extension support (1 if the farmer received any extension support and 0 otherwise); *Plantden* denotes planting density (number of trees per acre); *Chemspray* denotes chemical spraying (1 if the farmer sprays chemical on crops and 0 otherwise); *Fertuse* denotes fertilizer use (1 if the farmer applies fertilizer and 0 otherwise); *Psesame* denotes planting sesame (1 if the farmer

plants sesame and 0 otherwise); $\alpha_0, \beta_0, \omega_0$ and φ_0 are the constant terms; $\alpha 1, \alpha 2, \ldots, \alpha 13$; $\beta 1$, $\beta 2$, ..., $\beta 13$; $\omega 1, \omega 2, \ldots, \omega 13$; $\varphi 1, \varphi 2, \ldots, \varphi 13$ are the coefficient terms and μ is the error term.

All observable explanatory variables added to the models employed in this study rest on documented empirical findings which reveal that age, education, gender, farm size, hired labour, off-farm income, group membership, credit access, and extension support have a significant effect on the adoption of agricultural technologies (Elias et al., 2016; Emmanuel et al., 2016; saint Ville et al., 2016; Turner et al., 2014). Consequently, the adoption of agricultural technologies – with respect to fertilizer usage (Emmanuel et al., 2016) – has been shown to significantly affect farmers' production levels (Buehren et al., 2017; Dendena and Corsi, 2014; Sajeev et al., 2014; Sanyang et al., 2009). The planting sesame variable was added to the model as a proxy for diversified agriculture. Sesame is often cultivated in intercropping systems with cashew trees in the area as international NGOs together with the local government introduced the crop as an alternative to cassava – which is also commonly planted with cashew trees.

Table 2 provides the descriptive statistics of variables used in the regression models, and the main results are described in the following section.

Table 2: Summarized statistics of dependent and independent variables used for Logit and linear regression analysis, N=372.

Variable	Question type	Scale and measurement	Frequency	% of respondents
Dependent variables				
Planting density	open question	Continuous scale; number of trees per acre	351 [b] $\bar{x}$=10.00 σ=02.60	100.00
Economic performance (income per acre)	open question	Continuous scale; KES[a] per acre per year	268 [b] $\bar{x}$=1813.45 σ=2589.61	100.00
Fertilizer usage	multiple choice	Binary response		
		0 - no	294	79.03
		1 - yes	78	20.97
Chemical spraying	multiple choice	Binary response		
		0 - no	270	72.58
		1 - yes	102	27.42
Independent variables				
Farmer's age	open question	Continuous scale; years	372 [b] $\bar{x}$=48.59 σ=14.32	100.00
Education	open question	Continuous scale; years	295 [b] $\bar{x}$=09.74 σ=02.60	100.00
Farm size	open question	Continuous scale; acres	372 [b] $\bar{x}$=06.28 σ=04.98	100.00
Gender of household head	multiple choice	Binary response		
		0 - female	128	34.41

		1 - male	244	65.59
Hired labour	multiple choice	Binary response		
		0 - no	281	75.54
		1 - yes	91	24.46
Off farm income	multiple choice	Binary response		
		0 - no	243	65.32
		1 - yes	129	34.68
Loans	multiple choice	Binary response		
		0 - no	262	70.43
		1 - yes	110	29.57
Extension support	multiple choice	Binary response		
		0 - no	270	72.58
		1 - yes	102	27.42
Plant sesame	multiple choice	Binary response		
		0 - no	238	63.98
		1 - yes	134	36.02
Group membership	multiple choice	Binary response		
		0 - no	269	72.31
		1 - yes	103	27.69

[a] costs estimated in KES (Kenyan shilling), [b] number of observations, descriptive statistics: mean ($\bar{x}$) and standard deviation (σ) of continuous variables.

3.4 Results

3.4.1 Description of the sample

Figure 4 shows the distribution of samples from the three counties capturing the youth and women components. The sample was divided into 3 categories of male representatives, female representatives, and youth representatives, as adapted from (FAO, 2013). The more detailed description of these groups following the cleaned dataset for wrong or missing data to 390 entries (61 young male farmers, 34 young female farmers, 202 adult male farmers and 93 adult female farmers - distribution of 4 categories among 3 counties) is visualized in Figure 4. Male denotes farmer representatives where the respondent is the owner or co-owner of the farm, is a male, married or single, older than 35 years, and involved personally in farm work. Female denotes farmer representatives where the respondent is owner or co-owner of the farm, is a female, married or single, older than 35 years, involved personally in farm work. Youth denotes farmer representatives where the respondent is owner or co-owner of the farm, is a young farmer, married or single, of age 15-35 years involved personally in farm work as adapted from (FAO, 2013). Whilst respondents were geographically sampled for farming-related questions as follows; Kwale (142), Kilifi (138) and Lamu (92). From all sampled respondents from the 3 counties, there are 35 young male farmers planting cashew, 22 young female farmers planting cashew, 196 adult male farmers planting cashew, 98 adult female farmers planting cashew, 11 young male farmers planting sesame, 8 young female farmers planting sesame, 73 adult male farmers planting sesame and 42 adult female farmers planting

sesame. Of those respondents who do own cashew trees, not all of them harvest cashew. The case is mostly seen in young women, where more than half doesn't harvest cashew. As 30 young male farmers, 10 young female farmers, 168 adult male farmers and 86 adult female farmers reported that they were harvesting cashew. On the other hand, in the case of older women, only 12% of the respondents don't harvest cashew. This affirms the findings from the unstructured interviews that older women are often very good with their resources and try to make the most use of them without waste.

Based on the qualitative data collected through unstructured interviews, it can be observed that the situation of women involved in cashew farming in the Coastal province of Kenya has undergone a significant improvement. However, despite this progress, there are still considerable gaps and traditional gender roles that persist. The prevailing gender roles perceive women as solely responsible for household chores, while men are considered the primary providers, decision-makers, and land or tree owners among local farmers. Furthermore, our quantitative data highlights several disparities, including the fact that 40% of female adult farmers have received no education, compared to 18% of male farmers. Nevertheless, it is encouraging to see that the younger generation is embracing positive changes. Unfortunately, youth, in general, are shying away from agriculture due to the availability of other lucrative opportunities, such as the rapidly growing motorcycle transport business known as "picky-picky."

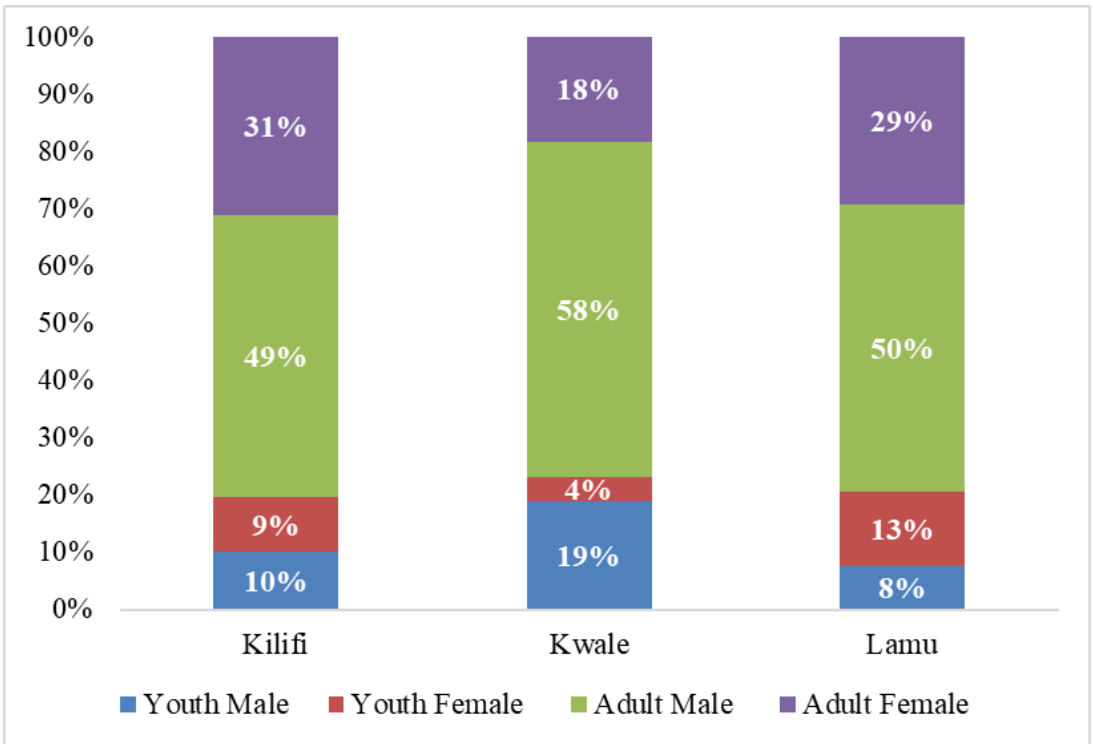


Figure 4: Distribution of sample from the three main cashew producing counties – Kilifi, Kwale and Lamu

3.4.2 Farming system in the study area

The Coastal Province harbours a significant number of cashew trees, primarily comprised of undistinguished and substandard varieties. The local cashew is markedly heterogeneous, exhibiting substantial variations in output, nut sizes, nut quality, apple hues, and tree formations. The majority of the currently operational trees were sown two decades ago, a period of considerable government investment in the cashew industry. Meanwhile, several other trees have surpassed their prime years and ceased to be productive.

Presently, there is a growing interest in the cashew sector, resulting in the introduction of new varieties to the Province. One of the most common types of cashew tree varieties imported as scions to the Coastal Province is the Brazilian dwarf, which can mature relatively early when combined with local rootstock. This variety can produce the first fruit within 24 to 26 months, unlike other lines. Although there are other lines available, their precise scientific nomenclature is unknown due to the unorganized nature of imports. The improved trees are still too young to demonstrate practical results on potentially improved yields. It is noteworthy that there is currently no unique Kenyan line of cashew trees available.

Based on our quantitative data, the productive local cashew tree can bear on average 6.4 kg/nuts/year, while the maximum reported productivity from some respondents is around 30 kg/year. Nevertheless, because of the low quality of most trees, which grow without any care, productivity can decrease to about 2-10 kg/tree/year. For the most intensive farmers from our sample, the overall yield can reach 80-120 kg/acre (200-300 kg/ha), which is extremely low compared to other cashew-producing countries, and far less than the Food and Agriculture Organization of the United Nations (FAO) official statistics show. The majority of cashew farms situated within the Coastal Province comprise modest plots of approximately 5 acres devoted to cashew production. In these small holdings, a scattered assortment of fewer than 20 cashew trees is typically dispersed around the farmers' dwellings. Adult male farmers tend to have access to the most extensive tracts of land dedicated to cashew cultivation. Additionally, there are remnants of governmental plantations dating back to the 1980s, which contain numerous cashew trees. Nevertheless, both the smallholder farms and the old plantation trees have remained uncultivated for the last two decades.

The span between the trees is usually 8-12 metres, but with frequent gaps caused by dead trees. The average density of the trees of our respondents is around three trees per acre. The trees exhibit excessive growth and limited capacity for producing high-quality nuts. Approximately half of the trees are unproductive, and among cashew tree owners, not all are able to successfully harvest cashews. A minority of farmers have taken steps to recover old trees or establish new plantations. The common approach to reviving existing cashew plantations involves top working, which involves trimming the tops of the trees to encourage the growth of fresh sprouts. In recent times, some farmers have opted to plant new and improved varieties of cashew trees that are available through government channels. However, it is noteworthy that the distribution of a limited number of seedlings has occurred only twice in the past decade. There are no advanced plantations that would be regularly pruned and cut to increase productivity. The main cashew inputs include seedlings, fertilizers, manure, and machinery. If we look at practices of pest and disease control and the use of fertilizers, we can observe that the trees are cared for by a minimal number of farmers. The use of fertilizers and pesticides happens once or twice a year, usually when symptoms of diseases start to emerge. However, farmers' knowledge of using chemicals on their trees is minimal. 80% of the respondents don't use any fertilizers on the farms (Table 2). The most favoured types of fertilizer, if used, are manure and DAP. The government and international NGOs started to spread the know-how related to the organic methods of cashew farming with the potential to add value to the final certified product. However, the farmers have not initiated the conversion to the organic system, and no farmers were practising organic agriculture at the time of data collection.

The majority of respondents don't use any agro-chemical inputs on their farms. For those who do use them, the most popular kind is pesticide and fungicide. Around 25% of farmers use hired labour on their farms (usually 2-3 people). Besides the general characteristics of local cashew farming systems, we also analyzed the productivity of local cashew in terms of gross income and associated costs. The average gross income of cashew is extremely low, around 4000 KES or 40 US dollars per year (all expenses estimated in KES, Kenyan shilling, at the following exchange rate: 1 USD = 101.4). The highest costs were associated with fertilizers, agro-chemicals and land preparation. However, it should be noted that only a small proportion of farmers ever spent on these costs.

3.4.3 Cashew farmers information-seeking behaviour

The adoption of improved technologies by cashew farmers in the Coastal Province is low. It is estimated that less than 30% of all cashew farmers surveyed have received extension support for their crops, as seen in table 2. As depicted in table 3, almost 50% use the services of the government extension officers in the area, while approximately 25% use extension services sourced from Non-Governmental Organizations (NGOs). Only a small number of farmers use private firms (19%) or other farmers (14%).

Inadequate resources have resulted in a further reduction of contact time between extension staff and farmers, hindering the provision of necessary agricultural services. The scarcity of younger and motivated field officers has proven to be a challenge for local government authorities, as most extension workers are approaching retirement age. Only 11% of respondents received any training in cashew cultivation (Table 3). Besides two distributions of new seedlings (2008 – 50.000 seedlings; 2014 – 30.000 seedlings), there is no direct support for cashew farmers, only a general crop-cultivation extension service. For instance, the county Agricultural Office runs a system of 17 general-focused Farmer Field Schools in the area.

Most of the interviewed farmers have not received any recent training related to cashew. 50% of those who received training received them in the 2016-2018 period. Nevertheless, several international donors and projects targeted the same cashew communities in the area: the most relevant intervention was the project “Empowering Women Cashew Farmers” in Kilifi, implemented by the NGO Self-Help Africa and funded by the Wal-Mart Foundation.

The qualitative interviews revealed that more than 20% of the population in the coastal counties belong to producer groups cultivating farm produce such as maize, mango, cashew, cassava, sweet and Irish potatoes, and green grams (legumes), oranges, and vegetables. 10% are involved in marketing groups, 60% are active members of savings’ groups, and the rest belong to social and services groups. However, compared to the rest of Kenya, the Coastal Province seems to lack producer group development and popularity. Besides a few dairy and beekeeping cooperatives, functional marketing cooperatives are almost non-existent among farmers and exist only in the memories of former members.

In the context of small-scale agriculture, a significant obstacle to the success of cooperative groups has been the lack of sustained collaboration among farmers. This

phenomenon can be attributed to the belief among some farmers that engaging with others within the same industry may impede their individual revenue streams. Furthermore, the passive demeanor of group members, coupled with their low attendance rates during meetings, presents additional limitations. Many farmers are often hesitant to share information, thus hindering the collective growth of the group. Apathy among young farmers also poses a challenge, as older members often hold leadership positions for extended periods, which may discourage the younger generation from joining. Governance issues, such as reported cases of malpractice among leadership, further exacerbate the situation by undermining the confidence of the general membership. The quantitative data confirms that almost 30% of farmers in our target regions are members of a group (Table 2). Belonging to a group seems prevalent, especially in the case of women. This may be because they show better organizational and teamwork skills and are more diligent at fulfilling their requirements, as we have learned from qualitative data. 50% of farmers already in a group meet weekly, which confirms an observation during one of the unstructured interviews with key informants that farmers are used to working and sharing resources in many different informal groupings.

A commonly discussed problem might be that membership in the group is tied to land ownership. However, linking membership to trees' ownership and not only land might encourage more women and youth to become members. As we learned from interviews with representatives of Cooperative Unions, which support the result shown in table 2, more than 25% of the farmers in the coastal counties belong to a group. However, there is neither any active and wide-reaching national association of cashew producers, a cashew commodity board, nor any export promotion association common in major cashew-producing countries. As gathered, the Kenya Nut Grower Association does not include many cashew producers in the Coastal Province. The main problem frequently discussed is the lack of capital (though the membership contribution fees are very low – usually 20 KES/year) to pay on time to members bringing their cashew production to the cooperative, along with the negative mindset towards cooperatives among farmers on the coast. However, according to an interview with the Cooperative Officer in Kilifi, the local government plans to provide subsidized loans to cooperatives, and renewed interest among farmers can be expected. We also analyzed general trust in society. From the data, it can be infered that most farmers perceive a high level of trust and cooperation (Table 3).

Table 3: Summarized descriptive statistics of cashew farmers in Kenya's coastal region.

Question code	Question [a] type	Question text	List of answers	Frequency	% of respondents
Access-related variables					
Type of extension support	MCo	From whom have you received extension support?	1 - government extension officers	50	48.36
			2 - other farmers	14	11.48
			3 - private firms	19	15.57
			4 - NGOs	25	24.59
Training	MCo	Have you ever received any training on your cashew nut production?	no	331	88.98
			yes	41	11.02
Farmer groups-related variables					
Number of group members in groups	-	-	1-Youth male	11	10.68
			2-Youth female	8	7.77
			3-Adult male	48	46.60
			4-Adult female	36	34.95
Peer-farmers interaction index	MCo	Frequency of group meetings?	1 - weekly	53	51.46
			2 - bi-weekly	4	3.88
			3 - monthly	40	38.83
			4 - quarterly	4	3.88
			5 - annually	2	1.94
Group participation index	MCo	As a member, how active are you in participation in the group (voting)?	1 - rather active	33	32.04
			2 - unbiased	8	7.77
			3 - very active	62	60.19
Information sharing-related variables					
Peer support index	MCo	Most neighbouring farmers are willing to help farmer if in need?	1 - absolutely no	12	3.23
			2 - rather no	30	8.06
			3 - unbiased	6	1.61
			4 - rather yes	148	39.78
			5 - absolutely yes	176	47.31
Perceived trust in the last 5 years	MCo	Over the last 5 years the level of trust and solidarity in the community has become better?	1 - absolutely no	4	1.08
			2 - rather no	21	5.65
			3 - unbiased	15	4.03
			4 - rather yes	170	45.70
			5 - absolutely yes	162	43.55
Other technology adoption-related variables					
Pruning	MCo		0 - no	79	22.51

		Has any pruning ever been done to the trees?	1 - yes	272	77.49
Fertilizer type	MCo	Type of fertilizer used?	1-NPK[b]	6	7.69
			2-Manure	29	37.18
			3-Foliar feeds	17	21.79
			4-DAP[c]	10	12.82
			5-CAN[d]	16	20.51

[a]MCo: multiple choice, one answer, [b]"nitrogen, phosphorus, and potassium", [c]diammonium phosphate and [d]Calcium Ammonium Nitrate fertilizers respectively

3.4.4 Adoption of agricultural technologies: Fertilizer usage, chemical spraying and planting density

Table 4 provides the results of regression models analyzing determinants that affect the probability of using fertilizers, chemicals and appropriate planting density by smallholder farmers. It is worthy to note that several control variables were insignificant.

Table 4: Logit regression models and multiple linear regression for determinants of adopting modern agricultural technologies

Regressors	**Fertilizer usage**		**Chemical spraying**		**Planting density [a]**	
	Mean Marginal Effects	Std. Err.	Mean Marginal Effects	Std. Err.	Coef.	Std. Err.
Institution-related variables						
Group membership	**0.231****	**0.105**	**0.226***	**0.133**	**7.096*****	**2.197**
Extension	**0.087***	**0.048**	0.083	0.058	**1.980****	**0.980**
Explanatory variables						
Age	0.002	0.002	0.002	0.002	**0.073****	**0.036**
Education	0.014	0.008	-0.003	0.011	**-2.233****	**1.132**
Gender of household head	0.010	0.061	-0.102	0.069	-0.031	0.172
Off farm income	0.022	0.050	**0.106***	**0.058**	0.961	0.929
Loans	**0.118****	**0.048**	0.030	0.059	-1.019	0.950
Farm size	**-0.011****	**0.006**	-0.002	0.006	**1.980***	**1.070**
Hired labour	-0.026	0.056	**0.173*****	**0.060**	0.084	0.087
Plant sesame	**0.131*****	**0.050**	**0.228*****	**0.056**	**2.625*****	**0.960**
Constant	-	-	-	-	1.582	2.225
Statistical Values for Calculating the Marginal Effects and multiple linear regression						
Number of observations	293		294		277	
prob > chi2	0.001		0.000		-	
pseudo R2	0.104		0.173		-	

log likelihood	-135.495	-144.736	-
prob > F	-	-	0.000
R-squared	-	-	0.186
Adjusted R-squared	-	-	0.156

[a] Dependent variable for multiple linear regression is planting density in value of trees per acre while *denote 10%, ** denote 5% and *** denote 1% significant levels respectively.

3.4.5 Impact of agricultural technologies adoption on farmers economic performance

The results of our multiple linear regression model presented in Table 5 shows that economic performance (income per acre) increases with planting density and surprisingly decreases when fertilizers are used. Access to loans negatively affected the economic performance of farmers in the study area. However, this effect was not significant. Probably farmers divert credit received for farming activities to other non-farming-related expenses. The use of pesticides does not show any statistically significant effect on economic performance. Off-farm income showed a significant negative effect on economic performance. That may be explained by the opportunity cost to farmers of investing time in other non-farm activities.

Table 5: Results of multiple linear regression (dependent variable: Income in value of KES per acre)

Regressors	Coef.	Std. Err.	P>t
Age	-6.630	15.104	0.661
Education	103.111	69.093	0.137
Gender of household head	353.336	456.490	0.440
Farm size	-46.125	34.779	0.186
Hired labour	**1521.582*** **	**427.369**	**0.000**
Off farm income	**-1211.753*** **	**393.322**	**0.002**
Group membership	-1006.125	842.923	0.234
Loans	-56.656	387.735	0.884
Extension	-81.899	410.792	0.842
Planting density	**70.400*** **	**24.218**	**0.004**
Chemical spray	102.546	240.798	0.671
Fertilizer use	**-1046.537** **	**436.296**	**0.017**
Plant sesame	**2364.191*** **	**392.988**	**0.000**
Constant	95.559	893.375	0.915
Number of observations	235		
Prob > F	0.000		
R-squared	0.355		
Adjusted R-squared	0.317		

*denote 10%, ** denote 5% and *** denote 1% significant levels respectively.

The implementation of intercropping techniques in cashew plantations, specifically through the cultivation of sesame, has yielded favorable outcomes for farm economic

performance. Recent empirical evidence from African contexts corroborates the profitability of intercropping as a viable strategy for cashew farmers, providing both a safety net and expedited income generation (Lawal and Uwagboe, 2017).

3.5 Discussion

The empirical results show that group membership, planting of sesame, access to loans and use of extension services increase the probability of fertilizer usage, and this confirms the apriori expectation. An increase in farm size decreases the likelihood of fertilizer use. This result is similar to another empirical finding from Kenya that showed a negative relationship between fertilizer use and farm size (Ouma et al., 2002). Unfortunately, it is very difficult to interpret this result. The underdeveloped cashew sector in Kenya's coastal regions, coupled with the absence of guaranteed markets, may lead farmers with larger cashew farmlands to view the use of fertilizers as uneconomical. Additional research is necessary to investigate this correlation.

Amongst other explanatory variables, the results show that cashew farmers who are members of a group and have access to extension services have a higher probability of taking up the use of fertilizer, which is consistent with empirical evidence from other African countries related to the impact of cooperatives on the adoption of agricultural technology (Abebaw and Haile, 2013). Thus, this confirms the first and second hypotheses: the positive influence of farmers' group membership and access to extension services on adopting modern agricultural technologies regarding fertilizer usage.

