University of Reading

The Use of Agricultural Innovation Systems approaches in Sierra Leone: Exploring Perceptions on Innovations in Rice Production, Research and Extension

Doctor of Philosophy (PhD)

School of Agriculture, Policy and Development

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DECLARATION

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged. No part of it has been submitted previously for a degree at any university.

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Lamin Ibrahim Kamara

DEDICATION

This study is dedicated to my family, particularly my wife – Mrs Jenneh Kamara, and my son – Faisal Lamin Ibrahim Kamara. They endured a great deal of deprivation of my time with them (amongst other things) in order for me to achieve this feat.

ABSTRACT

Agriculture is the major contributor to the economic development of Sierra Leone and by far the largest employer of the majority of the country's workforce. The Government's strive to bolster the development of the agriculture sector, has encouraged the pluralisation of research and extension innovation programmes, encompassing the participation of diverse actors beyond the public sector to increasingly embrace an Agricultural Innovation Systems (AIS) approach. However, limited knowledge exists on the effectiveness of research and extension innovations in the country, particularly from an innovation systems' perspective.

Rice has been promoted as the country's staple food crop since 2005. The purpose of this study has been to assess innovations within the rice sector, between 2005 and 2015, from an AIS perspective, by exploring the views of research and extension professionals, as well as smallholder farmers at community level; on four key innovations including Improved Rice Varieties, System of Rice Intensification, Technical Package on Rice and Agriculture Business Centers.

Specifically, the research objectives of the study were: 1) to investigate the rice innovation processes and systems in Sierra Leone and establish the extent to which an AIS approach has been effected, based on the perspectives of research and extension professionals; 2) to identify and analyse the beliefs, attitudes, and behaviours of research and extension professionals which influence their use of an AIS approach; and, 3) to assess the influence of research and extension programmes on smallholder rice farmers' innovation processes in the country.

The study used a mixed methods approach to gather and analyse data from agricultural research scientists, extension personnel, and smallholder farmers. The Theory of Planned Behaviour was applied to address objective two of the study; the remainder of the objectives were informed by AIS theory. Research tools for the data generation that informed the study included: workshops (2); focus group discussions (26); key informant interviews (73); structured questionnaires (322); and document reviews. The final sample size for the structured questionnaires comprised of farmers (n=200), research scientists from the Sierra Leone Agriculture Research Institute (n=35), extension professionals from the Ministry of Agriculture, Forestry and Food Security (MAFFS) and Non-Governmental Organisations (n=87).

Findings indicated a generally weak innovation system for rice in the country; Many innovations promoted within the study period involved a few dominant actors within the research and extension environment. There was also evidence of limited effort from research and extension actors to link

farmers to external service providers such as traders, transporters, agro-dealers, and financial institutions. The innovation system was further weakened by a myriad of structural constraints including poor training/mentoring of research and extension staff, poor credit and financial services, high cost of technologies, poor communication facilities, poor access to markets for farmers and mobility for staff, lack of trust and poor collaboration and interaction among innovation system actors, and poor institutional policies.

Further, the research found that research and extension professionals held positive attitudes towards the use of an AIS approach to innovation processes on rice. Their positive attitudes towards the AIS approach were largely influenced by their belief that using an AIS approach can have a range of desirable outcomes in rice production, including increasing productivity and profitability of innovations, food security, access to markets, reducing burden on any one actor, and capacity development of innovation stakeholders. However, the perceived control respondents have in their organisations, defined by their ability to take decisions on their activities, having the adequate knowledge and skills, as well as adequate financial resources, has the highest influence on their intention to use an AIS approach. This is followed by their perceived social pressure within their social circles (social referents), particularly employers, supervisors, colleagues, and donors. Their attitudes had the least influence on their intention to use an AIS approach.

Finally, the study found that research and extension programmes have not had the desired influence on smallholder farmers' innovation processes or their innovation capacity. Farmers were found to have either dropped or not used external innovations due to innovation-specific and general constraints. They largely depend on their own initiative or on traditional methods for rice cultivation. Smallholder farmers lack the support needed to establish reliable and useful links with actors beyond research and extension who could improve their access to services, such as finance, markets, and transportation, which therefore limits their innovative capacity in general.

The study highlights the need for the main AIS actors, including the MAFFS, to strengthen and facilitate the effective use of AIS approaches by research and extension professionals across all levels in the country. This may include creating an enabling environment for relevant actors beyond research and extension actors, to enhance the effective design and implementation of agricultural innovation programmes that are widely participatory and inclusive. This should involve addressing the perceived difficulties identified which influenced intention to use an AIS approach, together with perceived social pressure. This may deepen the sustainability and functional utility of agricultural innovation. Similar research in other countries is recommended to deepen understanding of what influences the use and effectiveness of AIS approaches.