This finding validates the efficacy of extension services as a crucial factor influencing the utilization of fertilizers, consistent with a recent empirical investigation that exposed the influence of agricultural extension services on the uptake of chemical fertilizers in Sub-Saharan Africa (Emmanuel et al., 2016). The aforementioned highlights the significance for the Kenyan government and policymakers to prioritize the provision of extension services to cashew farmers in the coastal region, in order to enhance the sector's productivity. The result is also consistent with findings from Kenya that adopters of an improved maize variety had better access to extension services – which were mainly sourced from the Ministry of Agriculture and NGOs – compared to their counterpart non-adopters (Ouma et al., 2002).

The results further demonstrate that farmers who are members of a group tend to have a higher probability of adopting agricultural technology. This result supports the

empirical evidence that group membership positively affects information flow in adopting farming technologies (Singh et al., 2016; Toma et al., 2018). Information flow among farmers on the coast might arise from other factors – like planting sesame.

The study findings indicate that off-farm income, which serves as one of the explanatory variables in the model, exhibits a positive yet statistically insignificant correlation with fertilizer utilization. A plausible inference from this observation is that farmers could possibly gain knowledge about the advantages of using organic fertilizers, such as manure, through networking with their peers while engaging in other profitable off-farm pursuits. This outcome aligns with the outcomes of a prior study conducted in Kenya, which demonstrated a significant positive correlation between off-farm income and the application of manure (Makokha et al., 2001). It is also worthy to note that a study conducted in Ethiopia established that participating in off-farm activities such as village leadership had a significant positive effect on the likelihood of cooperative membership – which in turn was a significant factor influencing fertilizer use (Abebaw and Haile, 2013). Hired labour showed a negative but insignificant relationship with fertilizer usage; this might be due to the expensive labour requirements in the study area as farmers might direct the services of hired farm workers to other activities on the farm. In Kenya, hired labour for manure application was also insignificant for farmers who only used manure on their farms (Makokha et al., 2001). On the contrary, Ouma et al. (2002) established hired labour as a statistically significant factor affecting the quantity of fertilizers used by farmers in Kenya.

The positive relationship between chemical spraying and group membership (Table 4) indicates the possibility that through some regular meetings, members might access and spread the knowledge about pest control using chemicals. The finding contrasts the recent empirical findings on Ghanaian cocoa farmers' decisions to use pesticides where membership of a farmer-based organization was statistically significant and negatively influenced the frequency of pesticide application (Denkyirah et al., 2016). As the study expressed "that farmers were more aware of insect pest thresholds due to being members of farmer-based organizations, which further indicates that farmer-based organizations are a reliable source of information to farmers." Overall, the result is consistent with previous studies that show farmer groups facilitate technology acquisition and dissemination (Sanyang et al., 2009) as

well as trust within farmers' networks encouraging uptake of new agricultural knowledge (saint Ville et al., 2016; Turner et al., 2014).

However, no statistically significant effect of extension access on the likelihood of applying chemicals in our model. Therefore, we do not accept the second hypothesis as the second hypothesis is related to other technologies but here, we do not accept it as regards chemical spraying. This further differs from the findings of the aforementioned study that showed access to extension services was statistically significant and negatively influenced pesticide use – probably due to the introduction of new technologies other than pesticides to farmers by extension agents (Denkyirah et al., 2016). This aligns with findings that show why farmers adopt biological control compared to pesticide spraying (Abdollahzadeh et al., 2016, 2015) as chemicals might be perceived as harmful substances and household heads might not want to endanger family members.

The relationship between access to loans and the adoption of agricultural technology (chemical spraying) was positive but not significant, which is in line with the findings of Emmanuel et al. (2016) that showed that access to formal credit was not significantly related to chemical fertilizer adoption as the authors further argued that credit might facilitate the purchase of agro-chemicals such as pesticides. The possibility that a farmer would purchase and use technologies like pesticides will likely increase if the farmer accesses credit. This positive but not significant relationship can be likened to a study conducted in Kenya that showed that adopters of technology had greater access to credit than non-adopters (Ouma et al., 2002).

The last model results show (Table 4) that group membership and access to extension services increased the number of cashew trees planted per acre (planting density). It is distinct from the number of farmers' schooling years, which negatively affects plant density. The causal effect of accessing extension services to increasing or using appropriate planting density is consistent with empirical evidence from Ghana, where it was observed that there was a significant positive mean difference between farmers who received extension services against their counterparts in terms of the adoption of row planting in rice fields (Emmanuel et al., 2016).

As observed in the study area (Table 2), most farmers did not plant any new trees in the last 30 years. Thus, the average plant density is 10 cashew trees per acre – which is

relatively low compared to the recommended plant spacing of 10 m by 10 m (100 trees per ha) (FAO, 2021). Sparingly, outlier farms with higher planting densities were observed where farmers did not cut down the old trees or planted new trees in between the old trees. This reflects the observed comments that "farmers often do not replant lost trees" during focus group discussions. This might be due to the additional cost incurred and extra person-hours for managing the nursing period for a new seedling on the farm.

Off-farm income and hired labour showed a positive but insignificant relationship with the number of cashew trees planted per acre. Logically, we deduce that if a farmer gainfully engages farm workers in transplanting and re-establishing cashew trees, this might reduce the frequent gaps caused by dead trees. Loans showed a negative relationship with planting density as farmers with access to credit surprisingly had fewer trees per acre.

According to the most recent empirical evidence on the impact of different irrigation regimes under varied planting densities on growth, yield and economic return on cashew planting conducted in India, increased planting density was instrumental to improving the raw cashew nut yield and invariably the net economic returns per unit area (Mangalassery et al., 2019). This affirms our findings on the significant positive impact of appropriate planting density per acre on economic performance – hence we accept the third hypothesis that adopting modern agricultural technologies (appropriate plant density) influences farmers' economic performance.

Access to extension services showed an unexpected negative effect on farmers' economic performance, but this effect is insignificant. Hence, we do not accept the fifth hypothesis. There might be sundry explanations for this unexpected insignificant effect of access to extension services on farmers' economic performance: (i) the impact of access to extension services on farmer economic performance is most likely a specific – rather than a universal – influencing element; (ii) in this context, probably more successful farmers (experienced farmers with larger farms) get their know-how from other sources and/or self-study – hence, access to extension services may not affect them; (iii) similar to (Nata et al., 2014), there is a high possibility of respondent's social desirability bias behaviour – as farmers might have responded that they access extension services to look socially hospitable during data collection by the trained local field officers within the EU Trust Fund for Africa-funded project and (iv) lastly, the extension services in the Kenyan cashew sector is relatively recent

with the re-birth of international donors, NGOs and government interests. Hence, translating this recent extension advice – like new information and technology – into higher income needs more time, especially for cashew.

Also, we reject the fourth hypothesis as an insignificant negative relationship between group membership and farmers' economic performance can be seen from the results. The study drew empirical evidence from cashew farmers cultivating extensive agriculture in the southern coastal regions, who require more technical information such as appropriate cashew tree density – which might not be easily obtained from farmer groups to improve yield. It is worth hlighting that the farmers surveyed in this study belong to several groups, such as savings associations and other rural groups, not necessarily those focused only on cashew production.

Other studies revealed that cooperative membership and other social capital variables have significantly influenced farmers' productivity (Balogun et al., 2018; Ingutia and Sumelius, 2022; Saha and Devi, 2016; Wossen et al., 2017), but studies investigating the effect on income considering the cost of production are yet missing. The policy implication is to focus resources on facilitating effective cashew-oriented farmer groups to increase information flow – especially the promotion of increased cashew planting density among farmers resident in the three major cashew-dominated counties, and especially to support rigorous studies on how the use of fertilizers and pesticides in the area affects the quality of nuts and the economic performance of smallholder farmers. The extension services should base their services and recommendations on the results of such studies' results as they aim is to optimize input use and increase economic performance.

Our results indicate that in areas with extensive agriculture, such as the one under consideration in this study, the use of (inorganic) fertilizers is not economical. The cost of investment in fertilizer is higher than the increase in sales. One explanation could be that extension agents discourage the extensive use of chemical fertilizers while promoting organic alternatives such as manure. Hence, farmers tend to use manure – a more affordable choice and probably perceived as more effective. This argument is consistent with Costa and Bocchi's (2017) advice that cashew trees react better to organic fertilizers owing to the relatively high amount of macro-and micronutrients such as calcium and magnesium that inorganic fertilizers do not provide (Costa and Bocchi, 2017).

Furthermore, manure has been adduced to slowly release nitrogen into the soil, reduce leaching and acidification and perhaps improve soil quality – structure and water content (Dendena and Corsi, 2014). A similar practice was observed in China, where extensive use of chemical fertilizers was discouraged due to the harmful effects on the soil Emmanuel et al., (2016). Lastly, the current underdeveloped market, does not provide premium payment for better quality nuts. Therefore, it will require time and high-quality buyers to appreciate higher quality nuts that might arise from practical fertilizer application. Therefore, the extension services need to provide information specific to the given location based on rigorous studies on input optimization to support the farmers in achieving of their economic goals.

3.6 Policy implications

The present study has examined the impact of farmers' group participation and access to agricultural extension services on farmers' adoption of modern agricultural technologies (specifically, the use of fertilizers, chemicals and appropriate plant density) and the consequent impact of adopting these agricultural technologies on farmers' economic performance (measured in income per acre) in the coastal regions of Kenya. In line with our empirical findings, we conclude that access to extension services and group membership have significant positive effects on adopting modern agricultural technologies, namely fertilizer and pesticide usage and appropriate planting density. It is worth noting that planting density consequently showed a significant effect on economic performance. The same positive effect can farmers obtain by higher planting density. However, we can observe that the chemical spraying of cashew trees – such as with pesticides – does not affect economic performance, while fertilizer usage has even a negative effect.

The findings revealed that there has been a noticeable improvement in the levels of trust and solidarity within the coastal communities over the past five years. As such, the local government can leverage this social capital to enhance the effectiveness of existing farmer groups, as well as facilitate the formation of new groups. Through this approach, it may be possible to effectively integrate modern technologies and optimize the performance of the cashew sector.

To encourage cashew farmers in Kenya to adopt economic and modern agricultural technologies, policies should be established to facilitate the provision of extension services by major stakeholders such as private firms and NGOs. This approach could promote healthy competition

among extension service providers and increase the number of farmers reached. Given the growing number of female farmers in the industry, extension agents should prioritize the active involvement of women in existing farmer groups and encourage the formation of new ones. Disseminating information on appropriate cashew planting density and other relevant agricultural technologies is critical as it has been proven to increase profitability and improve Kenya's positioning in the global economy.

The farmers' interest in improving the technology of cashew planting can only be achieved if there is a developed market and demand for high-quality nuts at reasonable prices. Support of investment in processing factories in the area is necessary. The first step in this direction has been taken in the project funded by the EU Trust Fund for Africa, "Enhancement of livelihoods in the Kenyan coastal region by supporting organic and Fair Trade certification of smallholders," which supports the establishment of a new large scale cashew processing factory in the area.

4. Case Study 2: Extrinsic rewards as job satisfaction predictors among extension workers in Nigeria

4.1 Introduction

Job satisfaction has been investigated in several disciplines. The wilderness of literature is saturated with documented studies from numerous domains; business, economics, management sciences, psychology, sociology and public administration (Asiedu-Darko and Amanor, 2016; Bayona et al., 2020; Cortini et al., 2019; Gazioglu and Tansel, 2006; Hansen and Stræte, 2020; Jankelová et al., 2020; Lee and Sabharwal, 2016; Maican et al., 2021; Meyerding and Lehberger, 2018; Muri et al., 2020; Wen et al., 2019; Windon, 2019; Yang et al., 2019). The growing relevance of probing into factors influencing job satisfaction is imperative to; building sustainable businesses (Jankelová et al., 2020), boosting organizational performance (Maican et al., 2021) and developing public policies (Kristensen and Johansson, 2008). Due to the warnings of possible increased job turnover, especially in the public sector, where financial motivation is less effective, as adduced by (Y. Lee and Sabharwal 2016), it is difficult to ignore the need to investigate factors that drive job satisfaction in this sector. Even though the literature is littered with scanty studies from the public sector on predictors of job satisfaction, only a handful have drawn evidence from the agricultural sector with allegedly

unique working conditions (Maican et al., 2021). The Green Report on Agriculture and the Food Industry (2018), as adduced in a recent study, 30.7% of the world's employed work in the agricultural sector, and there is still a dearth of evidence as regards predictors of job satisfaction in this sector (Jankelová et al., 2020). Particularly in developing nations where agriculture is essential to economic progress.

For economic viability and long-term sustainability of the agricultural sector, especially in developing countries, retaining skilled agricultural employees are indispensable (Mulinge and Mueller, 1998) and placing greater emphasis on the environmental and social – rather than the financial – aspects was recently recommended (Bayona et al., 2020). Furthermore, as observed in many developing economies, the public sector is instrumental in delivering agricultural extension services and the sector is often criticised for its ineffectiveness generally due to extension workers' low morale (Anang and Ayambila, 2020a; Anderson and Feder, 2004; Baloch and Thapa, 2019; Bruce and Costa, 2019; Sylla et al., 2019) amongst other challenges. Hence, the questions that come to mind begging to be considered are; what are the perceived importance of core competencies among extension workers and what are the contributing factors to the growing observation of low staff morale within the agricultural extension public sector domain, or what are the predictors of job satisfaction?

As highlighted in recent studies, various aspects have been investigated concerning job satisfaction, such as; gender, salary, age, work environment, relations with managers, job matching, income comparison and unemployment (Bayona et al., 2020; Hansen and Stræte, 2020; Ladele et al., 2017; Meyerding and Lehberger, 2018; Muri et al., 2020; Windon, 2019; Witt et al., 2020), motivation (Maican et al., 2021), personality and work status (Jankelová et al., 2020). Other studies have examined the direct consequence of certain extrinsic motivations, such as employee safety perception on health, but only a handful have established a relationship between this type of extrinsic reward and job satisfaction. These few studies drew empirical evidence from specific professionals like truck drivers (Huang et al., 2016), implications for healthcare workers (Witt et al., 2020), railroad workers, workers with disabilities, and those offering customer service (Lee and Park, 2021) whilst neglecting the agricultural sector. Hence, in addressing these concerns and drawing empirical evidence from the public sector, agricultural extension, and workers in Oyo State, Nigeria, we contribute to the growing behavioural economics literature by examining extrinsic rewards as

job satisfaction predictors. Social exchange theory (Blau, 1964) was used to establish organizational, social and convenience extrinsic rewards as predictors of job satisfaction.

4.2 Literature review

One of the earliest definitions of job satisfaction can be traced to Hoppock (1935), limning the emotional and physical state of employee satisfaction with environmental factors – as cited by (Wen et al., 2019). Further described by Hoppock as an internal feeling of satisfaction arising from a blend of psychological, physiological, and environmental factors (Witt et al., 2020). In later years, Locke (1969) described it as an extent of likeness an employee expresses towards his/her job (Mulinge and Mueller, 1998) or a self-assessment of various facets of their work as cited by (Gazioglu and Tansel, 2006; Meyerding and Lehberger, 2018). In 1997, Spector's job satisfaction survey listed 9 dimensions that influence job satisfaction; salary, promotions, superiors, extra benefits, reward incentives, operating environment, colleagues, work itself, and communication (Sahito and Vaisanen, 2017; Wen et al., 2019). These were later expanded based on extensive literature to include; appreciation, communication, co-workers, fringe benefits, job conditions, nature of the work itself, the nature of the organization itself, an organization's policies and procedures, personal growth, recognition and security as adduced by (Hansen and Stræte, 2020).

More recent studies affirm job satisfaction as a multifaceted concept (Yang et al., 2019) viewed as a function of perception (Hidayat et al., 2019) and often influenced by additional factors such as social interactions, as cited by (Wen et al., 2019). Such interactions can span outside work colleagues to other persons, as established in a recent study about external factors influencing physicians' turnover intention, where the doctor-patient relationship among other environmental variables was examined as suggested by (Abd-Ellatif et al., 2021). In recent years based on grounded theory, a common classification of job satisfaction predictors has been intrinsic and extrinsic rewards (Muri et al., 2020). As suggested by Ryan and Deci (2000), either intrinsic or extrinsic rewards may influence work performance, especially in agriculture-related jobs (Muri et al., 2020).

This study examines three forms of extrinsic rewards: organizational, social and convenience extrinsic rewards as depicted in the conceptual framework.

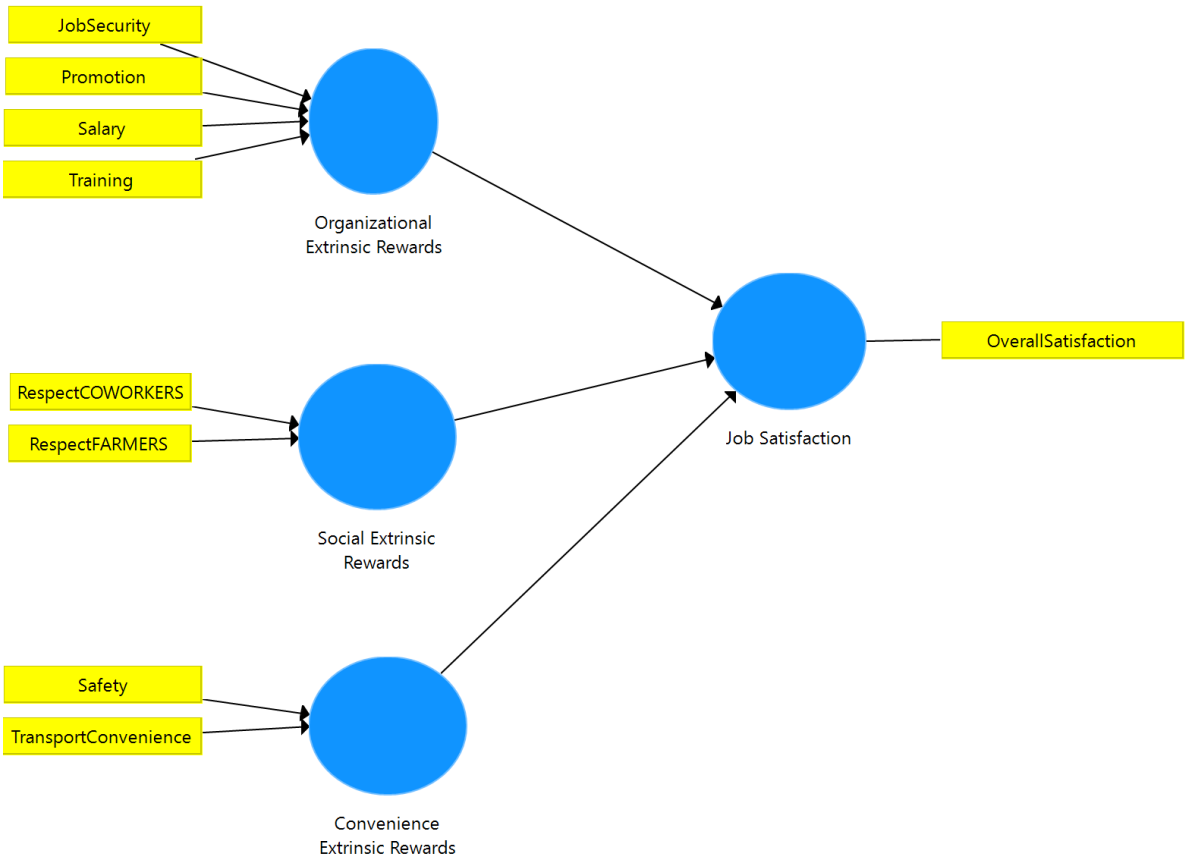


Figure 5: Conceptual framework for case study 2

4.2.1 Agricultural extension in Nigeria

Agriculture, forestry and fishing make up 24% of Nigeria's total Gross Domestic Product (World Bank, 2022b), with over 70% of the population engaged in subsistence agriculture (FAO, 2022). In 2004, international development agencies invested 10 billion dollars in public extension projects (Anderson and Feder, 2004), and it was reported that the World Bank had financed extension work in Nigeria by 150 million dollars for 3 years starting from 2007 (Ladele et al., 2017). It can be inferred that the justification for these investments was made based on the inherent potential of extension services to drive productivity in the agricultural sector. Especially in developing economies, a resident abode for almost 1 million extension workers (Anderson and Feder, 2004) and where extension services are predominantly provided by the public sector, as in Nigeria. The Nigerian 3 – federal, state and local – tiers of government are the main actors in delivering public extension services to predominantly small-holder farmers through the established state Agricultural Development Programmes (ADPs) (Hamisu et al., 2017; Olorunfemi et al., 2020). Numerous extension programs have been implemented in Nigeria since the 1950s to disseminate agricultural

information and technologies to farmers, thereby enhancing their productivity. The inception of recognizable agricultural extension practice in Nigeria dates back to 1954, marked by the establishment of three regional ministries of agriculture in the east, north, and west (Madukwe, 2008). In Nigeria, extension services have traditionally been provided and financed by the government. The Federal, State, and Local governments each have distinctive roles in the delivery and funding of agricultural extension services. The Federal Ministry of Agriculture and Natural Resources in Nigeria is responsible for providing policy direction and coordination. This is accomplished through the National Food Reserve Agency (NFRA), which was formerly known as the Federal Agricultural Coordinating Unit (FACU). The Federal Agricultural Coordinating Unit (FACU) was established together with the state Agricultural Development Programmes (ADPs) and the World Bank support in the early 1980s (Hamisu et al., 2017). The ADPs are state institutions mandated to provide extension services to improve rural living conditions and increase agricultural production. They serve as the extension arm of the State Ministry of Agriculture and Rural Development.

Several extension approaches are being employed in Nigeria, including the Training and Visit (T&V) extension, university-operated extension, ministry of agriculture-operated extension, commodity and sectoral agency extension, Special Program for Food Security (SPFS), Sasakawa Global 2000 (SG 2000), Community Based Agricultural and Rural Development Approach (CBARDA), and the farmers' field school (Hamisu et al., 2017). The latest extension service approach under incubation is the participatory approach to providing extension services to farmers. However, the Training and Visit (T&V) remains the most prevalent public extension delivery strategy, with the Research-Extension-Farmers-Inputs-Linkage-System (REFILS) serving as the management mechanism for linking agricultural research, extension, and farmers. However, it is worth noting that most commonly used communication tools by extension workers on the field are still in printed formats such as posters, pamphlets, flyers and booklets.

Albeit the public sector agricultural extension's promised potential in developing countries like Nigeria, most small-holder farmers rarely access extension services (Anang and Ayambila, 2020b; Bruce and Costa, 2019) or participate in extension programmes (Omotesho et al., 2016) due to the public extension system's ineffectiveness (Ladele et al., 2017; Sylla et al., 2019) that is ladened with certain challenges such as; low budgetary constraint (Bruce and

Costa, 2019; Sylla et al., 2019), poor transportation infrastructure (Baloch and Thapa, 2019) and observed low morale of extension workers (Anang and Ayambila, 2020a; Anderson and Feder, 2004; Baloch and Thapa, 2019; Bruce and Costa, 2019; Sylla et al., 2019). The observed poor job motivation among extension staff is probably strongly connected to the extension work environment on the field with recent conflict and civil unrest spikes in Sub-Saharan Africa.

For over 2 decades, scholars have documented the increased number of violent conflicts in African countries as listed in a recent report by the United Nations Office for West Africa and the Sahel: civil wars in Libya, Central African Republic and Somalia; terrorist attacks and farmer-herder conflicts in Nigeria (UNOWAS, 2018). A more recent study affirms the rise of the menace of terrorist attacks, transhumance-related violence and pastoralist-farmer conflicts in Nigeria (George et al., 2022). Many incidents of brutal fights between farmers cultivating crops and herdsmen have led to the loss of lives, crops and properties in different Sub-Saharan African countries such as Nigeria, Ghana and Namibia, to name a few (Ikhuoso et al., 2020). The negative effect of these incidents, especially the farmer-herder conflicts, has been felt in rural agriculture (UNOWAS, 2018) and probably on the safety of most extension workers disseminating information within the affected communities. Despite these hard realities, to the best of our knowledge, no empirical study has been conducted to investigate how extension workers' (outpost) safety impacts their job satisfaction which invariably influences how extension services are delivered in developing economies.