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The great Nigerian Writer, Chinua Achebe, once said: “A toad does not run in the day time for nothing, there must be a reason for it”. Indeed, there is always a reason, not only for the actions one takes, but also for having the ability to execute them well. This is so true in my case. My decision and my ability to undertake this study was due only to the function of a plethora actors. These actors are innumerable, thus any attempt to acknowledge them all by name will produce a copious piece to read. Hence, a deliberate attempt has been made to mention only a few who contributed in a variety of ways towards the success of this study.

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LIST OF ABBREVIATIONS

ABCs	Agricultural Business Units
ADB	African Development Bank
AGRA	Alliance for a Green Revolution in Africa
AKIS	Agriculture Knowledge and Information Systems
AIS	Agriculture Innovation Systems
BI	Behavioural Intention
CARD	Coalition for Africa Rice Development
CABI	Centre for Agriculture and Bioscience International
CARE	Cooperative for Assistance and Relief Everywhere
CAWeC	Community Action for the Welfare of Children
CIFD	Collective Initiative for Development
COOPI	Cooperazione Internazionale
CRS	Catholic Relief Services
DFID	Department for International Development
EU	European Union
FAO	Food and Agriculture Organisation
FBOs	Farmer Based Organisations
FEW	Frontline Extension Worker
FFS	Farmer Field School
FGD	Focus Group Discussion
FIOH	Future In Our Hands
FSR	Farming Systems Research
GAFSP	Global Agriculture and Food Security Programme
GbonFA	Gbonkolenken Farmers Association
GDP	Gross Domestic Product
GFRAS	Global Forum for Rural Advisory Services
GTZ	German Agency for Technical Cooperation
HIV/AIDS	Human Immuno Virus/ Acquired Immune Deficiency Syndrome
IDB	International Development Bank
IPPM	Insect Pest Prevention and Management

IPM	Integrated Pest Management
IVM	Integrated Vector Management
IFAD	International Fund for Agricultural Development
IFOAM	International Federation of Organic Agriculture Movements
ICT	Information and Communication Technology
IITA	International Institute for Tropical Agriculture
I-PRSP	Interim Poverty Reduction Strategy Paper
INGO	International Non-Governmental Organisations
IITA	International Institute for Tropical Agriculture
IRRI	International Rice Research Institute
IVS	Inland Valley Swamp
JICA	Japanese International Cooperation Agency
KII	Key Informant Interview
LNGOs	Local Non-Governmental Organisations
LRVs	Local Rice Varieties
MAF	Ministry of Agriculture and Forestry
MAFFS	Ministry of Agriculture, Forestry and Food Security
MAFFS	Ministry of Agriculture, Forestry and Food Security
NARCC	National Agricultural Research Coordinating Council
NARS	National Agricultural Research Systems
NERICA	New Rice for Africa
NGOs	Non-Governmental Organisation
NRS	National Recovery Strategy
NSADP	National Sustainable Agriculture Development Plan
PRSP	Poverty Reduction Strategy Paper
PICS	Purdue Improved Crop Storage.
PBC	Perceived Behavioural Control
RSL	Republic of Sierra Leone
RARC	Rokupr Agricultural Research Center
RIU	Research Into Use
SCP	Smallholder Commercialisation Programme

SLIEPA	Sierra Leone Investment and Export Promotion Agency
SRI	System of Rice Intensification
SLARI	Sierra Leone Agriculture Research Institute
SLeSCA	Sierra Leone Seed Certification Agency
SILC	Savings and Internal Lending Communities
SLANGO	Sierra Leone Association of NGOs
SMP	Seed Multiplication Project
TOT	Transfer of Technology
TORA	Theory of Reasoned Action
TP-R	Technical Package on Rice
TPB	Theory of Planned Behaviour
UNDESA	United Nations Department of Economic and Social Affairs
WAAP	West Africa Agricultural Productivity Programme
WARC	West Africa Rice Company
WFP	World Food Programme

CHAPTER 1 : BACKGROUND INFORMATION TO THE STUDY

1.1 Introduction

The focus of this chapter is as a general introduction which highlights key information and supports the need for conducting the study in the target area. It specifically provides background information on global poverty and hunger, the prevalence of agriculture and its corresponding importance with respect to poverty, hunger, and development. Agricultural research and extension is discussed as a key component of agricultural development and a brief overview of the agriculture sector in Sierra Leone is provided. A statement of the problem is made to highlight the role of agricultural research and extension, the different models that have been used in the delivery of extension services globally, and the changing perspectives (shifts) which concern the delivery of both research and extension programmes. Drawing on this, the key research objectives and questions of the study are identified, the approach adopted in the research and the structure of the thesis are also explained.