4.2.2 Extension workers perceived core competencies

To describe the perceived importance of core competencies among extension workers, 17 competency items were used in this case study, as adapted from a study conducted in South Africa (Oladele, 2015), were used to measure the level of perceived importance on a three-point scale designated as 1 = low importance, 2 = moderate importance, and 3 = high importance. This is an adapted first step of a modified Borich Needs Assessment Model used in a recent study (Umar et al., 2017). Borich, 1980, as cited by Umar et al.,2017, advocated for "a self-evaluative" method that depends on respondents' assessments of the 'relevance' of specific 'knowledge' domains; a major premise of this methodology is that the respondent can 'best' provide an objective evaluation of their proficiency upon request. The 17 competency statements are:

1. Evaluating the extension program based on farmers needs
2. Applying technical knowledge in the area of disseminating modern agricultural technologies
3. Coordinating work schedules with other colleagues
4. Involving farmers in program planning
5. Preparing visual aids to help deliver information
6. Presenting power point presentations or flip charts or seminar talks to convey extension messages effectively
7. Initiating ways to encourage farmers to adopt new technologies or innovations
8. Applying your understanding about block, people and culture
9. Dealing effectively with field-related challenges
10. Situational analysis of extension programs
11. Designing farmers' training
12. Persuading farmers to adopt modern agricultural technologies
13. Ability to foresee future extension prospects and challenges
14. Introducing new methods in extension work
15. Sensitive to the feelings and wishes of farmers
16. Confidence to work without guidance and support
17. Manage time effectively

4.2.3 Job satisfaction predictors

Intrinsic rewards – often associated with the internal feeling of accomplishment – are directly obtained by getting the job done (Mulinge and Mueller, 1998). These types of rewards have been acknowledged to motivate workers in the public and non-profit sectors (Lee and Sabharwal, 2016).

On the other hand, extrinsic rewards are possible job performance drivers, and unlike intrinsic rewards, are not obtained directly as a result of the work but are unintended benefits of the work (Mulinge and Mueller, 1998; Muri et al., 2020).

4.2.4 Organizational, social and convenience extrinsic rewards

Organizational extrinsic rewards motivate workers to carry out their duties (Mulinge and Mueller, 1998) – and probably promote staff retention. Some organizational extrinsic rewards documented in the literature are pay, fringe benefits, promotion, job security, and

good working conditions. The following organizational extrinsic rewards are examined; salary, promotion, job security and work-related training.

Empirical evidence from some countries in Sub-Saharan Africa, such as Nigeria, established the relationship between regular allowance payment (Ibrahim et al., 2008), salary and welfare package (Okwoche and Agabi, 2015) of extension workers with their job satisfaction. In Ghana, salary and fringe benefits were reported as major factors that affected the job satisfaction of agricultural workers (Asiedu-Darko and Amanor, 2016). Another study established poor remuneration as one of the leading causes of job discontent among extension workers in Southwest Ethiopia (Kassa, 2016). Africa Extension Reform Group (AERG) recent explorative survey of 393 extension staff in Ghana, Botswana, Tanzania, Cameroon, Senegal, Malawi, South Africa, Uganda, and Nigeria, revealed that low salaries and a lack of job-related incentives hampered job satisfaction (Ladele et al., 2017). More shreds of evidence from different cultural contexts, such as the recent survey of 149 Ohio State University extension program assistants, reported being less satisfied with their pay (Windon, 2019) and Morgan in 2014, as cited by (Witt et al., 2020) showed that job satisfaction was influenced by attractive salary. Another recent survey of 757 employees in agricultural companies in Slovakia reported that financial motivators (salary and benefits) were an important driver of job satisfaction, which in turn impacts business performance (Jankelová et al., 2020). This lends credence to past studies documented and recent findings that have shown that for-profit sector employees are strongly driven by salary (Lee and Sabharwal, 2016).

Promotion at work has been established to have a significant association with job satisfaction (Ibrahim et al., 2008; Kassa, 2016; Okwoche and Agabi, 2015; Windon, 2019). In addition, (Asiedu-Darko and Amanor, 2016) found recognition and reward to have a major effect on workers' satisfaction.

(Vila and García-Mora, 2005) inferred from the result of a survey of public sector employees, who reported being satisfied with most aspects of their job, that there are relatively low levels of uncertainty associated with public sector jobs. Another survey of 2427 cooperative extension workers revealed a statistically significant effect of job stability or security on the satisfaction of extension workers (Aguilar and Vlosky, 2010). The aforementioned studies conducted in Africa further provide evidence to the claims of the significant effect of job security on agricultural workers' satisfaction (Asiedu-Darko and Amanor, 2016; Okwoche and

Agabi, 2015). Ahemed et. al. 2017, as adduced in a recent study by (Lee and Park, 2021), further affirms the influence of job security on work performance – and invariably, the workers' satisfaction.

Empirical studies reveal that employees who received on-the-job training were more satisfied compared to their colleagues who didn't (Gazioglu and Tansel, 2006; Ibrahim et al., 2008; Okwoche and Agabi, 2015). Berman et al. 2012 as referenced in a study across the public, non-profit, and for-profit sectors, highlighted that training content and its effects are nuanced by the cross-sectoral setting of the employee (Lee and Sabharwal, 2016). In line with the aforementioned recent survey across 9 countries in Sub-Saharan Africa, extension workers' job satisfaction was reduced as the respondents lacked short-term training possibilities (Ladele et al., 2017). This affirms the impact of workers training on productivity through increased skill and work satisfaction. (Maican et al., 2021).

Research Question 1 (R1): Does a higher perception of organizational extrinsic rewards relate to higher job satisfaction?

These are social interaction derivatives. Kalleberg, 1977 as quoted by (Mulinge and Mueller, 1998), describes these as working conditions that meet employee social needs and are often associated with interpersonal interactions at work. Two social extrinsic rewards are examined in this study: respect from co-workers and farmers.

Extension studies literature is littered with streaks of empirical evidence for the effect of co-workers' interpersonal relationships on job satisfaction (Asiedu-Darko and Amanor, 2016; Kassa, 2016; Windon, 2019). A recent survey of public administration workers revealed relational gratitude as a determinant of job satisfaction (Cortini et al., 2019). While farmers from different cultural contexts expressed that working with colleagues and having good relationships with co-workers increases job satisfaction (Hansen and Stræte, 2020; Witt et al., 2020). Other studies highlighted that colleagues relationships affect job satisfaction while working on a farm (Maican et al., 2021) and "social environment" such as attitude – or respect – of the worker's immediate superior influences workers' motivation for non-farming jobs (Lee and Park, 2021)

Only a handful of empirical evidence on how social interaction with farmers affects extension workers' job satisfaction has been documented. As observed in National

Agricultural Technology Project (NATP) in India, a farmer-led participatory public extension system, there was a significant increase in extension workers' motivation and job performance due to the positive feedback received from farmer groups (Swanson and Rajalahti, 2010). Also, from a qualitative survey of public administration workers, the authors inferred a healthy work environment due to gratitude received from customers (Cortini et al., 2019) or clients – who are likened to farmers, in extension.

Research Question 2 (R2): Does a higher perception of social extrinsic rewards relate to higher job satisfaction?

These are often not of direct interest to workers but are critical in facilitating work processes and effective performance on the job. Convenience extrinsic rewards or costs were referred to as organizational constraints that impede employee performance by Kalleberg 1977, as cited in a study on employee satisfaction in Kenya, which includes convenient travel to and from work, pleasant surroundings and freedom from conflicting job demands (Mulinge and Mueller, 1998). This study examined 2 convenience extrinsic costs: outpost safety of public extension workers while working in the field in rural areas and convenient transportation.

It is hard to ignore the growing evidence of how a safe work environment influence job satisfaction. A case was established for individual safety climate perceptions as direct determinants of employee job satisfaction by Clarke in 2010, as adduced by (Huang et al., 2016) and a safe and secure – physical security– workplace guarantees employee retention (Meyerding and Lehberger, 2018). Safe working conditions were cited as influencing job satisfaction (Jankelová et al., 2020), and a survey of farmers using automatic milking systems showed that farmers were more satisfied with their occupational safety (Hansen and Stræte, 2020). A more contemporary study showed a negative relationship between fear of COVID-19 within the work environment and the job satisfaction of Egyptian physicians (Abd-Ellatif et al., 2021).

Some of the aforementioned studies highlighted the limited availability of the right resources for extension personnel to work with (Asiedu-Darko and Amanor, 2016; Ladele et al., 2017). Specifically, as regards convenient transportation, most NATP extension workers were not satisfied with the lack of adequate transportation to commute to farmer groups in

rural areas (Swanson and Rajalahti, 2010). A similar observation was noted among extension workers in Ethiopia (Kassa, 2016).

Research Question 3 (R3): Does a higher perception of convenience extrinsic rewards relate to higher job satisfaction?

It's been observed that, when considered as an exchange, the employment relationship may be defined as a series of social and/or economic transactions as adduced by (Gould-Williams and Davies, 2005). In this light, this study responds to the call for more empirical studies from developing countries on the application of social exchange theory in predicting factors affecting job satisfaction (Mulinge and Mueller, 1998) and examined employee perceptions of extrinsic rewards such as safety to employee outcomes beyond conventional studies (Huang et al., 2016). Hence, it contributes to the job satisfaction literature, as social exchange theory was used to establish organizational, social and convenience extrinsic rewards as predictors of job satisfaction.

For the evaluation of unbiased effects of the aforementioned extrinsic factors and appropriate model design, some socio-cultural control variables were also examined in this study, such as gender, age, educational level and if the public sector extension workers live in the same region as their job posting and speak the same language with the farmers. While other studies report no gender differences in job satisfaction (Aguilar and Vlosky, 2010; Meyerding and Lehberger, 2018), others showed women as more satisfied with their jobs when compared to men (Gazioglu and Tansel, 2006). Recent evidence has established the relationship between employees' age and satisfaction with farm and other agricultural-related work (Jankelová et al., 2020; Maican et al., 2021; Witt et al., 2020). As regards the effect of educational level on job satisfaction, some studies showed a positive significant effect (Ibrahim et al., 2008; Ladele et al., 2017; Vila and García-Mora, 2005), while a comparative study of the public, non-profit and for-profit sectors reported an increased education–job match increases job satisfaction in all sectors (Lee and Sabharwal, 2016). A survey of dairy farmers showed that education had a counter-negative effect on their job satisfaction (Hansen and Stræte, 2020), and a study that focused on female farmers revealed that education had no significant association with job satisfaction (Witt et al., 2020). (Kristensen and Johansson, 2008) opined the plausible effect of cultural differences on job satisfaction and (Kassa, 2016)

restated that challenges associated with the residency of extension workers might also be a contributing factor.

4.3 Methodology

4.3.1 Study area

The explorative study was carried out in Oyo State, as it nestles most of the public sector agricultural extension institutions in the country (Olorunfemi et al., 2020). The state is located in the western part of the country, with Kwara state, Ogun state, Osun state and the Republic of Benin bordering the north, south, east, and west, respectively. Oyo state houses a population of well over 5 million people that are actively involved in agriculture, a major driver of the economy, cultivating crops such as yams, maize, cassava, beans, millet, plantains, tobacco, cacao, palm oil and palm kernels, cotton, kola nuts, indigo and fruits (Britannica, 2013). The variety of the crops produced may be linked to the four predominant agroecological zones, namely, tropical rainforest, rainforest, savanna and guinea savanna.

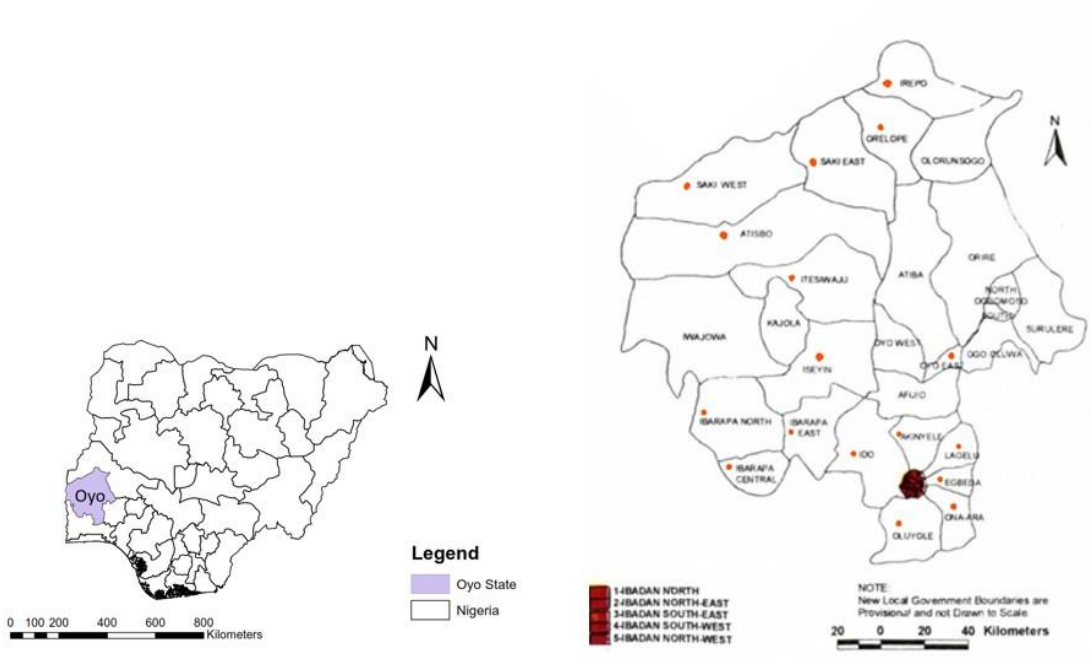


Figure 6: Map of Nigeria Showing Oyo State and the Selected LGAs

4.3.2 Data collection

A multi-stage sampling technique was employed to select respondents – public sector agricultural extension workers. Oyo State Agricultural Development Programme (OYSADEP), under the leadership of the Oyo State Ministry of Agriculture and Rural Development, divided the state into 4 Agricultural Development Programme (ADP) zones, namely Ibadan or Ibarapa,

Oyo, Ogbomoso and Saki zones, in line with the four dominant agroecological zones (Agboola et al., 2015). These ADP zones are further organized into 33 Local Government Areas (LGAs) consisting of 28 extension blocks and 224 farming household circles.

The first stage involved the random selection of three ADP zones - Ibadan, Oyo and Saki – out of the total four zones.

In the second stage, a random selection of 3 (Akinyele, Ido and Oluyole) out of 14 LGAs in the Ibadan zone was drawn, 4 (Afijo, Oyo West, Oyo East and Atiba) out of 4 LGAs in the Oyo zone was selected, and 9 (Atisbo, Irepo, Saki West, Saki East, Iwajowa, Kajola, Olorunsogo, Iseyin and Itesiwaju) out of 9 LGAs in Saki zone was selected. In brief, 16 LGAs were sampled out of 33 LGAs in the state.

The third stage involved a random sampling (Table 6) of 6 (Cocoa Research Institute of Nigeria, the National Institute of Social and Economic Research, the Institute of Agricultural Research and Training, the Forestry Research Institute of Nigeria, the National Horticultural Research Institute and the Oyo State Agricultural Development Programme) out of 9 agricultural institutes offering extension services to farmers and the purposive selection of 5 (Agricultural Economics, Agricultural Extension, Agronomy, Forestry and Animal Science) departments from 1 academic institution - University of Ibadan.

The last phase of the multi-stage sampling procedure involved a random selection of 170 agricultural extension workers. Primary data was obtained from the 170 surveyed extension workers with the aid of structured and pre-tested questionnaires. Unlike the study conducted by (Mulinge and Mueller, 1998), with respondents having formal training in agriculture and related fields, this study specifically draws evidence from trained public sector professionals only delivering extension services to farmers. Furthermore, in line with a recent review, the extension domain is linked to aspects of the social sciences (Cook et al., 2021), an area of science wherein the institutes and departments selected for this study can be classified. Questionnaires in the English language were structured into 4 sections; socio-cultural characteristics (23 questions), perceived level of importance with professional tasks (17 questions) and perceived level of satisfaction (13 questions).

Additional qualitative data was collected to gain better insight into job satisfaction predictors for public extension workers in the study area. A semi-structured, unstructured in-

depth interview and focus group were used. The focus group discussion lasted about forty-five minutes, while the interviews spanned twenty-five to thirty-five minutes, depending on the respondent's willingness to give more time. The qualitative data collection responses were: 6 semi-structured interviews with public extension workers from the 6 aforementioned research institutes, 10 unstructured interviews with respondents from the University of Ibadan, and 1 focus group discussion with 20 OYSADEP extension workers covering the Ibadan zone were conducted.

Table 6: Number of agricultural Extension Workers Surveyed Per LGA Per ADP Zone

ADP ZONES	LGAs	INSTITUTIONS	RESPONDENTS
Ibadan/Ibarapa	Akinyele	Agricultural Economics Department, University of Ibadan	10
		Agricultural Extension Department, University of Ibadan	10
		Agronomy Department, University of Ibadan	10
		Forestry Department, University of Ibadan	10
		Animal Science Department, University of Ibadan	10
		National Institute of Social and Economic Research	10
			32
Saki	Atisbo		4
	Irepo		2
	Saki West		4
	Saki East		8
	Iwajowa		1
	Kajola		1
	Olorunsogo	Oyo State Agricultural Development Propramme	2
Oyo	Afijo		2
	Oyo West		1
	Oyo East		3
	Iseyin		1
	Itesiwaju		2
	Atiba		2
Ibadan/Ibarapa	Oluyole		1
	Ido	Cocoa Research Institute of Nigeria	10
		Forestry Research Institute of Nigeria	10
		Institute of Agricultural Research and Training	14
		National Horticultural Research Institute	10
3	16	7	170

The 6 face-to-face semi-structured interviews and 10 face-to-face unstructured interviews were conducted to understand the prevalent civil unrest situation in the study area. Each public extension worker was asked to narrate his/her subjective perspective of the conflict situation along the following categories, namely; terrorist attacks, transhumance-

related violence and pastoralist-farmer conflicts and to identify which ADP zones and corresponding LGAs were relatively safe based on these categories. This was done to triangulate empirical findings in the literature to current violent conflicts in the region and to guide the main researcher and data enumerators on how to reach other public extension workers for a further quantitative and qualitative survey. Having described the current violent conflicts, the relatively safe ADP zones and corresponding LGAs in the region as the main outcome of the semi-structured and unstructured interviews, the quantitative survey (structured into 4 sections; socio-cultural characteristics, perceived level of importance with professional tasks and perceived level of satisfaction) was carried out. During the focus group discussion, insights were recorded in the form of notes sequel to a series of guided questions to gather insights on some modalities of operation of extension workers in the study area – which have been aptly described in the discussion section. The descriptive coding approach was used to identify statements related to extension workers' perceptions of organizational, social and convenience extrinsic rewards. Selected statements were used to corroborate findings revealed from the quantitative data analysis – which are also presented in the discussion section of the study.

4.3.3 Data analysis

Triangulation of 3 – binary logit regression, ordered logit regression and Partial Least Squares Structural Equation Model (PLS SEM) – data analytical methods were applied in this study. This was done to ensure that possible different measures of the job satisfaction scale were considered during the analysis. As the binary logit regression analyzed the dichotomous measure of job satisfaction, the ordered logit regression analyzed job satisfaction in four categories since an ordinal or interval measure of job satisfaction permits the identification of factors that influence a lower level of satisfaction to a higher one (Abrudan et al., 2020). Furthermore, the PLS SEM was used to investigate the 3 manifest indicators "organizational, social and convenience extrinsic rewards" predicting job satisfaction construct as adduced by (Mulinge and Mueller, 1998). Also, the PLS SEM allowed combining empirical data available for all measured observable indicators (Salary, promotion, job security, work-related training, respect from co-workers and farmers, safety on the field and transportation convenience of public extension workers) into respective single scores of the 3 manifest indicators as shown in Figure 5.

Table 7 : Summarized statistics of dependent and independent variables used for Logit regression analysis, N=170.

Variable	Question	Scale and measurement	% of respondents
Dependent variable			
Extension workers job satisfaction	How satisfied are you overall working as an extension or rural advisory worker in the past 2 – 3 years?	Multiple response; 0 - strongly dissatisfied 1 - dissatisfied 2 - satisfied 3 - strongly satisfied	 03.60 29.40 58.80 08.20
Independent variables			
Gender	Gender of extension or rural advisory worker?	Binary response; 0 - female 1 - male	 35.30 64.70
Age	Age of extension or rural advisory worker?	Continuous scale; years	100.00
Formal education	Total number of years spent in formal education?	Continuous scale; schooling years	100.00
Same language	Do you speak the same language as the farmers you are in contact with?	Binary response; 0 - no 1 - yes	 08.80 91.20
Same region	Do you reside in the same region/LGA/district/village of your extension work placement?	Binary response; 0 - no 1 - yes	 41.80 58.20
Work-related trainings received	Do you receive training on the job?	Binary response; 0 - no 1 - yes	 04.70 95.30
Salary	Your salary exceeds your expectations considering invested time?	Multiple response; 0 - strongly disagree 1 - disagree 2 - uncertain 3 - agree 4 - strongly agree	 29.40 48.80 10.60 08.80 02.40
Promotion	Promotion at your work place is commensurate to your experience?	Multiple response; 0 - strongly disagree 1 - disagree 2 - uncertain 3 - agree 4 - strongly agree	 13.60 39.40 07.60 30.60 08.80
Transportation convenience	The means of transportation provided is convenient?	Multiple response; 0 - strongly disagree 1 - disagree 2 - uncertain 3 - agree 4 - strongly agree	 18.80 44.10 08.20 26.50 02.40
Job security	You feel a high sense of job security at your work place?	Multiple response; 0 - strongly dissatisfied 1 - dissatisfied 2 - uncertain 3 - satisfied 4 - strongly satisfied	 08.30 12.90 14.70 56.50 07.60
Respect from coworkers	You feel …….with the respect received from co-workers?	Multiple response; 0 - strongly dissatisfied 1 - dissatisfied 2 - uncertain 3 - satisfied 4 - strongly satisfied	 01.00 04.00 14.00 72.00 09.00

Respect from farmers	You feel ……..with the respect received from farmers?	Multiple response;	
		0 - strongly dissatisfied	01.00
		1 - dissatisfied	02.00
		2 - uncertain	11.00
		3 - satisfied	67.00
		4 - strongly satisfied	19.00
Safety on field	You feel…… with the level of safety when carrying out your work responsibilities?	Multiple response;	
		0 - strongly dissatisfied	14.80
		1 - dissatisfied	28.20
		2 - uncertain	19.40
		3 - satisfied	34.10
		4 - strongly satisfied	03.50

In line with previously cited studies and research questions, the selected variables were examined – as described in Table 7 – for the study. For the dependent variable, the perceived level of job satisfaction, a single-item scale was used in line with the recommendation regarding the reliability of overall measures (Scarpello and Campbell, 1983). The dependent variable was structured to capture levels of dis/satisfaction rated on a 5-point Likert scale (0: strongly dissatisfied, 5: strongly satisfied) as used in similar studies (Abd-Ellatif et al., 2021; Bayona et al., 2020; Cortini et al., 2019; Gazioglu and Tansel, 2006; Huang et al., 2016; Jankelová et al., 2020; Kassa, 2016; Mulinge and Mueller, 1998; Wen et al., 2019) contrary to the 4-point scale used by (Lee and Park, 2021) and 7-point scale used by (Yang et al., 2019). However, to allow for the triangulation of the 3 data analytical methods applied in this study, data for the dependent variable on a 5-point Likert scale (0: strongly dissatisfied, 5: strongly satisfied) was analyzed using the PLS SEM before the data was cleaned into 4 multiple responses then analyzed using ordered logit regression. Lastly, the data was cleaned into a dichotomous dependent variable that takes the value zero (0) if a respondent was strongly dissatisfied or dissatisfied and one (1) if strongly satisfied or satisfied for binary logit regression.

The 3 types of extrinsic rewards (independent variables) analyzed are organizational extrinsic rewards; Salary, promotion, job security and work-related training, social extrinsic rewards; respect from co-workers and farmers and convenience extrinsic rewards; safety on the field and transportation convenience of public extension workers. While the socio-cultural characteristics (control variables) considered are age, gender, level of education, same region and language.