1.2 Background

Poverty and hunger remain critical challenges in the developing world, regardless of the gains made in many regions. An estimated 30% of the world's population (1.57 billion people) live in multidimensional poverty (Human Development Report, 2013); an estimated 70% of the world's poor live in rural areas; and, nearly all (84% to 99%) of the world's poor rely on agriculture for their livelihoods (FAO 2006a)

According to the World Bank, poverty levels among people in Sub-Saharan Africa (SSA) are the highest (48.5%) when compared to other regions in the developing world, such as South Asia (31.0%), East Asia (12.5%), and Latin America/Caribbean (5.5%) (cited in Moore, 2014). While there has been a drop in the numbers of those suffering from global poverty, from 31% of the population in 1990 to 14% in 2008 (World Bank, 2012a), improvements in South Asia, East Asia, and Latin America/Caribbean have greatly outpaced those in SSA. Hunger prevalence in SSA is also the highest (26.8%) when compared to South Asia (17.6%), East Asia (11.5%), and Latin America/Caribbean (8.3%); and, even though there has been a slight fall in global hunger from 1999 to 2012 (13.2%), the trends differ markedly by region (FAO, 2012). In South/East Asia hunger decreased from 23.7% to 13.9%, and from 14.6% to 8.3% in Latin America/Caribbean, while in SSA, the number of people living in hunger increased by 90 million during the same period – a two percent increase per year since 2007 (Wiggins & Leturque, 2010; World Hunger, 2013). Similarly, a report by the FA0 (2013) indicated that hunger and malnutrition affected nearly one in three persons in SSA.

Hunger and poverty are intertwined and have been major setbacks for development in the region (Moore, 2014). Poverty, at the local level, contributes to hunger by impacting negatively on community and household food security (Moore, 2014). Poverty affects food access, among other problems, by limiting the ability to purchase adequate amounts of quality food. On the other hand, hunger has dire impacts which exacerbate poverty. Hunger-related illnesses lead to widespread deaths, affect the spread and severity of infectious disease, reduce educational attainment, decrease economic growth and production, and cause other negative societal conditions (Moore, 2014). The Food and Agriculture Organisation (FAO) (2013) estimated the socio-economic burden of malnutrition to be $US3.5 trillion annually, or $US500 per person.

While agriculture is the major mainstay in most developing countries (Mulhall and Garforth, 2000), for underdeveloped nations dominated by agriculture its development is highly important, especially as it is in these nations where the majority of the world's poor and hungry are located (World Bank, 2013). Agriculture remains the principal occupation of the majority of people in Africa and constitutes the largest productive sector, averaging 32 percent of GDP (Bagchee, 1994:9). Addison (2005: 1) similarly claims, "overall development success or failure is often an outcome of what happens in agriculture". Agriculture and food production alleviate poverty and hunger by improving food security and reducing food costs, especially in the developing world where the agricultural sector dominates national economies (FAO, 2013; World Bank, 2013). Estimates from the World Bank show that agriculture accounts for over a third of Africa's GDP, while in many countries the sector provides 60-90% of employment (World Bank, 2008). The European Union (2007) also estimates that agricultural production on small-scale farms in low-income countries accounts for a large proportion of staple food crop production on the continent. The Department for International Development in the UK notes that increases in agricultural production improve rural incomes, promote local and national economic growth, and can lower food costs (DFID, 2004). Bresciani and Valdes (2007) similarly comment that agriculture plays an important role in economic growth, food security, poverty reduction, livelihoods, rural development, and the environment. They found that agricultural development had a greater impact on poverty reduction than growth in other sectors, an assertion supported by Christiansen and Demery (2007) and Ravallion (2009). According to the International Fund for Agricultural Development (IFAD), a 1% increase in per capita agricultural GDP had more than five times the impact on poverty reduction as GDP increases in other sectors (IFAD, 2013). In Africa, a 10% increase in yields was found to create a 7% reduction in poverty across the continent (IFAD, 2013). These figures emphasise the important linkages between agricultural development and poverty reduction. Clearly, the development of agriculture is viewed as an important tool in poverty alleviation, employment creation, and economic growth. This is particularly true in the developing world where the majority of the poor depend on agriculture for their livelihoods and it is the poorest people who are most positively impacted by agricultural development (Ligon & Sadoulet, 2008). The Nobel Prize winning development economist, Theodore Schultz (1980), argued that “most of the world’s poor people earn their living from agriculture, so if we knew the economics of agriculture we would know much of the economics of being poor”.

Consistently, the majority of rural poor depend on small-scale agriculture (less than two hectares), and this is the predominant form of farming worldwide (IFAD, 2013). The IFAD (2013) reported an estimated 500 million small farms and 2.5 billion people to be involved in small-scale agriculture, and that more than 80% of the food consumed in the developing world originates from small farms, especially in the world’s poorest regions, such as South Asia and SSA. Smallholder farmers, according to the International Federation of Organic Agriculture Movements (IFOAM), are the “backbone of agriculture and food security” (IFOAM, 2001:1). Therefore, the development of smallholder agriculture, in particular, has a widespread impact on development, poverty reduction, and other socio-economic factors (Hazell, 2011; Wiggins & Leturque, 2010). As such, smallholder farmers are often the focus of development efforts that target poverty and hunger, especially in the developing world.

Given the increasing population trend, especially in the context of a global population that reached 7 billion in 2012 and is projected to reach 9 billion by 2050 (United Nations Department of Economic and Social Affairs (UNDESA] (2013), the FAO warned that the production of staple crops must increase by 60% by 2050 to meet the growing demands related to these population dynamics (FAO, 2013b). Demand for cereal crops, in particular, will increase from 2.1 billion tons in 2013, to over 3.25 tons in that same period (FAO, 2009). Increasing yields and production capacity on limited land is essential and important for hunger alleviation at the global, national, and local levels. This focus within the fields of agricultural development and food security has augmented food productivity over the past 50 years (Moore, 2014), and per capita food production has increased by 141% worldwide. From the 1960s to 2013, much of this growth has occurred in staple crop production, particularly of the three main cereal grains – maize, rice, and wheat (FAO, 2013b). Global cereal production increased by nearly 300% from 1961 to 2013 (FAO, 2013).

The development of agriculture is, to a large extent, a function of agricultural research and extension (Swanson et al., 1997). Both highly important catalysts for agricultural growth (Mulhall and Garforth, 1994; Cervantes-Godoy & Dewbre, 2010), these services improve the productive capacity of the agricultural sector and help promote sustainable livelihoods for farmers (Longley et al., 2007; Scoones, 1998). As such, the establishment of effective and stable research and extension institutions and processes is the goal of virtually all agricultural development strategies (Swanson & Rajalahti, 2010).

In some countries these services have primarily been the responsibility of universities, while in others ministries of agriculture have been responsible for their provision directly to farmers (Swanson & Rajalahti, 2010, p. 1). Public extension systems are the predominant model around the world, and especially in developing nations (Moore, 2014). While the objectives of research and extension services have changed over time, and differ by context, most systems focus primarily on improving national food security (Swanson & Rajalahti, 2010). This goal has traditionally been accomplished by identification of improved varieties, technologies, and practices which would increase production. From the 1960s to the early 1980s, a technology transfer model was mostly used to disseminate these innovations and accompanying technical information to farmers through the use of "extension experts" (Seevers, Graham, & Conklin, 2007). Experts were often employed through a country's Ministry of Agriculture as extension officers, or subject matter specialists. As the provision of extension services transcended beyond the transfer of technology to more participatory models, it became a challenge to continue such provision to farmers, particularly in developing nations where funding is often inadequate to allow expenses, which include payment and training of extension personnel (Feder, Willett, & Zijp, 1999; Swanson et al., 1997). This, together with economic constraints arising from structural adjustment, led to the privatisation and/or pluralisation of research and extension services in many countries in order to enhance their effectiveness for farmers (Roling, 1986; Swanson et al., 1997). Privatisation did not include a total shift in provision to the private sector, rather it resulted in a reduction in specific aspects of research and extension service delivery via the public system, and an expansion via private actors (Swanson & Rajalahti, 2010). However, privatisation in the developing world was viewed cautiously and not considered feasible for the provision of extension services to populations with high numbers of smallholder subsistence farmers – the weaknesses of privatisation can often outweigh the benefits (Feder et al., 1999; Umali-Deininger, 1996). This has led to an increase in some public systems pursuance of the pluralisation of extension services to better address modern extension objectives and realities (Hazell, 2011; Swanson & Rajalahti, 2010). Pluralistic extension approaches contain diverse service providers, approaches/models, sources of funding, and information available to farmers (Mulhall and Garforth, 1994; Leeuwis, 2004; World Bank, 2012b). Pluralistic extension systems may include: government/public systems; private companies; international or domestic NGOs; non-affiliated community extension workers; or other actors (World Bank, 2012b). Governments, or public extension systems, normally serve as facilitators and help coordinate extension actors to deliver services that utilise the relative strengths of each entity (Feder et al., 1999; Swanson & Rajalahti, 2010; World Bank, 2012b).