The data collected were coded and summarized using Microsoft Excel (Microsoft 365 version) before being imported to STATA software version 12.0 (StataCorp. LP, College Station,

TX, USA) and Smart Partial Least Squares-structural equation modelling (Smart PLS SEM software version 3.0 Boenningstedt: SmartPLS3 GmbH) for data analysis. Descriptive statistics were used to describe the socio-cultural characteristics for the independent and dependent variables, while means and standard deviation were used to describe the perceived importance of core competencies among public sector extension workers.

The dependent variable was whether a public extension worker was generally satisfied with their job. Several studies have adopted a dichotomous measure of job satisfaction, a binary regression model (Caillier, 2012; Lee and Sabharwal, 2016; Van Ryzin, 2014; Witt et al., 2020). According to Sackett and Larson (1990), a single-item/binary measure of job satisfaction is adequate if the construct is clear and explicit (Sackett and Larson Jr., 1990). Ordinal/interval and single-item measures of job satisfaction have been found to have a high correlation in a meta-analysis (Wanous et al., 1997). It has been argued that combining several facets of job satisfaction into one index in multiple-item or scale measure might be misleading because all the items used for the scale might not be important to the respondents (Lee and Sabharwal, 2016; Nagy, 2002). However, a single measure of job satisfaction remains controversial in empirical literature due to reliability problems (Lee and Sabharwal, 2016). Ordinal/interval measure of job satisfaction permits the identification of factors that influence a lower level of satisfaction to a higher one (Abrudan et al., 2020).

The study, therefore, used binary logistic regression and ordered logistic regression models to capture both the dichotomous and ordinal/interval measures of job satisfaction. Thus, the dichotomous dependent variable takes the value zero (0) if a respondent was strongly dissatisfied or dissatisfied and one (1) if strongly satisfied or satisfied. We estimate the logistic regression model in the first step, followed by the ordered logistic regression. Findings from both models as well as from the SEM are presented in the results and discussion section of the paper.

The logistic regression model is specified as follows;

$$\frac{prob(y_i=1)}{prob(y_i=0)} = \frac{\rho_i}{1-\rho_i} = e^{(\gamma_0+\gamma_1 X_{1i}+\gamma_2 X_{2i}+\cdots+\gamma_k X_{ki})}$$

=

$$L_i = \ln\left(\frac{\rho_i}{1-\rho_i}\right) = \gamma_0 + \gamma_1 X_{1i} + \gamma_2 X_{2i} + \cdots + \gamma_k X_{ki}$$

Where ρ_i represents the probability of satisfaction, $(y_i = 1)$; $1 - \rho_i$ is the probability of dissatisfaction, $(y_i = 0)$; X_i respresent the explanatory variables; γ_0 is the intercept; γ_1, $\gamma_2, \ldots, \gamma_k$ are coefficients of the explanatory variables X.

For the purpose of this study, our empirical model is specified as:

$$L_i = \ln\left(\frac{\rho_i}{1-\rho_i}\right) = \alpha + \beta R_i + \lambda P_i + \delta T_i + \mu S_i + \vartheta Z_i + \theta M_i + \pi F_i + \Omega K i + \varepsilon_i, \quad i = 1, 2, 3, \ldots, N \quad \text{Eq. (2)}$$

Where L_i is the probability of job satisfaction, R_i denotes salary, P_i is promotion, T_i represents convenience of transportation for the extension worker, S_i denotes extension workers' perception about their job seecurity status, Z_i and M_i represent percieved respect from framers and percieved respect from extension workers' colleague, F_i denotes their percieved safety on the field and K_i represents a vector of socio-cultural characteristics of an extension worker. ε_i is the random error which assumes independence and standard logistic distribution.

On the other hand, the ordered logistic regression, based on a continous latent dependent variable (i.e., job satisfaction measured on a four-point Likert sacle) is modeled as follows:

$$y_i^* = \beta' X_i + \varepsilon_i \qquad -\infty < y_i^* < -\infty$$

Where y_i^* is the dependent variable (i.e., job satisfaction – strongly dissatisfied, dissatisfied, satisfied, and strongly satisfied), β_i is a vector of parameters, X_i is a vector of independent variables and ε_i is the logistically distributed random error term.

We cannot apply standard regression methods because job satisfaction (y_i^*) is a latent variable. Considering y_i as a descret and observable variable which shows different levels of job satisfaction, the relationship between the latent variable (y_i^*) and observable variable (y_i) can be modelled as follows:

$$\begin{aligned}
&y_i = 1 \quad \text{if} \quad -\infty \le y_i^* < \theta_1, \quad i = 1, \ldots, n,\\
&y_i = 2 \quad \text{if} \quad \theta_1 \le y_i^* < \theta_2, \quad i = 1, \ldots, n,\\
&y_i = 3 \quad \text{if} \quad \theta_2 \le y_i^* < \theta_3, \quad i = 1, \ldots, n,\\
&\ldots\ldots \quad \ldots \quad \ldots\ldots \quad \ldots\ldots\\
&y_i = j \quad \text{if} \quad \theta_{j-1} \le y_i^* < +\infty, \quad i = 1, \ldots, n,
\end{aligned}$$

Where n is the number of the sample size, θ and $'\infty'$ are the thresholds that define the discrete answers. The probability of $y_i = j$ can be estimated as follows:

$$\Pr(y_1 = j) = \Pr\left(y_1 \ge \theta_{j-1}\right) = \Pr(\varepsilon_1 \ge \theta_{n-1} - \beta X_1) = F(\beta X_1 - \theta_{j-1})$$

In cumulative probability terms, the ordered logit model calculates the probability of the $'i^{th'}$ unit (i.e., extension worker) to be at the $'j^{th'}$ level (i.e., job satisfaction) or less $(1, \ldots, j-1)$. Thus, the response categories in ordered logit are ordered. Therefore, the ordered logit model can be specified as:

$$log\left[\frac{\pi_j(X_i)}{1-\pi_j(X_i)}\right] = \theta_j - [\beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki}] \qquad j = 1, \ldots., m;\ \ i = 1, \ldots., n$$

But the cumulative probability (π_j) is espressed as follows:

$$\pi_j(X_i) = \pi_j\left(\theta_j - \beta' X_i\right) = P(y_i \leq j | X_i)$$

Where β is a column vector of the parameters $(\beta_1, \beta_2, \ldots., \beta_k)$ whilst X_i is a column vector of covariates. θ_j is dependent on the likelihood of predicting category which is not dependent on the covariates. The script part, $(\beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki})$, is the indenpent part of the category. Both θ_j and $(\beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki})$ ensures that the response categories are ordered and also show that the results are a series of parallel lines. We used the parrallel regression test to evaluate the equality of parrameters of all categories assumption. The parrallel regression test compares the estimated model with a series of coefficients for all the categories with a separate series of coefficients for each category (Mohammadi et al., 2015). The χ^2 statistic in parrallel regression test can be expressed as:

$$\chi^2 = -2LogLikelihood_{Cm} - (-2LogLikelihood_{Gm})$$

Where Cm and Gm are the current and the general model respectively. Our current model is said to be correctly estimated (i.e., we reject the null hypothesis) if the calculated X^2 is more than the tabulated X^2. We estimate the parameters of the model by the maximum likelihood method which maximizes the possibility of categorization.

Coefficients of the ordered logit do not have direct interpretation (Das and Rahman, 2011; Mohammadi et al., 2015). According to Mohammadi *et al.* (2015), changes in the probability of orderd logit are dependent on two factors, should the predicting variable increase. The first factor is the predicting value whereas the other factor is dependent on other variables; since changes in probability are not constant, coefficients are not directly interpreted. Marks are therefore used to change the probability in ordered logit for the extreme categories (first and last). We estimated the average marginal effects for each category for interpretation. The marginal effect of a unit change in X_k predictor on the probability of $'j^{th'}$ category can be espressed as:

$$\frac{\partial P(y_i=j|X_i)}{\partial X_k} = \left[\frac{\partial \pi(\theta_j - \beta' X_i)}{\partial X_k} - \frac{\partial \pi(\theta_{j-1} - \beta' X_i)}{\partial X_k}\right]$$

$$= \left[\lambda(\theta_{j-1} - \beta' X_i) - \lambda(\theta_j - \beta' X_i)\right]\beta_k$$

Where $\theta_j = +\infty,\ \theta_0 = -\infty,\ \lambda_j(X_i) = {\partial \pi_j(X_i)}/{\partial X_k}$

The marginal effect depends on the values of all explanatory variables, hence decision making on the use of variables' value in estimation is important. The total marginal effect for each variable is equal to zero since total probability is always equal to 1.

Furthermore, the PLS SEM was used to investigate the 3 manifest indicators "organizational, social and convenience extrinsic rewards" predicting job satisfaction construct. Also, the PLS SEM allowed combining empirical data measured in a multi-item scale (Hair et al., 2021) for all measured observable indicators (Salary, promotion, job security, work-related training, respect from co-workers and farmers, safety on the field and transportation convenience of public extension workers) into respective single scores of the 3 manifest indicators as shown in Figure 5. The Partial Least Squares Structural Equation Model (PLS SEM) construct reliability and validity, collinearity statistics (inner VIF values), outer loadings and path diagram are reported in the results section of the study.

4.4 Results

4.4.1 Description of the sample

Table 7 shows that more than half (67 percent) of the surveyed government-employed extension workers expressed overall higher levels of job satisfaction with their current employment in public service. The respondents further expressed their (dis)satisfaction with the measured organizational, social and convenience extrinsic rewards. A lower percentage of the respondents (11.2 percent) perceived their salary exceeded their expectations considering the invested time in public service. While 39.4 percent of the respondents perceived that promotion within the public sector is commensurate to their work experience. More than half (64.1 percent) of the public service workers perceived a high sense of job security, and almost all (95.3 percent) surveyed respondents have received training on the job. 81 percent expressed higher levels of satisfaction with the level of respect received from colleagues within public service. Due to the nature of public extension work that requires a considerate amount of travelling to the field, only a few respondents expressed higher levels of satisfaction

with the means of transportation provided (28.9 percent) and their perceived level of safety on the field (37.6 percent).

Table 8 describes the average competency scores of public sector extension workers. 17 competency items, as adapted from a study conducted in South Africa (Oladele, 2015), were used to measure the level of perceived importance on a three-point scale designated as 1 = low importance, 2 = moderate importance, and 3 = high importance. This is an adapted first step of a modified Borich Needs Assessment Model used in a recent study (Umar et al., 2017). Borich, 1980, as cited by Umar et al.,2017, advocated for "a self-evaluative" method that depends on respondents' assessments of the 'relevance' of specific 'knowledge' domains; a major premise of this methodology is that the respondent can 'best' provide an objective evaluation of their proficiency upon request. 'manage time effectively' is observed to be the most important skill by the respondents with a mean (M) rating of 2.629 and standard deviation (SD) of 0.531. The following competencies and tasks were also observed to be important: 'confidence to work without guidance and support' (M=2.582, SD=0.551), 'persuading farmers to adopt modern agricultural technologies' (M=2.559, SD=0.575), 'coordinating work schedules with other colleagues' (M=2.541, SD=0.545) and 'dealing effectively with field related challenges' (M=2.535, SD=0.545). These results are close to the aforementioned study by Oladele (2015) conducted in South Africa but were not highly important to extension workers in Malaysia, according to Umar et al. (2017).

Table 8: Perceived importance of core competencies among public sector extension workers

COMPETENCY STATEMENT	MEAN	STANDARD DEVIATION
Evaluating the extension program based on farmers needs	2.488	0.557
Applying technical knowledge in the area of disseminating modern agricultural technologies	2.500	0.547
Coordinating work schedules with other colleagues	**2.541**	0.545
Involving farmers in program planning	2.353	0.692
Preparing visual aids to help deliver information	2.249	0.722
Presenting power point presentations or flip charts or seminar talks to convey extension messages effectively	2.118	0.752
Initiating ways to encourage farmers to adopt new technologies or innovations	2.489	0.618
Applying your understanding about block, people and culture	2.412	0.602
Dealing effectively with field related challenges	**2.535**	0.545
Situational analysis of extension programs	2.394	0.618
Designing farmers' training	2.500	0.627

Persuading farmers to adopt modern agricultural technologies	**2.559**	0.575
Ability to foresee future extension prospects and challenges	2.476	0.598
Introducing new methods in extension work	2.465	0.593
Sensitive to the feelings and wishes of farmers	2.494	0.568
Confidence to work without guidance and support	**2.582**	0.551
Manage time effectively	**2.629**	0.531

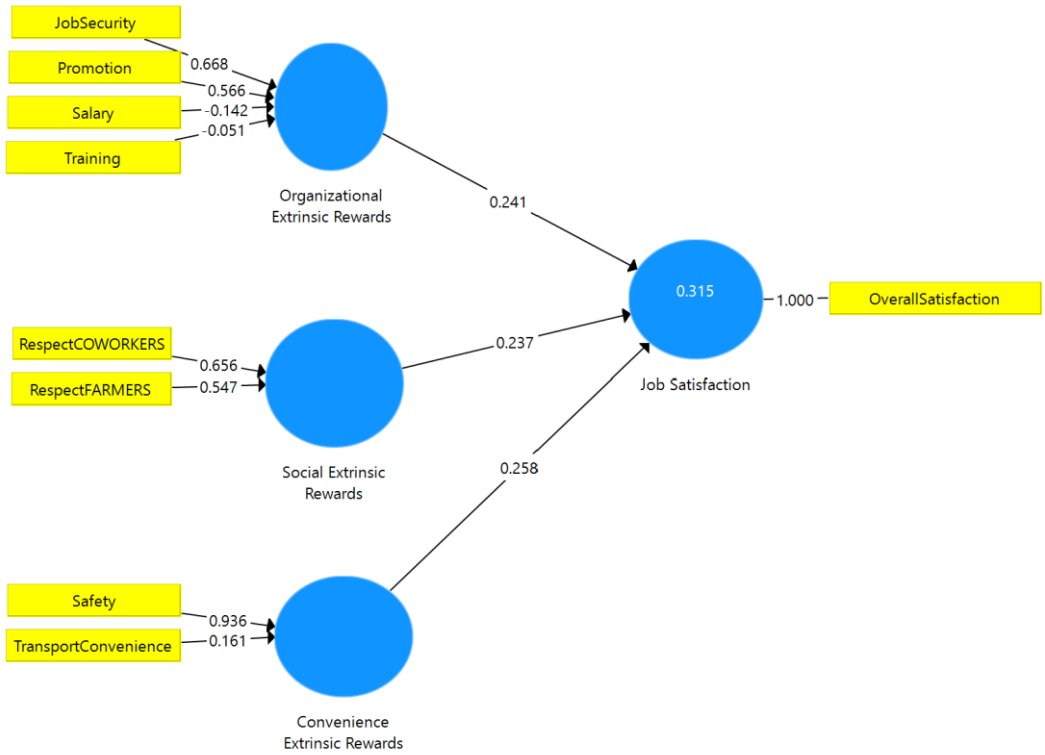


Figure 7: Partial Least Squares Structural Equation Model path diagram

Table 9: Binary Logit model for determinants of job satisfaction

Regressors	Coefficient	Std. Err.	P>z	Average Marginal Effect	Std. Err.	P>z
Gender (dummy)	-0.073	0.499	0.883	-0.010	0.066	0.883
Age (years)	0.049	0.027	0.068	0.006	0.003	0.060
Educational level	-0.106	0.222	0.632	-0.014	0.029	0.631
Same region (dummy)	0.761	0.503	0.130	0.101	0.065	0.123
Same language (dummy)	0.448	0.969	0.644	0.059	0.128	0.643
Work-related training (dummy)	-0.168	0.969	0.862	-0.022	0.128	0.862
Salary	-0.310	0.234	0.185	-0.041	0.030	0.177
promotion	0.520	0.213	0.014	**0.069**	0.026	0.009
Transportation convenience	0.259	0.229	0.258	0.034	0.030	0.254
Job security	0.475	0.217	0.029	**0.063**	0.027	0.020
Respect from coworkers	0.905	0.400	0.024	**0.120**	0.050	0.017
Respect from farmers	0.734	0.373	0.049	**0.097**	0.047	0.041
Safety on field	0.581	0.232	0.012	**0.077**	0.029	0.007

Constant	-13.109	3.275	0.000
Number of observation	170		
LR chi2(13)	75.590		
Prob > chi2	0.000		
Pseudo R2	0.351		
Log likelihood	-69.942		

4.4.2 Extrinsic rewards as job satisfaction predictor

Results from the triangulation of 3 – binary logit regression, ordered logit regression and Structural Equation Model – data analytical methods applied in this study are presented in this section. For the first analytical method, PLS SEM, the convergent validity test can be observed by examining the values of the loading factor value of all measured observable indicators (Salary, promotion, job security, work-related training, respect from co-workers and farmers, safety on the field and transportation convenience of public extension workers) into respective single scores of the 3 manifest indicators as shown in Figure 7. In line with the theoretical assumptions of PLS SEM (Hair et al., 2021), a factor weight of 0.5 or more is considered to have sufficiently strong validation to explain the 3 manifest indicators. As shown in Figure 7 the following met the convergent validity requirements: overall job satisfaction (1.000 > 0.500), organizational extrinsic rewards; promotion (0.566 > 0.500) and job security (0.668 > 0.500), social extrinsic rewards; respect from co-workers (0.656 > 0.500) and respect from farmers (0.547 > 0.500) and convenience extrinsic rewards; safety on the field (0.936 > 0.500). The value of Cronbach's alpha, composite reliability and Average Variance Extracted **(**AVE) for job satisfaction construct can be seen in Table 11. The job satisfaction construct satisfied the construct reliability test as seen examined from the Cronbach's alpha value and the composite reliability values are more than 0.7 (Hair et al., 2021). Table 12 shows the collinearity statistics (inner VIF values) to determine whether there is collinearity in the model. If the inner VIF value is higher than 5, there is a possibility of collinearity in the model (Hair et al., 2021). As shown in Table 12, the estimated values are less than 5, meaning that the model does not have a collinearity issue. Table 13 shows the outer loadings of extension workers' perceptions of promotion and job security (organizational extrinsic rewards), respect from co-workers and farmers (social extrinsic reward) and safety on the field (convenience extrinsic reward) as significant in the model since the values are more than 0.7. The Standardized Root Mean square Residual (SRMR) was evaluated by Smart PLS SEM software to be 0.07, which was recommended to be sufficient (Iacobucci, 2010).

While the second analytical method, binary logit regression model (Table 9), shows that extension workers' perceptions of promotion and job security (organizational extrinsic rewards), respect from co-workers and farmers (social extrinsic reward) and safety on the field (convenience extrinsic reward) were significant determinants of job satisfaction.

Lastly, the ordered logit regression analysis (Table 10) shows that extension workers' perceptions of promotion and job security (organizational extrinsic rewards), respect from co-workers (social extrinsic reward), safety on the field (convenience extrinsic reward) and their age (control variable) were significant in the model.

4.4.3 Organizational extrinsic rewards as job satisfaction predictor

Table 10 shows that the extension worker's higher promotion perception has a significantly positive association with a higher level of job satisfaction. This is consistent with other studies that showed promotion as having a significantly positive relationship with job satisfaction (Ibrahim et al., 2008; Kassa, 2016; Kristensen and Johansson, 2008; Mulinge and Mueller, 1998; Okwoche and Agabi, 2015; Wen et al., 2019; Windon, 2019). As seen from the satisfied and strongly satisfied categories (Table 10), a higher promotion perception increases the probability of a public sector extension worker reporting a higher level of job satisfaction. The key informants' interviews with the public sector workers at the 6 research institutes and at the university revealed that promotion was commensurate to staff experience on the job.

Likewise, the results show that a higher sense of job security increases the probability of a public sector extension worker reporting a higher level of job satisfaction which is similar to the findings from other studies that established a significantly positive relationship between Job security and job satisfaction (Aguilar and Vlosky, 2010; Gazioglu and Tansel, 2006; Mulinge and Mueller, 1998; Mussagulova et al., 2019; Okwoche and Agabi, 2015)**.** Also, some recent studies observed that respondents ranked job security as highly important when considering factors related to their job satisfaction (Lee and Park, 2021; Wen et al., 2019). Additionally, employees in the public sector feel more job security as time goes by compared to those in the for-profit sector (Lee and Sabharwal, 2016). A common view shared by most participants of the focus group discussion is that they deeply expressed their high sense of job security as employees in the public sector. This was captured in an extension agent's quote: '… one thing I'm happy about is the fact that I don't feel I will be laid off from work easier compared to my friends who work in private firms'. Contrary to the findings highlighted above, a study showed

that workers were more motivated when they felt less secure in their jobs (Gould-Williams and Davies, 2005).

The perception of public service workers as regards salary, considering their invested time at work, was not significant. This affirms findings from a cross-sectorial analysis where salary showed no significant effect on the job satisfaction of workers in the public sector (Lee and Sabharwal, 2016). Although, as seen from the satisfied and strongly satisfied categories (Table 10), the result reveals a negative relationship between salary and job satisfaction. This is consistent with findings from a study conducted in Southwest Ethiopia, where Kassa (2016) showed that salary had a significantly negative relationship with job satisfaction and was one of the primary causes of job discontent among (public) extension workers. Another study established a significant negative relationship between monetary related rewards and job satisfaction (Muri et al., 2020), while evidence from another developing context revealed a negative relationship between public service workers' job satisfaction and their salary (Mussagulova et al., 2019) and a negative association between employees' perception of fair salary on their intention to remain (Gould-Williams and Davies, 2005). On the contrary, salary has been established to have a significantly positive relationship with job satisfaction (Ibrahim et al., 2008; Okwoche and Agabi, 2015; Windon, 2019) and Oloruntoba and Ajayi, (2003) identified a decent level of remuneration as a key motivator influencing job satisfaction on large-scale farms in Nigeria (Maican et al., 2021). Another study showed a statistically significant positive effect of financial motivation – such as salary and other financial benefits – on employee job satisfaction (Jankelová et al., 2020).

As seen from the ordered logit regression model, work-related training was insignificant. Although, the focus group discussion with OYSADEP participants indicated that public sector extension workers in the study area received regular training on the job, especially during their mandatory fortnight meetings. This training often includes; communication practices to disseminate modern agricultural technologies and information to farmers, current collaborations with non-profit organizations such as the farmer's business school initiative and clarifying internal communication through the organizational structure from field extension officers through the Area Extension Coordinator to the top management.

Table 10: Ordered Logit models for determinants of job satisfaction

Regressors	Coefficient	Std. Err.	P>z	**Category 1†**			**Category 2†**			**Category 3†**			**Category 4†**		
				AME‡	Std. Err.	P>z	AME‡	Std. Err.	P>z	AME‡	Std. Err.	P>z	AME‡	Std. Err.	P>z
Organizational Extrinsic Rewards															
Salary	-0.146	0.192	0.445	0.002	0.003	0.467	0.026	0.035	0.447	-0.023	0.030	0.448	-0.005	0.007	0.454
Promotion	0.306	0.170	**0.073**	-0.004	0.003	0.156	**-0.055**	0.031	0.074	**0.048**	0.027	0.082	**0.011**	0.007	0.095
Job security	0.451	0.177	**0.011**	**-0.006**	0.003	0.082	**-0.081**	0.033	0.013	**0.070**	0.029	0.016	**0.017**	0.008	0.034
Work-related training (dummy)	-0.203	0.774	0.793	0.003	0.010	0.794	0.037	0.139	0.793	-0.032	0.120	0.793	-0.007	0.029	0.793
Social Extrinsic Rewards															
Respect from coworkers	0.852	0.289	**0.003**	**-0.011**	0.006	0.057	**-0.153**	0.054	0.004	**0.133**	0.049	0.006	**0.031**	0.013	0.017
Respect from farmers	0.067	0.310	0.828	-0.001	0.004	0.829	-0.012	0.056	0.828	0.010	0.048	0.829	0.002	0.011	0.829
Convenience Extrinsic Rewards															
Safety on field	0.667	0.192	**0.001**	**-0.008**	0.004	0.046	**-0.120**	0.035	0.001	**0.104**	0.032	0.001	**0.025**	0.009	0.008
Transportation convenience	0.028	0.168	0.867	0.000	0.002	0.868	-0.005	0.030	0.867	0.004	0.026	0.867	0.001	0.006	0.867
Socio-cultural Characteristics (Control Variables)															
Gender (dummy)	-0.257	0.372	0.490	0.003	0.004	0.490	0.045	0.065	0.481	-0.039	0.054	0.474	-0.010	0.015	0.513
Age (years)	0.034	0.021	**0.100**	0.000	0.000	0.177	**-0.006**	0.004	0.101	**0.005**	0.003	0.102	**0.001**	0.001	0.100
Educational level	-0.180	0.168	0.281	0.002	0.002	0.330	0.033	0.030	0.280	-0.028	0.026	0.285	-0.007	0.006	0.295
Same region (dummy)	0.465	0.366	0.204	-0.006	0.005	0.262	-0.084	0.066	0.206	0.072	0.058	0.213	0.017	0.014	0.217
Same language (dummy)	0.268	0.666	0.687	-0.003	0.009	0.694	-0.048	0.120	0.686	0.042	0.104	0.687	0.010	0.024	0.686
/cut1	4.602	2.118													
/cut2	7.917	2.162													
/cut3	12.184	2.318													
Number of observation	170														
LR chi2(13)	70.370														
Prob > chi2	0.000														
Pseudo R2	0.208														
Log likelihood	-134.087														

†Category 1 = strongly dissatisfied; category 2 = dissatisfied; category 3 = satisfied; category 4 = strongly satisfied

‡AME = Average marginal effect

Table 11: Partial Least Squares Structural Equation Model construct reliability and validity

Constructs	**Cronbach's Alpha**	**rho_A**	**Composite Reliability**	**Average Variance Extracted (AVE)**
Job Satisfaction	1.000	1.000	1.000	1.000
Organizational Extrinsic Rewards		1.000		
Social Extrinsic Rewards		1.000		
Convenience Extrinsic Rewards		1.000		

Table 12: Partial Least Squares Structural Equation Model collinearity statistics (inner VIF values)

	Job Satisfaction	Organizational Extrinsic Rewards	Social Extrinsic Rewards	Convenience Extrinsic Rewards
Job Satisfaction				
Organizational Extrinsic Rewards	1.339			
Social Extrinsic Rewards	1.197			
Convenience Extrinsic Rewards	1.267			

Table 13: Partial Least Squares Structural Equation Model outer loadings

Variables	Job Satisfaction	Organizational Extrinsic Rewards	Social Extrinsic Rewards	Convenience Extrinsic Rewards
Job Satisfaction	**1.000**			
Job Security		**0.847**		
Promotion		**0.782**		
Respect from coworkers			**0.863**	
Respect from farmers			**0.795**	
Safety on field				**0.988**
Salary		0.068		
Work-related training		-0.003		
Transportation convenience				0.463

Also, during these fortnight meetings, extension officers are encouraged to share the current challenges they face on the field, which are noted in the minutes of the meeting and forwarded to upper management. Although, some of the focus group discussants expressed their discontent at the slow feedback rate they often receive due to the highly bureaucratic management structure.

4.4.4 Social extrinsic rewards as job satisfaction predictor

The ordered logit model for the third and fourth categories (Table 10) shows that a higher perceived level of respect received from colleagues increases the probability of a public

sector extension worker reporting a higher level of job satisfaction. The perception of respect received from co-workers is probably an indicator of good interpersonal relationships in public service, which has been established by other studies to positively influence workers' job satisfaction (Hansen and Stræte, 2020; Windon, 2019; Witt et al., 2020). Additionally, a survey of public administration workers established relational gratitude (another indicator of good interpersonal relationships) as a determinant of job satisfaction (Cortini et al., 2019). Contrary to these findings, in Ethiopia, it was observed that the presence of good co-workers relationships was less likely to affect job satisfaction (Kassa, 2016).

4.4.5 Convenience extrinsic rewards as job satisfaction predictor

Table 10 shows that the extension worker's higher safety perception when carrying out their work responsibilities on the field has a significantly positive association with higher levels of job satisfaction. Similarly, a significantly positive correlation was observed between employee safety climate perception and their job satisfaction (Hansen and Stræte, 2020; Huang et al., 2016). Huang *et. al.* (2016) reasoned that this relationship exists due to the fact that positive safety climate perceptions indicate to employees that a basic need for safety at work is met and may result in their positive feelings toward the job. Another study observed that respondents ranked physical environment (direct risks present at work) higher than earnings (Lee and Park, 2021). Additional qualitative data gathered during the focus group discussion revealed that respondents expressed deep concerns as regards the fact that there was no hazard insurance or allowance package allocated to public extension staff who work on the field amidst the prevalent farmer-herder conflicts. Some of the focus group discussants highlighted the fact that some public sector extension workers could not carry out their field tasks in Local Government Areas located in the Ogbomoso ADP zone due to the increased transhumance-related violence in the area.

Only one of the control variables (age) in the model was found to have a significantly positive relationship with higher levels of Job satisfaction. Some studies have established that job satisfaction increases with age (Gould-Williams and Davies, 2005; Jankelová et al., 2020; Kristensen and Johansson, 2008), while other studies showed that age was not significantly associated with overall job satisfaction (Bayona et al., 2020; Ibrahim et al., 2008; Vila and García-Mora, 2005; Windon, 2019; Witt et al., 2020) and it was shown to have a significantly

negative relationship with Norwegian sheep farmers' affective job satisfaction (Muri et al., 2020).

4.5 Discussion

Overall, almost 70 per cent of the surveyed public extension workers were satisfied with their job. As seen from the average competency scores of public sector extension workers (Table 8), 'manage time effectively' is observed to be the most important skill by the respondents. We deduce that this skill might have been prioritized due to the wide disparity in extension staff-farmer ratio, poor transport network and distance between farm blocks often associated with developing countries in Sub-Saharan Africa. Hence, extension workers need to effectively manage travel time to meet farmers who reside in 'geographically dispersed communities' (Anderson and Feder, 2004).

The results are consistent with social exchange theory, the exchange of extrinsic rewards from employers and a response with job satisfaction from employees. Empirically the result makes a compelling case for social exchange theory, evidenced by the direction of the significant treatment variables; as higher perceptions of organizational (promotion and job security), social (respect from coworkers) and convenience (safety on the field) extrinsic rewards increases the probability of a public sector extension worker reporting higher levels of job satisfaction – which is consistent with findings from other relevant studies (Gould-Williams and Davies, 2005; Huang et al., 2016; Mulinge and Mueller, 1998). Also, the results are further consistent with Maslow's Need Hierarchy Theory (1954), which postulates that lower-level needs will be addressed before higher-level ones. The results show that the convenience extrinsic rewards (safety on the field), which can be categorized under employee safety needs, were addressed, as well as the social component measured as respect from coworkers.

This study contributes to the growing behavioural economics literature by examining job satisfaction increases when public sector workers perceive higher extrinsic rewards.

4.6 Policy implications

The study sought to investigate extrinsic rewards as job satisfaction predictors among public sector employees in Sub-Saharan Africa, taking Nigeria as an exemplary case. Using social exchange theory as a theoretical background, the ordered logit model along four

dimensions (strongly dissatisfied, dissatisfied, satisfied, and strongly satisfied) revealed that; higher perceptions of organizational (promotion and job security), social (respect from coworkers) and convenience (safety on the field) extrinsic rewards increases the probability of a public sector extension worker reporting higher levels of job satisfaction. The ordered logit model and findings offer practical insights into other extrinsic rewards – beyond financial motivations – as job satisfaction predictors that may inform and form public management strategy and policy.

Specifically, the organizational promotion process and structure within the public sector agricultural extension sector is recommended to be improved by incorporating more team bonding exercises to further boost the working relationship within teams. Also, the significance of convenience extrinsic rewards such as safety on the field amongst the rising menace of terrorist attacks, transhumance-related violence and pastoralist-farmer conflicts in SSA and particularly in the study area, can affect the job satisfaction of public sector workers which invariably impacts public management outcomes. The qualitative results of this study highlight that there are no hazard insurance and allowance packages allocated to public extension staff; hence we recommend that policymakers invest resources into such packages to further motivate workers. Also, in line with recent recommendations by C. Lee & Park (2021), this study makes a compelling case for government and policymakers to look beyond the traditional safety and working condition studies when formulating new policies related to public sector working conditions. We conclude that, regardless of the category, other extrinsic rewards beyond financial motivations are important job satisfaction predictors premised on the fact that a public management policy of creating job satisfaction is imperative for boosting public sector performance.

5. General conclusions, remarks and limitations of the study

5.1 General conclusions

The thesis sought to investigate the effect of different information sources available to smallholder farmers on the adoption of modern agricultural technologies, the impact of adopting these modern agricultural technologies on smallholder farmers' economic performance, and to determine the effects of extrinsic rewards on agricultural extension workers' job satisfaction. The thesis relied on two case studies by drawing empirical evidence from cashew farmers in Kenya and public extension workers in Nigeria. As regards the first

case study, the empirical findings support the conclusion that access to extension services and membership in a group has a significant and positive impact on the adoption of modern agricultural technologies, including the utilization of fertilizers and pesticides, as well as the implementation of appropriate planting density. It is noteworthy that planting density has a significant impact on economic performance, and farmers can benefit from higher planting density. However, the results indicate that the application of chemical sprays, such as pesticides, on cashew trees, does not impact economic performance, whereas the use of fertilizers has a negative effect. Furthermore, as regards the second case study, the study concludes that higher perceptions of organizational (promotion and job security), social (respect from coworkers) and convenience (safety on the field) extrinsic rewards increase the probability of a public sector agricultural extension worker reporting higher levels of job satisfaction.

5.2 Summarized policy implications

As the agricultural sector continues to modernize, the efficient flow of relevant information has become a crucial factor in its overall performance. The increasing importance of information in the field of agriculture can no longer be ignored. To ensure the success of the industry, access to credible and precise information must be emphasized. The first case study provides insights into the adoption of technology theory by investigating the factors that influence farmers' adoption of modern agricultural technologies. In the second case study, social exchange theory was utilized as a valuable framework to explain the extrinsic incentives behind actors' willingness to partake in information sharing within knowledge markets. This has significant implications for the agricultural sector, especially with regard to information exchange between two parties – the farmers (demand side) and the extension workers (supply side). Social exchange theory can offer a deeper understanding of the information behaviour of actors involved in the agricultural landscape of SSA, particularly with respect to job satisfaction predictors of extension workers who are responsible for communicating and interacting with farmers. Conversely, extension workers seek feedback from farmers to improve the effectiveness of agricultural extension services. The success of disseminating and utilizing information by farmers greatly depends on the skills and proficiency of extension workers. There is a widening knowledge gap between extension service providers and farmers, which is hindering the efficient flow of relevant information. This widened knowledge gap between extension service providers and farmers, especially in SSA agricultural sector,

poses a significant challenge for both African policymakers and the international development community at large. As bridging this gap is highly instrumental in effecting a positive change in the overall performance of the agricultural sector in the region. To bridge this gap, the following policy recommendations are put forth:

- Policies should emphasize the significance of the efficient flow of relevant information – as an important production factor – in the agricultural sector. By providing systems and structures that facilitate easy collaboration among major stakeholders such as private firms, NGOs and international development practitioners in delivering affordable relevant information to farmers.
- Public management policies should focus on facilitating extrinsic rewards that motivate extension workers to further engage with farmer groups, especially as regards advocating for more active participation of female farmers in existing farmer groups and the formation of new ones.
- Emphasis should be placed on disseminating information regarding modern agricultural technologies to facilitate the adoption of these technologies in order to improve the economic performance of farmers, among other benefits.
- High-level forums among policymakers should focus on resolving social tensions and regular dialogues at the grassroots to mitigate rural farmer-pastoralist conflicts and transhumance-related violence so that the safety conditions of extension workers on the field are improved for effective dissemination of relevant agricultural information.

5.3 Limitations of the study

This first case study examined the impact of farmers' group participation and access to agricultural extension services on farmers' adoption of modern agricultural technologies (specifically, the use of fertilizers, chemicals and appropriate plant density) and the consequent impact of adopting these agricultural technologies on farmers' economic performance (measured in income per acre) in the coastal regions of Kenya. Nevertheless, there are certain potential drawbacks. One limitation is the quality of data – especially with no records of any financial indicators by farmers. The spacing of trees had to be cross-checked during data collection since farmers could not specify the exact number of trees per acre. Sometimes even this data was a rough estimation by farmers. Also, we do not know the type of fertilizers farmers use. As cashew farmers are receiving more information on cashew

recently and starting to use modern technologies, we recommend future investigations relating to the effect of extension services on farmers' economic performance in the Kenyan cashew sector.

Another potential drawback is the type of analytical model explored, as the problem could have benefited from a more robust model than the OLS and logistic regression, possibly applying structural equation modelling. However, after a careful review of the literature on the considerations for using the Structural Equation Model (Hair et al., 2021; Ullman and Bentler, 2012), which is dependent on the type of research question and empirical data available. It is worth highlighting that for this study, the suggested model does not fit the available empirical data due to the following reasons;

- Composite variable: The empirical data available for the latent variable or construct "adoption of agricultural technologies" does not permit aggregating the data following any known pre-existing formula(e) for combining the three measured observable indicators (fertilizer use, chemical spraying and planting density) into a single score.
- Measurement: The data available on two directly observable indicators/items/manifest variables (fertilizer use and chemical spraying) is not a sufficient multi-item scale to avoid measurement error as recommended (Hair et al., 2021). While a single-item construct was strongly discouraged as it also reduces the measurement quality (Hair et al., 2021).
- Data coding: The dataset available for most variables was not measured with interval, ratio or recommended Likert-point scales to fulfil the requirement of symmetry and equidistance for the Structural Equation Model.

Furthermore, the aforementioned considerations in using SEM from a theoretical standpoint (Hair et al., 2021) were double-checked by attempting to analyze the available data set using the SEM. The results i.e., the SEM path diagram with coefficients (Appendix I) and the construct reliability and validity (Appendix III), validate the fact that the SEM does not fit the data available from an empirical perspective due to the following reiterated reasons:

- Composite variable: The three directly observable indicators/items/manifest variables – fertilizer use, chemical spraying and planting density – are not sufficient for the single construct of "adoption of agricultural technologies", as seen from the coefficients in the SEM path diagram (Appendix I). As two directly observable indicators/items/manifest variables – fertilizer use and chemical spraying – are not valid for the "adoption of

agricultural technologies" construct, as shown in Appendix I. Hence, only one manifest variable – planting density – was valid. This is contrary to the strong recommendation by (Iacobucci, 2010) that Ideally, each construct in an SEM would be measured by at least three indicator variables.

- Indirect effects: As shown in Appendix II, the indirect effects of farmer group membership status and access to an extension service on farmers' economic performance are not significant.
- Construct reliability and validity: Even though (Iacobucci, 2010) recommended not to be overly critical if the SRMR is not quite 0.09, but as shown in Appendix IV, the SRMR is relatively too low.

However, it is worth noting that the sample size of the empirical data used and the test for model fit (Appendix IV) has been argued in literature to be probably ok.

From an analytical standpoint, a final setback for the first case study could possibly be the lack of not using an endogenous switching regression model to analyze "the simultaneous effects of farmer group membership status and access to an extension service on farmers' adoption of agricultural technologies". However, after running the analysis with the empirical data available, the following results (Appendix V and Appendix VI) below further suggest that this model is also not a good fit as the assumptions for endogenous switching regression were not sufficiently satisfied due to the following reasons:

- Fertilizer use: As regards the computation of the endogenous switching regression for one of the directly observable indicators – fertilizer use – as shown in Appendix VI, the results obtained after analyzing the data with gross income – which is NOT our intended dependent variable for the study. Using the "Movestay" command in STATA as recommended by a study (Mojo et al., 2017), it is worthy to highlight that a problem of convergence during the computation of the endogenous switching regression with the intended dependent variable for the study – income per acre – hence, the use of gross income as an alternative variable. Although, the coefficient of correlation 'r1' was not significant – which is an important requirement for using the model. Further action to drop some of the explanatory variables, as shown in Appendix V still, the coefficient of correlation 'r1' was not significant in both models. Furthermore, if these results were possibly worth considering, we found that our chosen instrument variables (extension and

group membership status) were significant at 10%, which is often not regarded in literature (Mojo et al., 2017; Shiferaw et al., 2014).

- Chemical spraying: Results were not obtained for the second indicator for the adoption of agricultural technologies as the problem of convergence occurred during the computation of endogenous switching regression.
- Planting density: Endogenous switching regression could not be applied to the last directly observable indicator for the adoption of agricultural technologies – planting density – as this is a continuous variable which is not suitable for the model. Attempts to recategorize this variable using the FAO-recommended planting density for cashew farmers in SSA (FAO, 2021), but only three farmers out of the total sample met this criterion. Hence, using this category will make this variable unrepresentative of the data.

The second case study is, of course, not without some limitations. The limitations highlighted below are regarding sample size and context. Concerning the sample, we drew data from one state from the country with the largest population – Nigeria – in Africa thus, this might not be sufficient to make deductions and to generalize our findings. Also, there might be reasonable considerations as to if the findings in this study are specific to the Nigerian context, evaluated at this point in time. It is worth noting that our results are consistent with empirical literature supporting the application of the social exchange theory as a theoretical background in understanding job satisfaction predictors. Furthermore, as regards the theoretical framework applied in the second case study, Mulinge and Mueller (1998) warned about the application of social exchange-based arguments originating from industrialized nations in developing contexts which is prone to accusations of disregarding contextual and cultural variations. However, the authors encouraged drawing empirical evidence from other developing countries to further enhance the fitness of job satisfaction to social exchange theory suggesting cross-cultural applicability.

5.4 Suggestions for future studies

The first case study enhances our understanding of the adoption of technology theory by examining factors, in particular, farmers' group participation and access to agricultural extension services on farmers' adoption of modern agricultural technologies (specifically, the use of fertilizers, chemicals and appropriate plant density) and the consequent impact of adopting these agricultural technologies on farmers' economic performance in the Kenyan cashew sector - due to the potential for cashew as a cash crop and awakened interest in making

the cashew sector vibrant has garnered attention from the Kenyan government and international donors. Future studies are encouraged to apply developed concepts in this thesis whilst reevaluating the investigated factors in the first case study using a panel data set with other possible analytical techniques that can simultaneously resolve the effect of farmer group membership status and extension services with the dependent variables – the adoption of modern technologies and economic performance. One striking result discussed from the first case study in Kenya requires reiterating here as a recommendation for further studies is the likelihood of fertilizer use decreasing with an increase in farm size. Although within the context of the first case study, the cashew sector is underdeveloped, farmers with larger acres of farmlands might perceive fertilizer application as not economical. However, further studies should be conducted on a different agricultural cash crop from the same context or cashew sector from other countries in SSA. Hence, rural development practitioners and gender and inclusion advisors in the global food and agribusiness system are encouraged to design advisory programs that integrate gender-responsive and youth-sensitive interventions to disseminate economically feasible technologies, such as appropriate cashew planting density – as this help the farmers achieve their economic goals – since fertilizers do not seem economical in areas with extensive agriculture, such as the cashew sector considered in this article.

With regards to the second case study, it is advisable that forthcoming research should employ more extensive datasets to verify the models formulated in this thesis on diverse samples from Sub-Saharan Africa and other developing regions. This will reinforce the application of social exchange theory in these contexts. Additionally, further investigations are recommended to utilize social exchange theory as a framework for examining intrinsic rewards as predictors of job satisfaction in the private, public, and non-profit sectors that provide agricultural extension and rural advisory services.

6. References

Abate, G.T., Rashid, S., Borzaga, C., Getnet, K., 2016. Rural Finance and Agricultural Technology Adoption in Ethiopia: Does the Institutional Design of Lending Organizations Matter? World Dev 84. https://doi.org/10.1016/j.worlddev.2016.03.003

Abd-Ellatif, E.E., Anwar, M.M., AlJifri, A.A., El Dalatony, M.M., 2021. Fear of COVID-19 and Its Impact on Job Satisfaction and Turnover Intention Among Egyptian Physicians. Saf Health Work 12, 490–495. https://doi.org/10.1016/J.SHAW.2021.07.007

Abdollahzadeh, G., Sharifzadeh, M.S., Damalas, C.A., 2016. Motivations for adopting biological control among Iranian rice farmers. Crop Protection 80, 42–50. https://doi.org/10.1016/j.cropro.2015.10.021

Abdollahzadeh, G., Sharifzadeh, M.S., Damalas, C.A., 2015. Perceptions of the beneficial and harmful effects of pesticides among Iranian rice farmers influence the adoption of biological control. Crop Protection 75, 124–131. https://doi.org/10.1016/j.cropro.2015.05.018

Abdoulaye, T., Wossen, T., Awotide, B., 2018. Impacts of improved maize varieties in Nigeria: ex-post assessment of productivity and welfare outcomes. Food Secur 10, 369–379. https://doi.org/10.1007/S12571-018-0772-9/TABLES/5

Abebaw, D., Haile, M.G., 2013. The impact of cooperatives on agricultural technology adoption: Empirical evidence from Ethiopia. Food Policy 38, 82–91. https://doi.org/10.1016/j.foodpol.2012.10.003

Abrudan, I.N., Pop, C.M., Lazăr, P.S., 2020. Using a general ordered logit model to explain the influence of hotel facilities, general and sustainability-related, on customer ratings. Sustainability 12, 9302. https://doi.org/10.3390/SU12219302

Afful, D.B., Ayisi, K.K., 2016. Extension Support for Grain Crop Producers Under Climate Variability Scenario: Implications for Extension Management in Limpopo Province, South Africa. Journal of Agribusiness and Rural Development 41, 223–235. https://doi.org/10.17306/JARD.2016.49

Agboola, A.F., Adekunle, I.A., Ogunjimi, S.I., 2015. Assessment of youth participation in indigenous farm practices of vegetable production in Oyo State, Nigeria. Journal of Agricultural Extension and Rural Development 7, 73–79. https://doi.org/10.5897/jaerd2014.0590

Aguilar, F.X., Vlosky, R.P., 2010. Gender differences in determinants of job satisfaction among cooperative extension workers in the United States. Appl Econ Lett 17, 175–179. https://doi.org/10.1080/13504850701719959

Anang, B.T., Ayambila, S.N., 2020a. Participation in Agricultural Extension and Labor Productivity: A Case Study of Smallholder Farmers in Ghana. International Journal on Food System Dynamics 11, 297–306.

Anang, B.T., Ayambila, S.N., 2020b. Participation in Agricultural Extension and Labor Productivity: A Case Study of Smallholder Farmers in Ghana. International Journal on Food System Dynamics 11, 297–306.

Anderson, J.R., Feder, G., 2004. Agricultural extension: Good intentions and hard realities. World Bank Res Obs 19, 41–60.

Asiedu-Darko, E., Amanor, M., 2016. Factors Affecting Job Satisfaction of Agricultural Sector Workers in Ghana. American Journal of Business, Economics and Management 4, 89–93. https://doi.org/10.15192/PSCP.ASR.2016.15.1.1722

Babu, S.C., Singh, M., Hymavathi, T. v., Rani, K.U., Kavitha, G.G., Karthik, S., 2016. Improved nutrition through agricultural extension and advisory services: case studies of curriculum review and operational lessons from India. 94887.

Baiyegunhi, L.J.S., Majokweni, Z.P., Ferrer, S.R.D., 2019. Impact of outsourced agricultural extension program on smallholder farmers' net farm income in Msinga, KwaZulu-Natal, South Africa. Technol Soc 57, 1–7. https://doi.org/10.1016/J.TECHSOC.2018.11.003

Baloch, M.A., Thapa, G.B., 2019. Review of the agricultural extension modes and services with the focus to Balochistan, Pakistan. Journal of the Saudi Society of Agricultural Sciences 18, 188–194. https://doi.org/10.1016/J.JSSAS.2017.05.001

Balogun, O.L., Ogunsina, I.J., Ayo-Bello, T.A., Afodu, O.J., 2018. Effects of Social Capital on Productivity of Cassava Farmers in Ogun State, Nigeria. J Agric Sci (Belihuloya) 63, 99–112.