Therefore, the provision of agricultural research and extension services has progressed through different phases, ranging from top-down, supply-driven, technology transfer models in the 1960s, to participatory, demand-driven models in the 2000s. Where these services were predominantly provided by Ministries of Agriculture and by universities, they gradually shifted to systems where the role of the private sector was embraced and viewed as important (Mulhall and Garforth, 1994; Leeuwis, 2004; World Bank, 2012b). This is evident in the shift of perspectives in the support of agricultural innovations. Such shifts include moving away from the top-down model of Diffusion and Adoption of agricultural innovations, mainly prominent in the 1960s, to Farming Systems Research (FSR) in the 1970s, to the Agriculture Knowledge and Information Systems (AKIS) in the 1990s, and to the AIS perspective in the 2000s. Being the most recent perspective in systems thinking, the AIS focuses on obtaining a better understanding of agricultural innovation processes and looking at them as multidimensional and complex interactions which consist of novel and interdependent practices implemented by diverse actors (Gervacio, 2012). It focuses on the influence of institutions and infrastructures on learning and innovation, as well as the inclusion of all relevant organisations/stakeholders beyond agricultural research and extension systems (Klerkx et al., 2012).

Along with many developing countries, Sierra Leone is an agrarian economy and depends largely on agriculture for economic growth. About 75% of its population depend on agriculture as a basic source of livelihood (MAFFS, 2004; Conteh, 2003; Bangura, 2006). Therefore, the Government prioritises agriculture as an engine for economic growth (RSL, 2009; MAFFS, 2012) and has been developing policies to bolster the development of the sector. Recently, the focus has been on the commercialisation of agriculture through encouragement of smallholder farmers to engage in intensive and diversified crop production, value–addition, and effective engagement with markets (MAFFS, 2010). Achieving this aim has led to an emphasis on strengthening the research and extension system in the country. The Agricultural Extension Division was made autonomous after being a mere item in the basket of the Crop Science Department of the MAFFS for decades (MAFFS, 2012). The extension system was pluralised to allow the participation of various actors in the provision of research and extension services, including local and international NGOs and private companies. Given their diversity of focus, target groups, coverage and life span of projects/programmes, and sources of funding, these actors employed different extension models and strategies in their provision of research and extension services to farmers nationwide (MAFFS, 2004, 2012). This study therefore assesses the innovation system on rice in Sierra Leone primarily from an Agricultural Innovation System perspective.

1.3 Statement of the Problem and Justification for the Study

The development of agriculture is, to a large extent, a function of the level of improvement in agricultural productivity of smallholder farmers, which in turn depends on farmers' willingness to innovate (DAES, 2010). Agricultural research and extension is the most useful tool to stimulate farmers' ability to innovate and, therefore, to contribute to addressing the challenge of low productivity (Swanson et al., 1997). Agricultural research and extension services can engage farmers, they can ensure that farmers have access to improved and proven technologies and that their concerns and needs are properly addressed (Mgalama, 2014). Bagchee (1994) claims that agricultural research and extension contributes to improving the welfare of farmers and other people living in rural areas, and that extension advisory services and programmes strengthen farmers' capacity to innovate by providing access to knowledge and information.

Invariably, the provision of agricultural research and extension services has evolved through many stages/perspectives. The initial application of some of these extension models followed the traditional adoption and diffusion theory advanced by Rogers (1993), a transfer of technology (TOT) approach (Hellin, 2012; Agwu et al., 2008), where the course of agricultural knowledge and information is viewed as a hierarchical flow, and innovations come from the scientists to be diffused to farmers through extension services (Mulhall and Garforth, 2000; Gervacio, 2012). The change agent is basically perceived as a "messenger" whose function is to transfer and disseminate the ready-made knowledge from researchers to farmers. This approach has been criticised for its failure to recognise the roles of different actors in the generation, dissemination, and use of knowledge information in agriculture. There are gaps and missing links associated with the research-extension-farmer system; universities and research institutes innovate in isolation, there is dysfunctional coordination among the actors, and poor linkage to the productive sector (Gervacio, 2012). With the TOT approach, farmers' innovations have not been included in the knowledge system (Agwu et al., 2008). Hence, there has been an increasing emphasis on a shift from top-down to participatory approaches of the 1970s (e.g., FSR) to those of the 2000s (e.g., AIS). For instance, the World Bank (2008) emphasised that research and extension should shift away from technology transfer and toward the creation of connections to outlets, institutions, and people. Thus, there is the need for extension services to provide a wider range of support to a diverse clientele to improve their capacity to access, adapt, and use knowledge, inputs, and services – extension agents being intermediaries and knowledge brokers. The shortfalls associated with this linear approach (TOT), has led to the evolution of more participatory approaches that enhance the participation of all stakeholders in the knowledge and information system.