Bayona, J.A., Caballer, A., Peiró, J.M., 2020. The Relationship between Knowledge Characteristics' Fit and Job Satisfaction and Job Performance: The Mediating Role of Work Engagement. Sustainability 12, 2336. https://doi.org/10.3390/SU12062336

Birner, R., Anderson, J.R., 2007. How to Make Agricultural Extension Demand-Driven? The Case of India's Agricultural Extension Policy. Washington, DC. https://doi.org/IFPRI Discussion Paper 00729

Blau, P.M., 1964. Power and exchange in social life.

Britannica, 2023a. Country profile: Republic of Kenya [WWW Document]. https://www.britannica.com/place/Kenya#ref37522. URL https://www.britannica.com/place/Kenya#ref37522 (accessed 3.23.23).

Britannica, 2023b. Country profile: Nigeria [WWW Document]. https://www.britannica.com/place/Nigeria. URL https://www.britannica.com/place/Nigeria (accessed 3.23.23).

Britannica, 2013. Oyo [WWW Document]. T. Editors of Encyclopaedia. Encyclopedia Britannica. URL https://www.britannica.com/place/Oyo-state-Nigeria (accessed 1.22.22).

Bruce, A.K.K., Donkoh, S.A., Ayamga, M., 2014. Improved rice variety adoption and its effects on farmers' output in Ghana. J Dev Agric Econ 6, 242–248. https://doi.org/10.5897/JDAE2013.0544

Bruce, K., Costa, H., 2019. Enabling environment for PPPs in agricultural extension projects: Policy imperatives for impact. J Rural Stud 70, 87–95. https://doi.org/10.1016/J.JRURSTUD.2019.07.005

Buehren, N., Goldstein, M., Molina, E., Vaillant, J., 2017. The Impact of Strengthening Agricultural Extension Services: Evidence from Ethiopia. (No. 1), World Bank Policy Research Working Paper 8169, 1. Ethiopia. https://doi.org/10.1017/CBO9781107415324.004

Caillier, J.G., 2012. The impact of teleworking on work motivation in a US federal government agency. The American Review of Public Administration 42, 461–480. https://doi.org/10.1177/0275074011409394

Cook, B.R., Satizábal, P., Curnow, J., 2021. Humanising agricultural extension: A review. World Dev 140, 105337. https://doi.org/10.1016/J.WORLDDEV.2020.105337

Cortini, M., Converso, D., Galanti, T., Di Fiore, T., Di Domenico, A., Fantinelli, S., 2019. Gratitude at Work Works! A Mix-Method Study on Different Dimensions of Gratitude, Job Satisfaction, and Job Performance. Sustainability 11, 3902. https://doi.org/10.3390/SU11143902

Costa, S., Bocchi, S., 2017. Manual for small-scale cashew cultivation in Sierra Leone.

Das, S., Rahman, R.M., 2011. Application of ordinal logistic regression analysis in determining risk factors of child malnutrition in Bangladesh. Nutr J 10, 1–11. https://doi.org/10.1186/1475-2891-10-124

Dendena, B., Corsi, S., 2014. Cashew, from seed to market: a review. Agron Sustain Dev 34, 753–772. https://doi.org/10.1007/s13593-014-0240-7

Denkyirah, Elisha Kwaku, Okoffo, E.D., Adu, D.T., Aziz, A.A., Ofori, A., Denkyirah, Elijah Kofi, 2016. Modeling Ghanaian cocoa farmers' decision to use pesticide and frequency of application: the case of Brong Ahafo Region. Springerplus 5, 1–17. https://doi.org/10.1186/s40064-016-2779-z

Djoumessi, Y.F., 2022. New trend of agricultural productivity growth in sub-Saharan Africa. Sci Afr 18, e01410. https://doi.org/10.1016/J.SCIAF.2022.E01410

Elias, A., Nohmi, M., Yasunobu, K., Ishida, A., 2016. Farmers' satisfaction with agricultural extension service and its influencing factors: a case study in North West Ethiopia., Journal of Agricultural Science and Technology.

Elias, A., Nohmi, M., Yasunobu, K., Ishida, A., 2013. Effect of agricultural extension program on smallholders' farm productivity: Evidence from three peasant associations in the highlands of Ethiopia. Journal of Agricultural Science 5, p163. https://doi.org/10.5539/jas.v5n8p163

Emmanuel, D., Owusu-Sekyere, E., Owusu, V., Jordaan, H., 2016. Impact of agricultural extension service on adoption of chemical fertilizer: Implications for rice productivity and development in Ghana. NJAS - Wageningen Journal of Life Sciences 79, 41–49. https://doi.org/10.1016/j.njas.2016.10.002

Fadare, O.A., Akerele, D., Toritseju, B., 2014. Factors Influencing Adoption Decisions of Maize Farmers in Nigeria. Int J Food Agric Econ 2, 45–54.

FAO, 2022. Nigeria at a glance | FAO in Nigeria | Food and Agriculture Organization of the United Nations [WWW Document]. https://www.fao.org/nigeria/fao-in-nigeria/nigeria-at-a-glance/en/.

FAO, 2021. Good practices for the establishment of a new cashew farm [WWW Document]. Food and Agriculture Organization of the United Nations / Technologies and Practices for Small Agricultural Producers (TECA). URL https://teca.apps.fao.org/teca/es/technologies/7461 (accessed 3.9.22).

FAO, 2017. Success stories on information and communication technologies for agriculture and rural development.

FAO, 2013. African Youth in Agriculture, Natural Resources and Rural Development. Nature and Faune 28.

FAO, 2011. Proceedings of the consultation workshop on market-oriented agricultural extension. RAP Publication.

FAO, ITU, 2022. Status of digital agriculture in 47 sub-Saharan African countries. https://doi.org/10.4060/cb7943en

FAO/IFAD/UNICEF/WFP/WHO, 2019. The state of food security and nutrition in the world 2019. Safeguarding against economic slowdowns and downturns. FAO, Rome, Italy.

Federal Ministry of Budget & National Planning, 2017. Federal Republic of Nigeria & Growth Plan. Economic Recovery Growth Plan 2017 140.

Gautam, M., 2000. Agricultural extension: The Kenya experience: An impact evaluation. Washington, DC, USA.

Gazioglu, S., Tansel, A., 2006. Job satisfaction in Britain: individual and job related factors. Appl Econ 38, 1163–1171. https://doi.org/10.1080/00036840500392987

George, J., Adelaja, A., Vaughan, O., Awokuse, T., 2022. Explaining transhumance-related violence: Fulani Ethnic Militia in rural Nigeria. J Rural Stud 89, 275–286. https://doi.org/10.1016/J.JRURSTUD.2021.12.003

Glendenning, C.J., Babu, S., Asenso-Okyere, K., 2010. Review of agricultural extension in India: Are farmers' information needs being met?

Gould-Williams, J., Davies, F., 2005. Using social exchange theory to predict the effects of HRM practice on employee outcomes. Public Management Review 7, 1–24. https://doi.org/10.1080/1471903042000339392

Gujarati, D.N., Porter, D.C., 2022. Basic econometrics, 5th ed. McGraw-Hill Irwin, New York.

Hair, Jr.J.F., Hult, G.T.M., Ringle, C.M., Sarstedt, M., 2021. A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM), third. ed. Sage publications.

Hall, H., Widén, G., Paterson, L., 2010. Not what you know, nor who you know, but who you know already: examining online information sharing behaviours in a blogging environment through the lens of social exchange theory. LIBRI International Journal of Libraries and Information Studies 6, 117–128. https://doi.org/https://doi.org/10.1515/libr.2010.011

Hamisu, S., Ardo, A.M., Makinta, M.M., Garba, L., Musa, G., 2017. A Review on Current Status of Agricultural Extension Service in Nigeria. Asian Journal of Advances in Agricultural Research 1, 1–8. https://doi.org/10.9734/ajaar/2017/34875

Hansen, B.G., Stræte, E.P., 2020. Dairy farmers' job satisfaction and the influence of automatic milking systems. NJAS: Wageningen Journal of Life Sciences 92, 1–13. https://doi.org/10.1016/J.NJAS.2020.100328

Hidayat, S.I., Indah, P.N., Nurhayati, T., Harya, G.I., Hendrarini, H., 2019. Satisfaction of the Farming Community Towards the Performance of Agricultural Extension Service: a Case Study in Benjeng Subdistrict of Gresik Regency, Indonesia. Russ J Agric Socioecon Sci 92, 197–203. https://doi.org/10.18551/rjoas.2019-08.21

Huang, Y.-H., Lee, J., McFadden, A.C., Murphy, L.A., Robertson, M.M., Cheung, J.H., Zohar, D., 2016. Beyond safety outcomes: An investigation of the impact of safety climate on job satisfaction, employee engagement and turnover using social exchange theory as the theoretical framework. Appl Ergon 55, 248–257. https://doi.org/10.1016/J.APERGO.2015.10.007

Hunecke, C., Engler, A., Jara-Rojas, R., Poortvliet, P.M., 2017. Understanding the role of social capital in adoption decisions: An application to irrigation technology. Agric Syst 153. https://doi.org/10.1016/j.agsy.2017.02.002

Iacobucci, D., 2010. Structural equations modeling: Fit Indices, sample size, and advanced topics. Journal of Consumer Psychology 20, 90–98. https://doi.org/10.1016/j.jcps.2009.09.003

Ibrahim, H., Muhammad, D.M., Yahaya, H., Luka, E.G., 2008. Role Perception and Job Satisfaction Among Extension Workers In Nasarawa Agricultural Development Programme (NADP) of Nasarawa State, Nigeria. Production Agriculture and Technology 4, 62–70.

Ikhuoso, A.O., Adegbeye, M.J., Elghandour, M.M.Y., Mellado, M., Al-Dobaib, S.N., Salem, A.Z.M., 2020. Climate change and agriculture: The competition for limited resources amidst crop farmers-livestock herding conflict in Nigeria - A review. J Clean Prod 272, 123104. https://doi.org/10.1016/J.JCLEPRO.2020.123104

Ingutia, R., Sumelius, J., 2022. Do farmer groups improve the situation of women in agriculture in rural Kenya? International Food and Agribusiness Management Review 25, 135–156. https://doi.org/10.22434/IFAMR2020.0142

Inusa, B.M., Calvin Daniel, P., dayagal, D.F., Stephen Chiya, N., 2018. Nigerian Economic Growth and Recovery: Role of Agriculture. International Journal of Economics & Management Sciences 07. https://doi.org/10.4172/2162-6359.1000512

Jankelová, N., Joniaková, Z., Romanová, A., Remeňová, K., 2020. Motivational factors and job satisfaction of employees in agriculture in the context of performance of agricultural companies in Slovakia. Agricultural Economics - Czech 66, 402–412. https://doi.org/10.17221/220/2020-AGRICECON

Kassa, G., 2016. Determinants of Job Satisfaction Among Agricultural Extension Workers in Southwest Ethiopia. American Journal of Agriculture and Forestry 4, 112. https://doi.org/10.11648/J.AJAF.20160405.11

Kassem, H.S., Alotaibi, B.A., Muddassir, M., Herab, A., 2021. Factors influencing farmers' satisfaction with the quality of agricultural extension services. Eval Program Plann 85, 101912. https://doi.org/10.1016/J.EVALPROGPLAN.2021.101912

Kondylis, F., Mueller, V., Zhu, J., 2017. Seeing is believing? Evidence from an extension network experiment. J Dev Econ 125, 1–20. https://doi.org/10.1016/j.jdeveco.2016.10.004

Kristensen, N., Johansson, E., 2008. New evidence on cross-country differences in job satisfaction using anchoring vignettes. Labour Econ 15, 96–117. https://doi.org/10.1016/J.LABECO.2006.11.001

Ladele, A., Huhela, K., Tselaesele, N.M., Msatilomo, H., Chowa, C., Zwane, E., 2017. The role of agricultural extension in Africa's development, the importance of extension workers and the need for change. International Journal of Agricultural Extension 5, 51–58.

Läpple, D., Renwick, A., Thorne, F., 2015. Measuring and understanding the drivers of agricultural innovation: Evidence from Ireland. Food Policy 51, 1–8. https://doi.org/10.1016/j.foodpol.2014.11.003

Lawal, J.O., Uwagboe, E.O., 2017. Cost effectiveness of intercropping patterns by cashew farmers in Oyo State, Nigeria. International Journal of Forest, Animal and Fisheries Research 1, 27–30.

Lee, C., Park, S., 2021. Changing Factors of Employee Satisfaction with Working Conditions: An Analysis of the Korean Working Conditions Survey. Saf Health Work 12, 324–338. https://doi.org/10.1016/J.SHAW.2021.04.003

Lee, Y., Sabharwal, M., 2016. Education–Job Match, Salary, and Job Satisfaction Across the Public, Non-Profit, and For-Profit Sectors: Survey of recent college graduates. Public Management Review 18, 40–64. https://doi.org/10.1080/14719037.2014.957342

Liverpool, L.S.O., Winter-Nelson, A., 2010. Poverty status and the impact of social networks on smallholder technology adoption in rural Ethiopia. Washington, DC, USA.

Madukwe, M.C., 2008. Practice without policy: The Nigerian agricultural extension service. An Inaugural Lecture of the University of Nigeria.

Maican, S. Ștefania, Muntean, A.C., Paștiu, C.A., Stępień, S., Polcyn, J., Dobra, I.B., Dârja, M., Moisă, C.O., 2021. Motivational factors, job satisfaction, and economic performance in Romanian small farms. Sustainability 13, 5832. https://doi.org/10.3390/SU13115832

Makokha, S., Kimani, S., Mwangi, W., Verkuijl, H., Musembi, F., 2001. Determinants of fertilizer and manure use for maize production in Kiambu District, Kenya.

Mangalassery, S., Rejani, R., Singh, V., Adiga, J.D., Kalaivanan, D., Rupa, T.R., Philip, P.S., 2019. Impact of different irrigation regimes under varied planting density on growth, yield and economic return of cashew (Anacardium occidentale L.). Irrig Sci 37, 483–494. https://doi.org/10.1007/s00271-019-00625-7

Martey, E., Wiredu, A.N., Etwire, P.M., Fosu, M., Buah, S.S.J., Bidzakin, J., Ahiabor, B.D.K., Kusi, F., 2014. Fertilizer adoption and use intensity among smallholder farmers in Northern Ghana: A case study of the AGRA soil health project. Sustainable Agriculture Research 3, 24–36. https://doi.org/10.5539/sar.v3n1p24

Meijer, S.S., Catacutan, D., Ajayi, O.C., Sileshi, G.W., Nieuwenhuis, M., 2015. The role of knowledge, attitudes and perceptions in the uptake of agricultural and agroforestry innovations among smallholder farmers in sub-Saharan Africa. Int J Agric Sustain 13, 40–54. https://doi.org/10.1080/14735903.2014.912493

Mekonnen, D.A., Gerber, N., Matz, J.A., 2018. Gendered Social Networks, Agricultural Innovations, and Farm Productivity in Ethiopia. World Dev 105. https://doi.org/10.1016/j.worlddev.2017.04.020

Meyerding, S.G.H., Lehberger, M., 2018. Gender and job satisfaction in German horticulture. International Food and Agribusiness Management Review 21, 1003–1022. https://doi.org/10.22434/IFAMR2017.0125/SUPPL_FILE/IFAMR2017.0125_ESM.PDF

Mgbenka, R.N., Mbah, E.N., 2016. A Review of Smallholder Farming in Nigeria: Need for Transformation. International Journal of Agricultural Extension and Rural Development Studies 3, 43–54.

Mohammadi, H., Torabi, S., Dogani, A., 2015. Application of ordered logit model in investigating the factors affecting people's income (a case study in Tehran City). International Journal of Academic Research in Economics and Management Science 5, 2226–3624.

Mojo, D., Fischer, C., Degefa, T., 2017. The determinants and economic impacts of membership in coffee farmer cooperatives: recent evidence from rural Ethiopia. J Rural Stud 50, 84–94. https://doi.org/10.1016/J.JRURSTUD.2016.12.010

Mottaleb, K.A., 2018. Perception and adoption of a new agricultural technology: Evidence from a developing country. Technol Soc 55, 126–135. https://doi.org/10.1016/j.techsoc.2018.07.007

Mulinge, M., Mueller, C.W., 1998. Employee job satisfaction in developing countries: The case of Kenya. World Dev 26, 2181–2199. https://doi.org/10.1016/S0305-750X(98)00089-8

Muri, K., Tufte, P.A., Coleman, G., Moe, R.O., 2020. Exploring work-related characteristics as predictors of Norwegian sheep farmers' affective job satisfaction. Sociol Ruralis 60, 574–595. https://doi.org/10.1111/SORU.12299

Mussagulova, A., van der Wal, Z., Chen, C.-A., 2019. What is wrong with job security? Public Administration and Development 39, 121–132. https://doi.org/10.1002/PAD.1863

Nagy, M.S., 2002. Using a single-item approach to measure facet job satisfaction. J Occup Organ Psychol 75, 77–86. https://doi.org/doi:10.1348/096317902167658

Nata, J.T., Mjelde, J.W., Boadu, F.O., 2014. Household adoption of soil-improving practices and food insecurity in Ghana. Agric Food Secur 3, 1–12. https://doi.org/10.1186/2048-7010-3-17

Navarra, C., Borzaga, C., Franchini, B., 2017. Identifying processes and policies conducive to cooperative development in Africa. An exploratory study on cooperative development projects in the agricultural sector. Summary, concluding remarks and hypotheses for further work.

Okwoche, V.A.O., Agabi, 2015. Determinants of Job Satisfaction Among Extension Agents In Benue State Agricultural And Rural Development Authority (Bnarda), Benue State, Nigeria. European Journal of Physical and Agricultural Sciences 3.

Oladele, I., 2015. Borich Needs Model Analysis of Professional Competence Among Extension Officers in North West Province, South Africa. Journal of Agricultural & Food Information 16, 151–162. https://doi.org/10.1080/10496505.2015.1013110

Olorunfemi, T.O., Olorunfemi, O.D., Oladele, O.I., 2020. Determinants of the involvement of extension agents in disseminating climate smart agricultural initiatives: Implication for scaling up. Journal of the Saudi Society of Agricultural Sciences 19, 285–292. https://doi.org/10.1016/J.JSSAS.2019.03.003

Omotesho, K.F., Ogunlade, I., Lawal, M.A., Kehinde, F.B., 2016. Determinants of Level of Participation of Farmers in Group Activities in Kwara S. Journal of Agricultural Faculty of Gaziosmanpasa University 33, 21–21. https://doi.org/10.13002/jafag887

Ouma, J.O., Murithi, F.M., Mwangi, W., Verkuijl, H., Geth, M., de Groote, H., 2002. Adoption of maize seed and fertilizer technologies in Embu district, Kenya.

Pardee, R.L., 1990. Motivation theories of Maslow, Herzberg, McGregor & McClelland. A literature review of selected theories dealing with job satisfaction and motivation.

Prasad, G., Shrivastava, K.K., Dhruw, Y.S., 2017. Communication Behaviour of Farmers Towards Groundnut Production Technology in Raigarh District of Chhattisgarh, India. Plant Arch 17, 637–640.

Rabany, C., Rullier, N., Ricau, P., 2015. The African cashew sector in 2015. Global trends and country profiles. Analysis of cashew production, processing and trade in Africa.

Radhakrishnan, A., Meti, S.K., Goudappa, S.B., 2016. Information Management Behaviour of Papaya growers of Karnataka: A comparative study. Indian Research Journal Extension Education 14, 31–35.

Sackett, P.R., Larson Jr., J.R., 1990. Research strategies and tactics in industrial and organizational psychology, in: Dunnette, M.D., Hough, L.M. (Eds.), Handbook of Industrial and Organizational Psychology. Consulting Psychologists Press, Palo Alto, California, Palo Alto, California.

Saha, B., Devi, R., 2016. Information Management Behaviour of traditional fish farmers in Assam. Indian Research Journal of Extension Education 14, 11–16.

Sahito, Z., Vaisanen, P., 2017. The Diagonal Model of Job Satisfaction and Motivation: Extracted from the Logical Comparison of Content and Process Theories. International Journal of Higher Education 6, 209–230. https://doi.org/10.5430/ijhe.v6n3p209

saint Ville, A.S., Hickey, G.M., Locher, U., Phillip, L.E., 2016. Exploring the role of social capital in influencing knowledge flows and innovation in smallholder farming communities in the Caribbean. Food Secur 8, 535–549. https://doi.org/10.1007/s12571-016-0581-y

Sajeev, M. v., Saroj, P.L., Lakshmisha, R., 2014. Technology impacts on area , production and productivity of cashew in Dakshina Kannada district, Karnataka. Journal of Plantation Crops 42, 62–69.

Sanyang, S.E., Kao, T.-C., Haung, W.-C., 2009. Comparative study of sustainable and non-sustainable interventions in technology development and transfer to the women's vegetable gardens in the Gambia. J Technol Transf 34, 59–75. https://doi.org/10.1007/s10961-008-9084-0

Savolainen, R., 2013. Information Behavior and Information Practice: Reviewing the "Umbrella Concepts" of Information-Seeking Studies. Chicago Journals 77, 109–132.

Scarpello, V., Campbell, J.P., 1983. Job satisfaction: are all the parts there? Pers Psychol 36, 577–600. https://doi.org/10.1111/J.1744-6570.1983.TB02236.X

Sebhatu, K.T., Gezahegn, T.W., Berhanu, T., Maertens, M., van Passel, S., D'Haese, M., 2021. Exploring variability across cooperatives: Economic performance of agricultural cooperatives in northern Ethiopia. International Food and Agribusiness Management Review 24, 397–419. https://doi.org/10.22434/IFAMR2019.0215/SUPPL_FILE/IFAMR2019.0215_ESM.PDF

Senyolo, M.P., Long, T.B., Blok, V., Omta, O., 2018. How the characteristics of innovations impact their adoption: An exploration of climate-smart agricultural innovations in South Africa. J Clean Prod 172, 3825–3840. https://doi.org/10.1016/j.jclepro.2017.06.019

Senyolo, M.P., Long, T.B., Omta, O., 2021. Enhancing the adoption of climate-smart technologies using publicprivate partnerships: lessons from the WEMA case in South Africa. International Food and Agribusiness Management Review 24, 755–776. https://doi.org/10.22434/IFAMR2019.0197

Shiferaw, B., Kassie, M., Jaleta, M., Yirga, C., 2014. Adoption of improved wheat varieties and impacts on household food security in Ethiopia. Food Policy 44, 272–284. https://doi.org/10.1016/J.FOODPOL.2013.09.012

Singh, N., Malhotra, P., Singh, J., 2016. Information needs and seeking behaviour of dairy farmers of Punjab. Indian Journal of Dairy Science 69, 98–104.

Sledge, S., Miles, A.K., Coppage, S., 2008. What role does culture play? A look at motivation and job satisfaction among hotel workers in Brazil. The International Journal of Human Resource Management 19, 1667–1682. https://doi.org/10.1080/09585190802295157

Suvedi, M., Ghimire, R., Kaplowitz, M., 2017. Farmers' participation in extension programs and technology adoption in rural Nepal: a logistic regression analysis. The Journal of Agricultural Education and Extension 23, 351–371. https://doi.org/10.1080/1389224X.2017.1323653

Swanson, B.E., Rajalahti, R., 2010. Strengthening Agricultural Extension and Advisory Systems: Procedures for Assessing, Transforming, and Evaluating Extension Systems (No. 45). World Bank, Washington, DC.

Sylla, A.Y., Mahama Al-Hassan, R., Egyir, I.S., Anim-Somuah, H., 2019. Perceptions about quality of public and private agricultural extension in Africa: Evidence from farmers in Burkina Faso. Cogent Food Agric 5, 1685861. https://doi.org/10.1080/23311932.2019.1685861

Tarde, G., 1903. The laws of imitation. Henry Holt and Co., New York.