The main aims and limitations of the emerging approaches - FSR, AKIS, and the AIS - are summarised here. The FSR emerged in the 1970s and 1980s in response to constraints of the linear, top-down TOT approach. It diagnoses the constraints and needs within the farming system and provides packages to increase efficiency using a multidisciplinary approach. It uses effective partnerships between key stakeholders, including farmers, technical advisors, social scientists, and more recently, extensionists and policy makers (Norman, 2002; Klerkx et al., 2012). However, the lack of focus on farmers, poor dialogue between researchers and farmers, difficulties associated with the coordination of multi-disciplinary teams, and poor communication of the knowledge gathered about the FSR approach (Chambers and Jiggins, 1987) have been some of its criticisms.

AKIS emerged around the 1990s (Klerkx et al., 2012) as a set of agricultural organisations and/or persons, and the links and interactions between them, who are engaged in the generation, transformation, transmission, storage, retrieval, integration, diffusion, and utilisation of knowledge and information, and who work together to support decision making, problem solving, and innovation in agriculture (Klerkx et al., 2012). AKIS has been criticised as it sees the agricultural research system as the centre of innovation, as opposed to the concept of multiple knowledge-bases, and that its capacity to analyse systems beyond the sphere of the public sector is limited, hence it lacks an understanding of the different kinds of actors involved (Hall et al., 2001). It is also perceived to have a limited perspective of the heterogeneity among agents, the institutional context that conditions their behaviours, and the learning processes that determine their capacity to change (Gervacio, 2012).

These shortcomings have led to the development and emergence of the AIS in the 2000s as a parallel framework for the enhancement of the effectiveness of the delivery of agricultural extension services (Leeuwis, 2004; Klerkx et al., 2012). The AIS perspective is the most recent of the many agricultural innovation systemic approaches (Gervacio, 2012). It focuses on obtaining a better understanding of the innovation processes, looking at them as multidimensional and complex interactions, and consisting of novel and interdependent practices implemented by diverse actors (Gervacio, 2012). Unlike the preceding systemic approaches, AIS is perceived to have a greater and more explicit focus on the influence of institutions (seen as organisations like companies, public research institutes, and governmental entities), and of infrastructures on learning and innovation. This is in addition to a focus on the inclusion of all relevant organisations beyond agricultural research and extension systems (Klerkx et al., 2012). Thus, the AIS perspective is considered to be a more holistic approach that promotes the participation of a range of actors outside the agricultural environment, including the institutions and policies that influence those actors' behaviours in agricultural innovation processes (Leeuwis, 2004).

However, despite this theoretical transition from top-down TOT approaches to participatory approaches, Roling (2006) maintains that TOT continues to dominate innovations in SSA, as well as the design and operation of research and extension services. Klerkx et al., (2012) similarly noted that despite the emergent AIS thinking, there remains adherence to TOT thinking and practice, as well as farming system thinking, disconnected from the broader systemic views on innovation. This suggests that, despite the perceived benefits of the AIS approach in increasing the impact of agricultural innovation programmes, there remains a limitation in its utility by practitioners for the implementation of research and extension programmes.

Such continued use of top-down TOT models is considered ineffective and unsustainable (DAES, 2010). Leeuwis (2004) maintains that the achievement of sustainable agricultural development is based less on material inputs (e.g., seeds and fertiliser), and more on the people involved in their use. This suggests the need for increasing focus on the development of human resources for increased knowledge and information sharing about agricultural production, as well as on appropriate delivery approaches, channels, and tools. Research and extension services are organised and delivered in a variety of forms, where the ultimate aim is to increase farmers' productivity and income (World Bank, 2008). The question is, "how can farmers gain access to knowledge and information on improving practices along the value chain to innovate, adopt, and increase productivity and income?" The success of research and extension services in achieving this will, however, depend on the research and extension model that is being used to reach, communicate with, or engage farmers (Axinn, 1988; DAES, 2010). The use of innovative approaches and strategies to increase coverage is, therefore, a concern for all involved in agricultural research and extension and advisory services (DAES, 2010). However, in many developing countries, low agricultural production has been attributed, among other factors, to poor linkages between research, advisory services, and farmers, and to ineffective technology delivery systems, including poor information packaging, inadequate communication and collaboration, as well as the lack of access to markets (DAES, 2010; Bagchee, 1994).

Sierra Leone, like most developing countries in SSA, is highly dependent on agriculture as the fundamental machinery for economic development, it contributes up to 46% of the country's GDP (MAFFS, 2012). It is a key sector which has hosted development interventions from key development actors in the country, ranging from NGOs to the private sector, in addition to the Government's MAFFS. These actors have been providing research and extension services, which are all geared towards boosting the development of the sector, in their own capacities. The sector currently hosts more than thirty NGOs who provide extension services to smallholder farmers nationwide (MAFFS, 2012), the majority promote rice innovations – rice being the staple food crop for the majority of Sierra Leoneans.