Toma, L., Barnes, A.P., Sutherland, L.-A., Thomson, S., Burnett, F., Mathews, K., 2018. Impact of information transfer on farmers' uptake of innovative crop technologies: a structural equation model applied to survey data. Journal of Technology Transfer 43, 864–881. https://doi.org/10.1007/s10961-016-9520-5

Turner, R.A., Polunin, N.V.C., Stead, S.M., 2014. Social networks and fishers' behavior: exploring the links between information flow and fishing success in the Northumberland lobster fishery. Ecology and Society 19, 38. https://doi.org/10.5751/ES-06456-190238

Ullah, A., Arshad, M., Kächele, H., Khan, A., Mahmood, N., Müller, K., 2020. Information asymmetry, input markets, adoption of innovations and agricultural land use in Khyber Pakhtunkhwa, Pakistan. Land use policy 90. https://doi.org/10.1016/J.LANDUSEPOL.2019.104261

Ullah, A., Khan, A., 2019. Effect of Extension-Farmers Contact on Farmers' Knowledge of Different Pest Management Practices in the Rain-Fed Districts of Khyber Pakhtunkhwa, Pakistan. https://doi.org/10.17582/journal.sja/2019/35.2.602.609

Ullah, A., Saqib, S.E., Kächele, H., 2022. Determinants of Farmers' Awareness and Adoption of Extension Recommended Wheat Varieties in the Rainfed Areas of Pakistan. Sustainability 2022, Vol. 14, Page 3194 14, 3194. https://doi.org/10.3390/SU14063194

Ullman, J.B., Bentler, P.M., 2012. Structural Equation Modeling, Second. ed, Handbook on Psychology. John Wiley & Sons, Inc. https://doi.org/10.1002/9781118133880

Umar, S., Man, N., Nawi, N.M., Latif, I.A., Samah, B.A., 2017. Core competency requirements among extension workers in peninsular Malaysia: Use of Borich's needs assessment model. Eval Program Plann 62, 9–14. https://doi.org/10.1016/J.EVALPROGPLAN.2017.02.001

UNOWAS, 2018. Pastoralism and security in West Africa and the Sahel | Towards peaceful coexistence.

Van Ryzin, G.G., 2014. The curious case of the post-9-11 boost in government job satisfaction. The American Review of Public Administration 44, 59–74. https://doi.org/10.1177/0275074012461560

Vila, L.E., García-Mora, B., 2005. Education and the Determinants of Job Satisfaction. Educ Econ 13, 409–425. https://doi.org/10.1080/09645290500251730

Wanous, J.P., Reichers, A.E., Hudy, M.J., 1997. Overall job satisfaction: how good are single-item measures? Journal of Applied Psychology 82, 247–252. https://doi.org/10.1037/0021-9010.82.2.247

Wen, X., Gu, L., Wen, S., 2019. Job satisfaction and job engagement: Empirical evidence from food safety regulators in Guangdong, China. J Clean Prod 208, 999–1008. https://doi.org/10.1016/J.JCLEPRO.2018.10.089

Wheeler, S.A., 2009. Exploring the influences on Australian agricultural professionals' genetic engineering beliefs: An empirical analysis. Journal of Technology Transfer 34, 422–439. https://doi.org/10.1007/s10961-008-9094-y

Wilson, T.D., 1999. Models in Information Behaviour Research. Journal of Documentation 55, 249–270.

Windon, S.R., 2019. Predictors of Job Satisfaction Among Extension Program Assistants. J Agric Educ 60, 232–245. https://doi.org/10.5032/jae.2019.03232

Witt, C.D., Reed, D.B., Rayens, M.K., Hunsucker, S., 2020. Predictors of Job Satisfaction in Female Farmers Aged 50 and Over: Implications for Occupational Health Nurses. Workplace Health Saf 68, 526–532. https://doi.org/10.1177/2165079920931895

World Bank, 2023a. Global Economic Prospects, January 2023. Washington, DC: World Bank. https://doi.org/10.1586/978-1-4648-1906-3

World Bank, 2023b. Regional profile: Sub-Saharan Africa [WWW Document]. https://data.worldbank.org/region/sub-saharan-africa?view=chart. URL https://data.worldbank.org/region/sub-saharan-africa?view=chart (accessed 3.23.23).

World Bank, 2023c. Country profile: Republic of Kenya [WWW Document]. https://data.worldbank.org/country/kenya?view=chart. URL https://data.worldbank.org/country/kenya?view=chart (accessed 3.23.23).

World Bank, 2023d. Country profile: Nigeria [WWW Document]. https://data.worldbank.org/country/nigeria. URL https://data.worldbank.org/country/nigeria (accessed 3.23.23).

World Bank, 2022a. Kenya Overview: Development news, research, data [WWW Document]. https://www.worldbank.org/en/country/kenya/overview. URL https://www.worldbank.org/en/country/kenya/overview (accessed 3.23.23).

World Bank, 2022b. Nigeria Country Profile | World Development Indicators Database [WWW Document]. https://data.worldbank.org/country/nigeria.

World Bank, 2018. Country profile: Republic of Kenya [WWW Document]. https://databank.worldbank.org/views/reports/reportwidget.aspx?Report_Name=CountryProfile&Id=b450fd57&tbar=y&dd=y&inf=n&zm=n&country=KEN%0D. URL https://databank.worldbank.org/views/reports/reportwidget.aspx?Report_Name=CountryProfile&Id=b450fd57&tbar=y&dd=y&inf=n&zm=n&country=KEN%0D

World Bank, 2008. World development report 2008: Agriculture for development. The World Bank, Washington DC USA. https://doi.org/10.5860/choice.45-4765

Wossen, T., Abdoulaye, T., Alene, A., Haile, M.G., Feleke, S., Olanrewaju, A., Manyong, V., 2017. Impacts of extension access and cooperative membership on technology adoption and household welfare. J Rural Stud 223–233.

Yang, J., Pu, B., Guan, Z., 2019. Entrepreneurial Leadership and Turnover Intention in Startups: Mediating Roles of Employees' Job Embeddedness, Job Satisfaction and Affective Commitment. Sustainability 11, 1101. https://doi.org/10.3390/SU11041101

Yaseen, M., Ahmad, M.M., Soni, P., 2018. Farm Households' Simultaneous Use of Sources to Access Information on Cotton Crop Production. Journal of Agricultural and Food Information 19. https://doi.org/10.1080/10496505.2017.1325743

Yigezu, Y.A., Mugera, A., El-Shater, T., Aw-Hassan, A., Piggin, C., Haddad, A., Khalil, Y., Loss, S., 2018. Enhancing adoption of agricultural technologies requiring high initial investment among smallholders. Technol Forecast Soc Change 134. https://doi.org/10.1016/j.techfore.2018.06.006

Zegeye, M.B., Fikire, A.H., Assefa, A.B., 2022. Impact of Agricultural Technology Adoption on Food Consumption Expenditure: Evidence from Rural Amhara Region, Ethiopia. Cogent Economics & Finance 10. https://doi.org/10.1080/23322039.2021.2012988

7. Author´s scientific contributions

This study consists of two individually conducted research works. The article structure was based on the specific journal requirements and submitted to suitable journals. The status of each manuscript is as follows:

1. Nnahiwe P, Hejkrlík J, Bavorova M. 2023. Adopting Modern Agricultural Technologies and Impact on Economic Performance: Evidence from Cashew Farmers in Kenya. International Food and Agribusiness Management Review. https://doi.org/10.22434/IFAMR2021.0100

2. Nnahiwe P, Agyemang S, Ulla A, H Kächele H, Bavorova M. 2022. Extrinsic rewards as job satisfaction predictors among public sector workers: Nigeria as an exemplary case. (Status: Under preparation)

In addition to the studies conducted for this thesis, the author was involved in the following scientific work:

1. Nnahiwe P, Hejkrlík J. 2022. An Impact Evaluation of Making Markets Work for the Poor (M4P) Approach to Farmer-Processor Linkage in Nigeria. Submitted to: Evaluation and Program Planning (Elsevier); (Status: Under Review)
2. Bavorova M, Nnahiwe P. 2021. Survey Design co-author on chapter 6: Quantitative Data Collection (published)

9. Conference contributions and projects

Conferences:

1. Nnahiwe P, Hejkrlík J. 2018. Linking Smallholder Farmers to Processor: A case for Making Markets Work for the Poor (M4P) Approach in Nigeria. 10th Euroleague for Life Sciences (ELLS) Scientific Student Conference, 9 - 10 November 2018, Wageningen University, The Netherlands.
2. Nnahiwe P, Hejkrlík J, Bavorova M. 2020. The Role of Extension and Famer Groups in Adopting Agricultural Technologies. TROPENTAG, September 9-11, 2020, virtual conference
3. Nnahiwe P, Hejkrlík J, Bavorova M. 2021. Adopting Modern Agricultural Technologies: Evidence from Kenya. XVI European Association of Agricultural Economists (EAAE) Congress, “Raising the impact of Agricultural Economics: Multidisciplinary, Stakeholder Engagement and Novel Approaches” 20–23 July 2021, Prague, Czech Republic.
4. Nnahiwe P, Agyemang S, Bavorova M. 2022. Agricultural extension workers job satisfaction in sub-Saharan Africa: Role of employee safety perception in Nigeria. Tropentag 2022 - Can agroecological farming feed the world? Farmers' and academia's views. 14-16 September 2022. Prague, Czech Republic

Projects:

V4 EU project with the main coordinator being Slovak Agency for International Development Cooperation. Monitoring and Evaluation Plan prepared jointly by Czech University of Life Sciences and Farm Africa for the project "Enhancement of livelihoods in the Kenyan Coastal Region by supporting Organic and Fair Trade certification of smallholders" implemented in accordance with the intervention programme "Conflict prevention, peace and economic opportunities for the youth" (EUTF05-HoA-KE-18). (Duration: September 2018 – November 2021)

Responsibilities: Literature review, data analysis, scientific publication and presentation of findings

8. Appendix

Appendix A

Appendix A1: Questionnaire used for data collection – Case Study 1

SECTION A: DEMOGRAPHICS

A1) Name of farmer	……
A2) Farmer mobile no	……
A3) County	……
A4) Location	……
A5) GPS location of farm	……
A6) Gender of farmer	a) Male b) Female
A7) Age of famer	……
A8) Number of household members	……
A9) Total size of farm (in acres)	……
A10) Acres of hired land	
A11) Which crops do you plant:	a. Cashew Nuts b. Sesame c. Both
A12) Who owns the farm?	a) Myself d) My parents b) Myself & Spouse e) Hired Land c) Family Property f) Other Specify
A13) Highest level of education reached	No formal education
	Primary education
	Secondary education
	Tertiary education

A14) Are you the head of the household?	a) Yes a) No	
A15) If not, relation to the head of the household?	a) Husband b) Wife	c) Parent d) Other specify
A16) Gender of owner of the farm	a) Male b) Female	

SECTION B: CASHEW NUT & SESAME FARMING

This section should only be asked for farmers who plant cashew nut

B1)	Number of cashew trees on farm	……
B2)	Density of trees	……trees/acre
B3)	Do all your Cashew nut trees bear nuts?	a) Yes b) No
B4)	If not, how many of them are bearing fruit?	……
B5)	When was the oldest tree planted (year)	……
B6)	When was the youngest tree planted (year)	……
B7)	Average age of the trees on the farm (years)	……
B8)	Has any pruning ever been done to the trees *Ushawahi punguza matawi kwenye mti wako?*	a) Yes b) No
B9)	Number of trees that have ever been pruned *Ni miti mingapi umeshawahi punguza matawi?*	……
B10	At what age are your trees pruned for the first time? *Kwa kawaida, unaaza kupunguza matawi ya miti yako yakiwa na umri gani?*	……

Ask only sesame farmers

B11)	Acreage under production for sesame	

PRODUCTION OF CASHEW AND SESAME IN LAST SEASON

		CASHEW NUTS	**SESAME**
B12	Unit of Harvest (Kg/Bag/Carton/Crate/buckets)		
B13	Unit Weight (Kgs)		
B14	Total Kg Harvested in last season		
B15	Total Units Sold (Kg/Bag/Carton/Crate/buckets)		
B16	Unit Price (KES)		
B17	Satisfaction with the purchasing price for product o Strongly satisfied o Satisfied		

	○ Dissatisfied ○ Strongly dissatisfied		
B18	Total Units Eaten (Kg/Bag/Carton/Crate/buckets)		
B19	Total Units damaged (Kg/Bag/Carton/Crate/buckets)		
B20	If there are quantities damaged, what are the reasons for spoilt crop?		
B21	Market outlet (directly to market, broker, export, TSA)		
B22	Payment type to market (M-Pesa, Cash, Bank Account)		
B23	Sale type (contractual, non-contractual)		
B24	Value of the contract		
B25	Duration of contract		
B26	Is the price dependent on the quality of production? **a)** Yes b) No		
B27	Explain your answer above		

Costs (Kshs)

		CASHEW NUTS	**SESAME**
B28	Monthly cost per acre hired		
B29	Seedling cost		
B30	Fertilizer cost		
B31	Chemical cost		
B32	Land Ploughing cost		
B33	Prunning cost		
B34	Planting cost		
B35	Weeding		
B36	Fertilizer application		
B37	Chemical application/ Spraying		
B38	Harvesting		
B39	Cost of transport		
B40	Cess/ tax		
B41	Other costs		
B42	**Total Expenditure (KES)**		

SECTION C: FARM PRACTICES

C1)	Is your farm Fairtrade Certified?	a) Fairtrade certified b) Audit underway a) Non-Certified
C2)	Is your farm Organic Certified?	a) Organic Certified

		b) Conversion underway b) Non-certified
C3)	Do you use fertilizer on your farm?	
C4)	If yes, Fertiliser Type	a) Manure, d) NPK, b) DAP, e) Foliar c) CAN, f) Other specify
C5)	Amount of fertilizer used per season? Kgs	
C6)	Do you spray any chemicals on your crops?	a) Yes b) No
C7)	Do you spray any chemicals on your crops?	c) Yes d) No
C8)	Chemical Type	a) Pesticide, b) Fungicide c) Other specify..
C9)	Amount of chemical used (Mls/Litres/Grams)	
C10)	Do you hire anyone to work on the farm?	1) No, only use family labour 2) Yes.
C11)	Type of hired labour	1) Permanent Staff – salaried 2) Casual workers
C12)	How many permanent, full-time employees do you employ to work on the farm? Number	
C13)	Total monthly spend on salaries? (Ksh)	
C14)	How many casual laborers did you work with in the entire season?	

OVERALL FARM ASSESSMENT:

C15)	On average, how much KES per year do you make by selling your cashew yield?	……KES/year
C16)	How much do you spend on cashew nut farming	……KES/year
C17)	On average, how much KES per season do you make by selling your sesame yield?	……KES/ssn
C18)	How much do you spend on sesame farming	……KES/ssn
C19)	Total farm income	……KES/year
C20)	Total income including non-farm income	……KES/year

SECTION D: LIVELIHOOD ACTIVITIES:

AGRICULTURAL ACTIVITIES:

For the following section, fill the answers in the table below. Interviewer: Make sure that when asking the question, you encourage your respondents to remember any source of income from farming.

D1) Other than Cashew and Sesame, what other agricultural activities are you/ members of your household engaged in?

_____

D2) Please state which of the produce mentioned in D1 is sold to the market

_____

D3) What is the distance to the market?

_____

D4) Of these, which are the 2 main crops sold to the market?

_____

D5) If sold, how much revenue did you receive in the last 6 months from the sale of crop?

_____

NON-AGRICULTURE ACTIVITIES:

D6) Is there any other additional income you get other than the farming related activities?

a) Yes

b) No

For the following section, fill the answers in the table below.

D7) If yes, what activities are these that bring in additional income?

D8) On average how much revenue did you receive from these streams in the last 6 months?

Interviewer: Encourage your respondents to remember any kind of money that came through activities not related to farming.

Activity	**Revenue received in the last 6months**
a) Salary	
b) Casual labour	
c) IGAs (Shop owner, cobblers, hawkers etc) *a. Specify IGA……..*	
d) Money received in kind (parents, siblings, family etc)	
e) Charities/ grants	
f) Government	
g) Others specify ……	

SECTION E: GROUP PARTICIPATION

	Are you part of a Group?	a) Yes b) No
	If No, are you willing to join producer groups?	a) Yes b) No
	How many groups are you part of	……
For each group fill in the following details:		
	Name of the Group	……

	Ward of operation	……
	Number of group members	……
	Frequency of group meetings	a) Weekly b) Bi-weekly c) Monthly d) Quarterly e) Annually
	As a member, how active are you in participation in the group (voting)	a) Very active b) Rather active c) Unbiased d) Rather passive e) Very passive
	Is there any active cooperation within the members of this group? *Cooperation is involvement in production or marketing or advocacy efforts to gain tangible benefits from such cooperation*	a) Yes b) No
	If yes, what benefits do you gain?	Collective production Collective sales of produce Others specify …
	Does the group have a VSLA component?	a) Yes b) No
	Average group savings per week	……
	Average amount of money given to members from VSLA	……
	MEMBERSHIP IN SACCOs	
	Are you part of a Sacco?	a) Yes b) No
	Name of Sacco	……
	Region of operation	……
	What is your monthly shares/ contribution in the Sacco?	……
	How satisfied are you with the services you receive from the Sacco?	Very satisfied – farmer has a positive experience Rather satisfied Unbiased Dissatisfied Very Unsatisfied

	Explain your answer above	……
Membership in associations		
	Are you part of a farmers' association?	a) Yes b) No
	If yes, please name the associations	……
FARMER PERCEPTIONS ON COMMUNITY ***Interviewer: for the following section read out the statement and let the farmer give their opinion to the statement. Circle the correct answer.***		
	Most neighbouring farmers are willing to help farmer if in need *Wakulima jirani wanajitolea kusaidia mkulima mwenza akihitaji usaidizi*	a) Absolutely yes b) Rather yes c) Unbiassed d) Rather no e) Absolutely no
	Over the last 5 years the level of trust and solidarity in the community has become better *Katika miaka mitano ambayo imepita uaminifu, uhusiano na umoja katika hii jamii umeimarika/ umeboreka*	a) Absolutely yes b) Rather yes c) Unbiassed d) Rather no e) Absolutely no
	Neighbouring farmers can be trusted *Wakulima jirani wanaeza aminika*	Absolutely yes Rather yes Unbiassed Rather no Absolutely no

SECTION F: ACCESS TO FINANCIAL SERVICES

F1	Do you save any money?	a) Yes b) No
F2	Where does the farmer save money	a) Sacco b) Bank c) Mobile money d) VSLA/Chama e) Other Specify
F3	Have you ever taken a loan?	a) Yes b) No
F4	If yes, from whom did the farmer borrow the loan	a) SHG/ Producer Group b) VSLA

		c) Bank d) Mobile money e) MFI f) Other specify
F5	What was the purpose of the loan	1. Running of farm activities (purchase inputs, management) 2. Buying /leasing land 3. School Fees 4. Others Specify ……
F6	In the last 6 months, what is the total amount of loans received from the different sources?	……
F7	How much did you pay back	……

SECTION G: ACCESS TO EXTENSION SERVICES & TRAINING

G1	Have you ever received any extension support for your crops?	a) Yes b) No
G2	If yes, from whom have you received extension support?	a) Gvt extension officers b) Other farmers c) Private firms…specify d) NGOs …Specify e) Others …specify
G3	Frequency of visits by extension service provider	a) Once a month or more b) Quarterly c) Once every 6 months d) Once a year e) Infrequent: Only when needed f) Other
G4	Quality of provided services	Very good Rather satisfactory Unbiased Rather passive Very passive
G5	Have you ever received any training on your cashew nut production?	a) Yes b) No
G6	Have you ever received any training on your sesame production?	a) Yes b) No
G7	When did you receive this training? *(year)*	

		……

Appendix B

Appendix B1: Questionnaire used for data collection – Case Study 2

Section A: *Socio-cultural characteristics*

A1) Name of E/RAW		
A2) E/RAW mobile number		
A3) L.G.A.		
A4) Village		
A5) Gender of extension or rural advisory worker (E/RAW)	0. Female 1. Male	
A6) Age of extension or rural advisory worker (years)		
A7) Highest level of education reached	0.No formal education 1. Primary education 2.Secondary education 3. Bachelors 4. Masters 5. Ph.D. 6. Post-doctoral 6. Other specify	
A8) What is the field of education?	0.Agricultural economics 1. Agricultural extension 2.Communications 3. Forestry 4. Animal sciences 5. Plant sciences 6. Rural development 6. Others	
A9) Total number of years spent in formal education		
A10) Years of experience as an extension or rural advisory worker	Can you recollect the year you started working as an extension agent _____? Was there a time you stopped discharging your duties as an extension worker? 1. Yes 2. No If yes, how long was this _____? What is the total number of your years of experience as an extension or rural advisory worker _____?	
A11) Are you married?	1. Yes	2. No
A12) Which extension programme do you work for?		
A13) Religious belief of extension or rural advisory worker	1. Muslim 4. Eckankar 2. Christian 5. Hari Krishna 3. Traditionalist 6. Other	

A14) Do you reside in the same region/LGA/district/village of your extension work placement?	1. Yes	2. No
A15) How far in kilometres do you live from your extension work placement?		
A16) Do you speak the same language as the farmers you are in contact with?	1. Yes	2. No
A17) Is your cultural origin the same with the farmers you are in contact with?	1. Yes	2. No
A18) Are you an extension agent or rural advisory worker	1. Yes	2. No
A19) Which of the following work designation or title do you use?	1. Extension officer 5. Programme coordinator 2. Agricultural technician 6. Project officer 3. Chief agricultural technician 7. Field assistant 4. Field officer 8. Other	
A20) Do you receive training on the job?	1. Yes	2. No
A21) How often do you receive training on the job?	1. less than once a year 2. At least once per year 3. At least once per month 4. At least once per week	
A22) Have you participated in any agricultural extension programme in the past 2 -3 years?	1. Yes	2. No
A23) If yes, which of the listed programmes did you participate in?	1.Fadama I 2. Fadama II 3.Fadama III 4. others	

Section B: Perceived level of importance of professional tasks

On a scale of low, moderate and high, rate the following tasks according to your perceived level of importance for quality of services provided to farmers

B1) Evaluating the extension program based on farmers needs	1. Low	2. Moderate	3. High
B2) Applying technical knowledge in the area of disseminating modern agricultural technologies	1. Low	2. Moderate	3. High
B3) Coordinating work schedules with other colleagues	1. Low	2. Moderate	3. High
B4) Involving farmers in program planning	1. Low	2. Moderate	3. High
B5) Preparing visual aids to help deliver information	1. Low	2. Moderate	3. High
B6) Presenting power point presentations or flip charts or seminar talks to convey extension messages effectively	1. Low	2. Moderate	3. High
B7) Initiating ways to encourage farmers to adopt new technologies or innovations	1. Low	2. Moderate	3. High

Section C: Perceived level of competence

On a scale of low, moderate and high, rate the following qualities according to your perceived level of importance for your job

C1) Applying your understanding about block, people, & culture	1. Low	2. Moderate	3. High
C2) Dealing effectively with field related challenges	1. Low	2. Moderate	3. High
C3) Situational analysis of extension programs	1. Low	2. Moderate	3. High
C4) Designing farmers' training	1. Low	2. Moderate	3. High
C5) Persuading farmers to adopt modern agricultural technologies	1. Low	2. Moderate	3. High
C6) Ability to foresee future extension prospects and challenges	1. Low	2. Moderate	3. High
C7) Introducing new methods in extension work	1. Low	2. Moderate	3. High
C8) Sensitive to the feelings and wishes of farmers	1. Low	2. Moderate	3. High
C9) Confidence to work without guidance and support	1. Low	2. Moderate	3. High
C10) Manage time effectively	1. Low	2. Moderate	3. High

Section D: *Perceived level of satisfaction*

To what degree is your perception about the following as regards **level of satisfaction** as extension and rural advisory workers

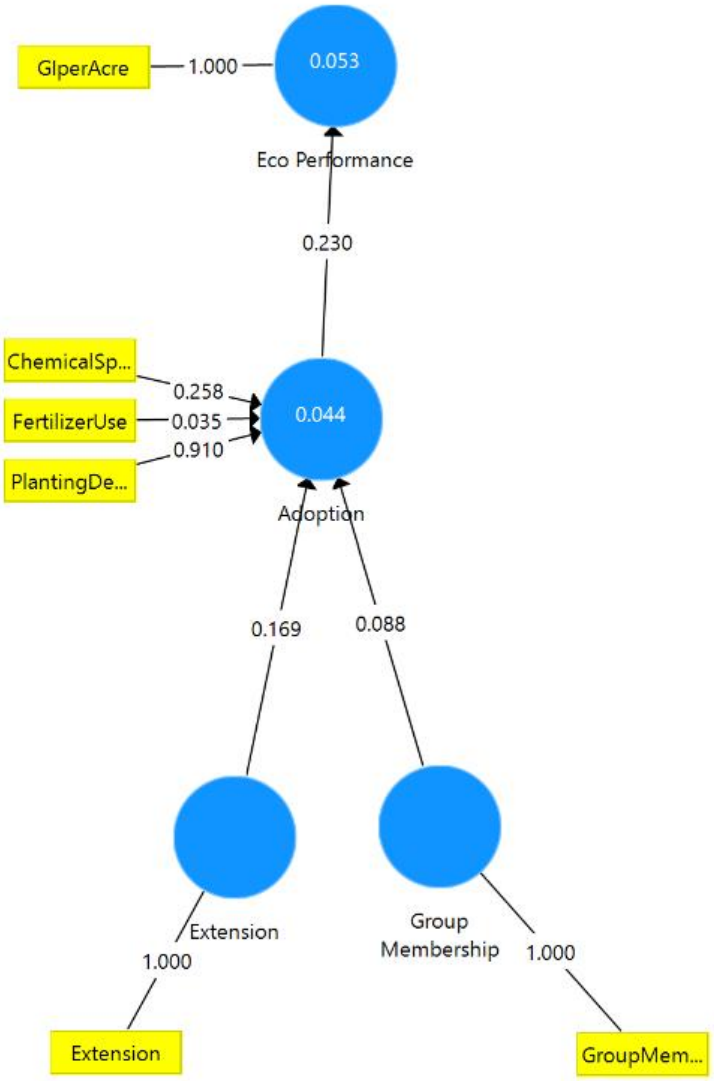
D1) Your job exceed your expectations overall				
1. Strongly disagree	2. Disagree	3. Uncertain	4. Agree	5. Strongly agree
D2) Your salary exceeds your expectations considering invested time				
1. Strongly disagree	2. Disagree	3. Uncertain	4. Agree	5. Strongly agree
D3) Promotion at your work place is commensorate to your experience				
1. Strongly disagree	2. Disagree	3. Uncertain	4. Agree	5. Strongly agree
D4) The means of transportation provided is convinient				
1. Strongly disagree	2. Disagree	3. Uncertain	4. Agree	5. Strongly agree
D5) Trainings received on the job are sufficient				
1. Strongly disagree	2. Disagree	3. Uncertain	4. Agree	5. Strongly agree
D6) You feel a high sense of job security at your work place				
1. Strongly dissatisfied	2. Dissatisfied	3. Uncertain	4. Satisfied	5. Strongly satisfied
D7) You feel …….. with the nature of your work				
1. Strongly dissatisfied	2. Dissatisfied	3. Uncertain	4. Satisfied	5. Strongly satisfied
D8) You feel ……..with the respect received from co-workers				
1. Strongly dissatisfied	2. Dissatisfied	3. Uncertain	4. Satisfied	5. Strongly satisfied
D9) You feel ……..with the respect received from farmers				

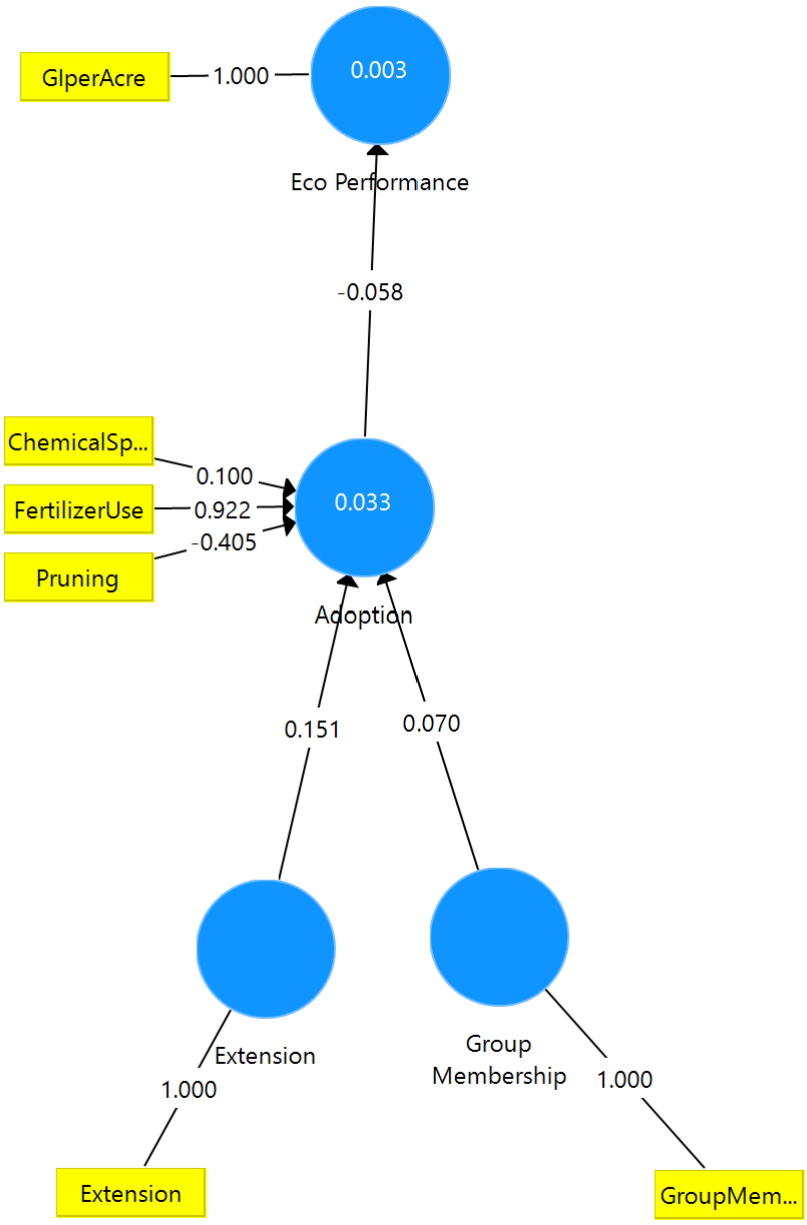
1. Strongly dissatisfied	2. Dissatisfied	3. Uncertain	4. Satisfied	5. Strongly satisfied
D10) You feel …….with the level of appreciation at work				
1. Strongly dissatisfied	2. Dissatisfied	3. Uncertain	4. Satisfied	5. Strongly satisfied
D11) You feel…… with the level of safety when carrying out your work responsibilities				
1. Strongly dissatisfied	2. Dissatisfied	3. Uncertain	4. Satisfied	5. Strongly satisfied
D12) How satisfied are you overall working as an extension or rural advisory worker in the past 2 – 3 years?				
1. Strongly dissatisfied	2. Dissatisfied	3. Uncertain	4. Satisfied	5. Strongly satisfied

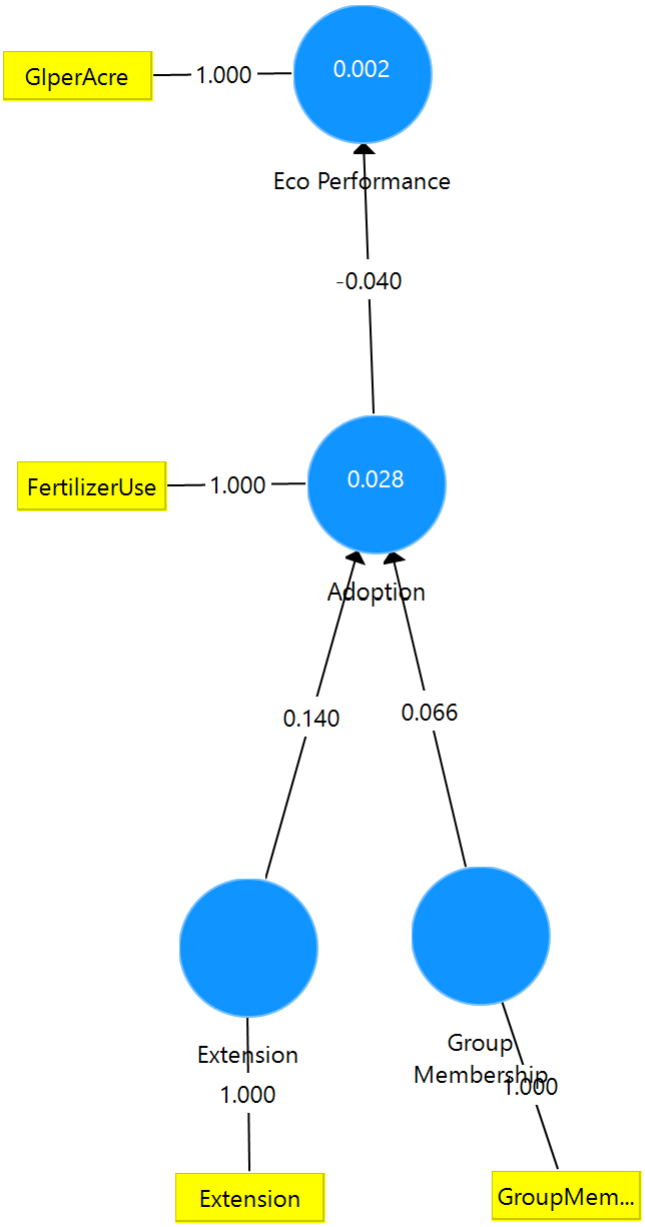
D13) Which of the areas below will you suggest for improvement?

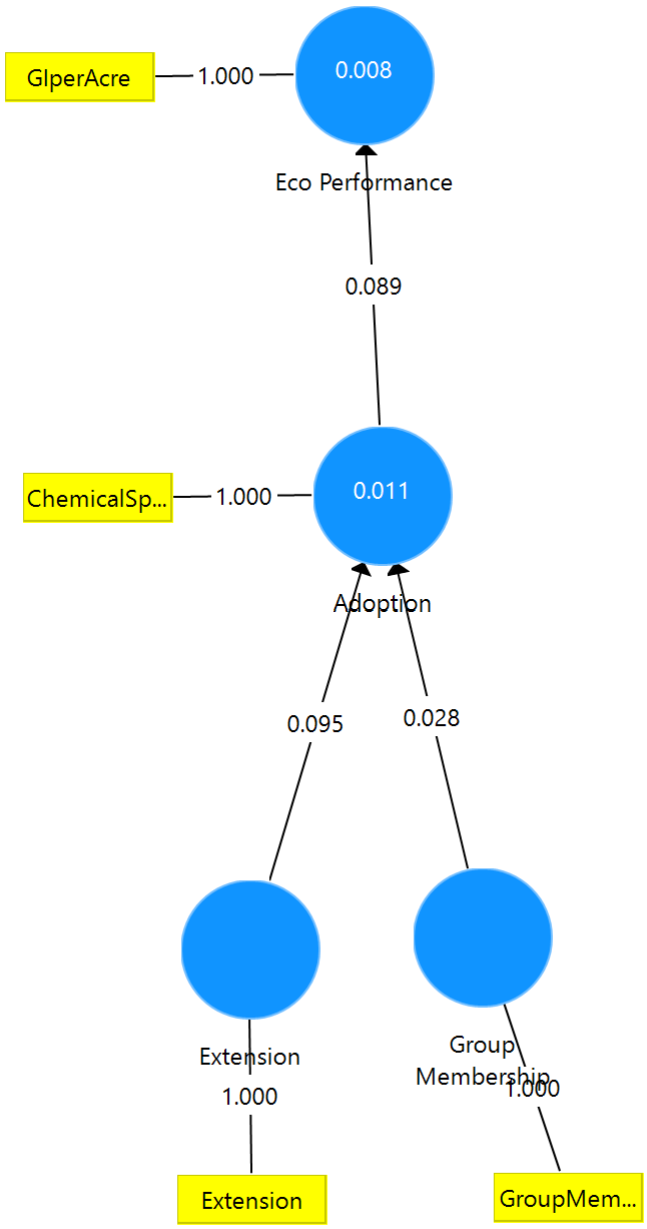
1.Pay	2. Promotion
3. Convenient means of transportation	4. Trainings
5. Job security	6. Respect from co-workers
7. Appreciation at work	8. Safety/Insurance for workers
9. Others	

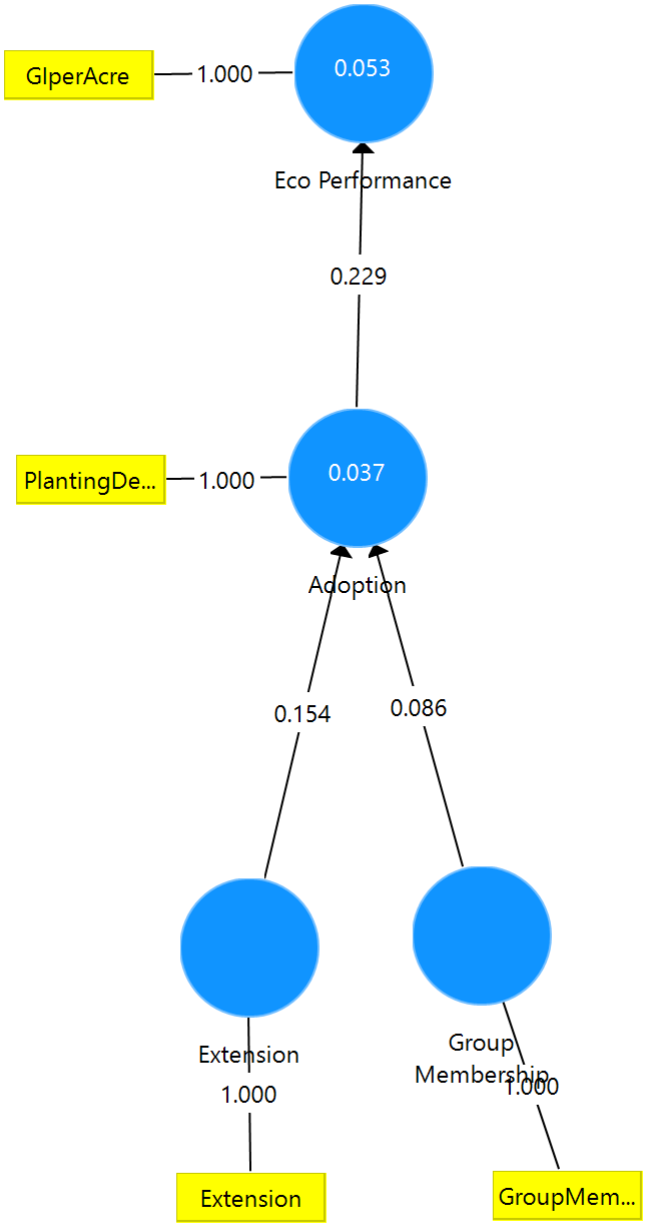
Appendix I - The SEM model for variable adoption




GlperAcre
1.000
0.003
Eco Performance
-0.058
ChemicalSp...
FertilizerUse
Pruning
0.100
0.922
-0.405
0.033
Adoption
0.151
0.070
Extension
1.000
Extension
Group
Membership
1.000
GroupMem...


GlperAcre
1.000
0.002
Eco Performance
-0.040
FertilizerUse
1.000
0.028
Adoption
0.140
0.066
Extension
1.000
Extension
Group Membership
1.000
GroupMem...


GlperAcre
1.000
0.008
Eco Performance
0.089
ChemicalSp...
1.000
0.011
Adoption
0.095
0.028
Extension
1.000
Group Membership
1.000
Extension
GroupMem...


GlperAcre
1.000
0.053
Eco Performance
0.229
PlantingDe...
1.000
0.037
Adoption
0.154
0.086
Extension
1.000
Group Membership
1.000
Extension
GroupMem...

Appendix II – Total indirect effects

SmartPLS Report

Please cite the use of SmartPLS: Ringle, C. M., Wende, S., and Becker, J.-M. 2015. "SmartPLS 3." Boenningstedt: SmartPLS GmbH, http://www.smartpls.com.

back to navigation

Total Indirect Effects

Mean, STDEV, T-Values, P-Values

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Adoption -> Eco Performance					
Extension -> Adoption					
Extension -> Eco Performance	0.039	0.042	0.023	1.706	0.089
Group Membership -> Adoption					
Group Membership -> Eco Performance	0.020	0.020	0.016	1.235	0.217

Appendix III – Construct reliability and validity

SmartPLS Report

Please cite the use of SmartPLS: Ringle, C. M., Wende, S., and Becker, J.-M. 2015. "SmartPLS 3." Boenningstedt: SmartPLS GmbH, http://www.smartpls.com.

back to navigation

Construct Reliability and Validity

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Eco Performance	1.000	1.000	1.000	1.000
Extension	1.000	1.000	1.000	1.000
Group Membership		1.000		
Adoption		1.000		

Appendix IV – Model fit

SmartPLS Report

Please cite the use of SmartPLS: Ringle, C. M., Wende, S., and Becker, J.-M. 2015. "SmartPLS 3." Boenningstedt: SmartPLS GmbH, http://www.smartpls.com.

back to navigation

Model_Fit

Fit Summary

	Saturated Model	Estimated Model
SRMR	0.035	0.036
d_ULS	0.026	0.028
d_G	0.005	0.006
Chi-Square	9.792	10.231
NFI	0.916	0.913

Appendix V – ESR with 4 explanatory variables

```
Endogenous switching regression model             Number of obs   =        298
                                                  Wald chi2(4)    =      11.37
Log likelihood = -3520.5915                       Prob > chi2     =     0.0227

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
gross_income_1 |
       hh_head |  -466.0085   4595.536    -0.10   0.919    -9473.093    8541.076
           age |    89.6129   149.6777     0.60   0.549      -203.75    382.9758
     farm_size |   1228.453   380.7156     3.23   0.001     482.2646    1974.642
  labour_hired |  -2211.316    3811.92    -0.58   0.562    -9682.541     5259.91
         _cons |   2938.473   10855.19     0.27   0.787    -18337.31    24214.26
-------------+----------------------------------------------------------------
gross_income_0 |
       hh_head |     757.93   3575.794     0.21   0.832    -6250.498    7766.358
           age |   260.2167   112.6348     2.31   0.021     39.45652    480.9769
     farm_size |   644.0248   289.5079     2.22   0.026     76.59976     1211.45
  labour_hired |   26836.54   3584.998     7.49   0.000     19810.07       33863
         _cons |  -9876.249   5295.585    -1.86   0.062    -20255.41    502.9073
-------------+----------------------------------------------------------------
fertilizer_use |
       hh_head |   .0674474   .2139645     0.32   0.753    -.3519154    .4868101
           age |   .0081533   .0066025     1.23   0.217    -.0047874     .021094
     farm_size |  -.0182633   .0173643    -1.05   0.293    -.0522967    .0157701
  labour_hired |   .2815224   .1871425     1.50   0.132    -.0852702     .648315
  group_member |   .3396392   .1997534     1.70   0.089    -.0518702    .7311487
     extension |   .3236021   .1959803     1.65   0.099    -.0605123    .7077165
         _cons |  -1.356528    .327718    -4.14   0.000    -1.998843   -.7142124
-------------+----------------------------------------------------------------
       /lns1 |   9.527355   .1226004    77.71   0.000     9.287063    9.767648
       /lns2 |   9.996997   .0466823   214.15   0.000     9.905501    10.08849
         /r1 |  -.2966078   .4012585    -0.74   0.460    -1.08306    .4898445
         /r2 |   .0415794   .1998523     0.21   0.835    -.3501238    .4332827
-------------+----------------------------------------------------------------
     sigma_1 |   13730.23   1683.332                      10797.43    17459.65
     sigma_2 |   21960.41   1025.163                      20040.31    24064.49
       rho_1 |  -.2882052   .3679291                     -.7943311     .454093
       rho_2 |   .0415555   .1995072                     -.3364854     .408061
------------------------------------------------------------------------------
LR test of indep. eqns. :            chi2(1) =    57.75   Prob > chi2 = 0.0000
------------------------------------------------------------------------------
```

Appendix VI – ESR with 7 explanatory variables

```
Endogenous switching regression model             Number of obs   =        298
                                                  Wald chi2(7)    =      25.16
Log likelihood = -3504.8753                       Prob > chi2     =     0.0007

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
gross_income_1  |
        hh_head |  -2598.888   4249.129    -0.61   0.541    -10927.03    5729.252
            age |    188.363   147.7635     1.27   0.202    -101.2482    477.9741
      education |   9454.548   4093.101     2.31   0.021     1432.216    17476.88
      farm_size |   1120.592   358.2409     3.13   0.002     418.4525    1822.731
   labour_hired |   -1876.53   3489.224    -0.54   0.591    -8715.283    4962.224
off_farm_income |   -8341.77   3853.098    -2.16   0.030     -15893.7   -789.8366
          loans |  -214.3566   3495.518    -0.06   0.951    -7065.446    6636.733
          _cons |  -5529.159   13467.09    -0.41   0.681    -31924.17    20865.85
----------------+----------------------------------------------------------------
gross_income_0  |
        hh_head |  -775.6736   3589.922    -0.22   0.829    -7811.792    6260.444
            age |   333.5178   121.9875     2.73   0.006     94.42666     572.609
      education |   6899.152   3940.042     1.75   0.080    -823.1891    14621.49
      farm_size |   518.9483   288.2301     1.80   0.072    -45.97227    1083.869
   labour_hired |   25937.77   3620.906     7.16   0.000     18840.92    33034.61
off_farm_income |  -8310.577   3719.587    -2.23   0.025    -15600.83   -1020.321
          loans |  -548.3234   3569.507    -0.15   0.878    -7544.429    6447.782
          _cons |  -14722.12   6851.372    -2.15   0.032    -28150.56   -1293.676
----------------+----------------------------------------------------------------
fertilizer_use  |
        hh_head |   .0913829   .2229248     0.41   0.682    -.3455416    .5283075
            age |   .0092128   .0070499     1.31   0.191    -.0046048    .0230304
      farm_size |   -.010501   .0176007    -0.60   0.551    -.0449977    .0239957
   labour_hired |   .2058533   .1957232     1.05   0.293    -.1777571    .5894636
off_farm_income |   .5030518    .183036     2.75   0.006     .1443079    .8617957
          loans |   .2374006   .1965113     1.21   0.227    -.1477544    .6225556
      education |   .0106604   .2271638     0.05   0.963    -.4345725    .4558932
   group_member |   .2249343   .2136825     1.05   0.292    -.1938758    .6437444
      extension |   .2328738    .196102     1.19   0.235     -.151479    .6172267
          _cons |  -1.660319   .4247787    -3.91   0.000     -2.49287   -.8277684
----------------+----------------------------------------------------------------
       /lns1 |   9.415281   .1099414    85.64   0.000       9.1998    9.630762
       /lns2 |   9.978631   .0465742   214.25   0.000     9.887348    10.06992
         /r1 |  -.2046272   .4445426    -0.46   0.645    -1.075915    .6666603
         /r2 |   .0220333   .2210674     0.10   0.921    -.4112508    .4553174
-------------+----------------------------------------------------------------
     sigma_1 |   12274.52   1349.477                      9895.146    15226.03
     sigma_2 |   21560.78   1004.175                       19679.8    23621.56
       rho_1 |  -.2018182   .4264362                     -.7916792    .5827788
       rho_2 |   .0220297   .2209601                     -.3895342    .4262601
------------------------------------------------------------------------------
LR test of indep. eqns. :            chi2(1) =    61.13   Prob > chi2 = 0.0000
```