Rice is cultivated by all small-scale farmers who contribute to meet the total annual per capita rice consumption of 104kg (MAF, 2000; Bangura, 2006). The contribution of rice to caloric intake in Sierra Leone is ranked the highest in SSA (MAF, 2004). Interestingly, despite the myriad of actors in the agriculture sector, the staple food (rice) production of the country cannot keep pace with the national food requirement of the populace. An estimated one-quarter of rice consumed in the country is imported, and households spend approximately 50% of their income on food (WARC, 2013). Although an increase in rice production was reported between 1960 and 1975, leading to the country's attainment of rice self-sufficiency in 1975 (Agriculture Sector Review, 2003), rice production decreased gradually in the 1980s when the average production levels were between 400-500,000 tons per year (MAF, 2000). In fact, FAO (2004) estimates that Sierra Leoneans consume 530,000 tons of rice annually, but the annual local rice production is only about 200,000 tons. Further, the FAO notes that the country's reliance on other countries for staple food products, such as rice, is potentially destabilising since it makes it vulnerable to external shocks.

The majority of smallholder farmers have thus remained in constant touch with poverty, due to the inability (amongst other issues) to produce not only enough to meet the food requirements of themselves and their families, but to produce a surplus to sell and thus meet other, non-food demands (MAFFS, 2012). As a consequence, the poverty situation in the country has been exacerbated and remains rife, particularly among the rural population who are mainly smallholder farmers (World Bank, 2013; MAFFS, 2012). An estimated 57% of the population live below the international poverty line and earn less than $US1.25 a day, 70% live below the national poverty line and earn less than $US2 a day, and 26% live in extreme poverty (World Bank, 2013). The country is among the 10 poorest countries in SSA; the 2011 Human Development Index, measured in terms of life expectancy, education, and per capita income, ranked the country 180 out of 187 countries. In 2012, the International Food Policy Research Institute ranked Sierra Leone among the nine least-improved countries in the world with the highest global hunger index score (24.7), and classified the hunger situation in the country as "alarming". About 45% of the population is estimated to be food insecure (CFSVA, 2011) as measured by the food consumption score[1]. Factors that have been identified as contributing to this include the low productivity of smallholder farmers, poor market access, poor extension services, and lack of inputs, to name but a few (CARD, 2009; WFP, 2011; MAFFS, 2012). This suggests that agricultural research and extension institutions have fallen short of their responsibilities to enhance the innovative capacity of smallholder farmers in the country, which will,

[1] The Food Consumption Score is a measure of the amount of food eaten by a household over a given period of time, taking into account its relative nutritional value.

in turn, bolster agricultural productivity and subsequently impact on the development of the sector, including meeting the food requirements of the majority of Sierra Leoneans. Farmers appear to be poorly engaged by research and extension professionals in innovation processes and have not been provided with services that could sustainably increase access to services to enhance their innovative capacity. Evidently, there have been gaps in the effective adoption of an AIS approach in the development and promotion of agricultural innovations by research and extension professionals. The Government of Sierra Leone (GoSL) (2009), for instance, highlighted that SLARI, the technical and research arm of MAFFS, continues to operate a conventional research-driven model as it has limited capacity at present to work with more interactive farm-based methodologies. This is contrary to claims by SLARI and MAFFS that there has been a shift to supply-driven models embedded in an AIS approach. Also, a study conducted by Research Into Use (RIU) (cited in MAFFS, 2012), shows that there exist many weak linkages and, in some cases, gaps in interaction between innovation actors and support systems. Gaps were mainly identified among units of the agricultural innovation system, such as farmers and intermediary organisations, including NGOs and support structures, and weak linkages between farmers, researchers, and educationists.

It is against this backdrop that this study assesses the effectiveness of rice research and extension innovations in the country, viewed through an AIS lens. Among other aims, this study attempts to critically investigate rice innovation processes and systems and the extent to which an AIS approach has been effected in the system by exploring perspectives of research and extension professionals. These professionals are of particular importance given the centrality of their roles to the development and promotion of rice innovations in the country. As noted earlier, the vast majority of rice research and extension programmes are being pioneered by research and extension institutions, therefore, attempts to understand their effectiveness can be best achieved by exploring the perspectives of the professionals who work in those institutions. Research Into Use (RIU) for example, (cited in MAFFS, 2012) adopted a similar approach in their study of AIS in Sierra Leone.

Further, in a bid to understand the extent to which an AIS approach is being adopted in innovation processes in the country, the current study also identified and analysed the beliefs, attitudes, and behaviours of research and extension professionals which influence their use of an AIS approach in innovation processes. Understanding the beliefs, attitudes, and behaviours of these professionals is important in that they affect their ability and willingness to effectively incorporate an AIS approach into their activities (World Bank, 2007). Interestingly, few, if any, studies have looked at this in the AIS literature. The closest example identified was by Mose (2013) who examined research and extension professionals' beliefs and attitudes towards the adoption of participatory approaches, but not AIS. The study also assessed the influence of research and extension programmes on smallholder rice farmers' innovation processes by exploring their perspectives. This was to deepen the understanding of the extent to which research and extension professionals have adopted an AIS approach in their interactions with smallholder farmers, and whether their interactions have had any positive influences on the innovative capacity of those farmers. Consistent with most studies on AIS (e.g., Gervacio, 2012; Gabb, 2013; Suchiradipta, 2014), exploring the perspectives of smallholder farmers to understand innovation processes and systems is important in that farmers are the ultimate beneficiaries. Their perspectives are therefore invaluable in making a thorough assessment of the effectiveness of the innovation system, as viewed through an AIS lens.

It is, therefore, hoped that the successful completion of this study will add valuable insights and make a valid contribution to the existing literature on AIS, particularly in Sierra Leone where there is currently a dearth of such research. The findings will add to the limited body of knowledge, in Sierra Leone and beyond), and will thus provide relevant information to policy makers, researchers, other development practitioners, and farmers themselves, on the functioning of agricultural innovation systems (particularly for rice), and factors influencing their effectiveness. Identifying and analysing the actors and their roles in innovation processes, their interactions and constraints, as well as factors which constrain their interactions, will be relevant to an understanding of the extent to which research and extension actors are adopting an AIS perspective in the design and delivery of their interventions. It may also throw light on the possible reasons that their success in addressing farmers' production problems in the country has been so limited. It will also enhance understanding of the extent to which research and extension processes have influenced the innovative capacity of smallholder farmers at grassroots level, which is an important component in bolstering the development of the agricultural sector in the country. Additionally, the multi-strategy research design that encompasses qualitative and quantitative (mixed-methods) perspectives will add to the limited existing literature on the use of mixed-method approaches in researching AIS, as well as increasing the research capacity of the principal investigator (researcher).

1.4 Research Objectives and Questions

The overall aim of the research is to examine the nature and effectiveness of rice research and extension from an AIS perspective in Sierra Leone. The study seeks to understand the innovation processes and system regarding rice as promoted by research and extension actors, and the role of research and extension in smallholder farmers' innovation processes. Behaviours, beliefs, and attitudes of research and extension actors play a crucial role in influencing the effectiveness of an innovation system and are therefore identified and analysed. The following are the specific objectives and questions that the research sets out to address.

1.4.1 Research Objectives

1. To investigate the rice innovation processes and system in Sierra Leone, and to establish the extent to which AIS has been effected in the system, based on perspectives of research and extension professionals.
2. To identify and analyse the beliefs, attitudes, and behaviours of research and extension professionals which influence the use of an AIS approach in Sierra Leone.

3. To assess the influence of research and extension programmes on smallholder rice farmers' innovation processes.
4. To contribute perspectives which could be useful in deepening and broadening understanding of agricultural innovation processes and systems with respect to rice in Sierra Leone, and beyond.

1.4.2 Research Questions

The following are the key research questions under each objective:

Objective 1*:*

Overall Question: How effective is the Agricultural Innovation System (AIS) on rice production in Sierra Leone based on perspectives of research and extension professionals?

Specific Questions:

- What are the key rice innovations promoted by research and extension actors in Sierra Leone in the ten years from 2005-2015?
- What are the perceived benefits of these innovations?
- Who are the key actors involved and what are their roles?
- What patterns of interactions exist among these actors?
- What factors constrain the effectiveness of the innovation system on rice cultivation in the country?

Objective 2:

Overall Question: What beliefs, attitudes, and behaviours of research and extension professionals influence the use of an AIS approach in Sierra Leone?

Specific questions:

- What are the identifiable beliefs, attitudes, and behaviours, of actors that constrain or enable the functioning of rice innovation processes and innovation systems?

- What identifiable beliefs and attitudes influence the facilitation of complex and dynamic interactions among diverse agricultural innovation system actors in AIS?

Objective 3:

Overall Question: What influence have research and extension programmes had on smallholder farmers' innovation processes?

Specific Questions:

- What innovative changes have farmers effected on their rice farming systems in the ten years from 2005-2015?
- What are the key drivers of these innovations?
- What actors are involved in these innovations and what are their roles?
- What are the key constraints associated with these innovations?
- What are the key factors influencing farmers' ability to innovate?

Objective 4

- What policy implications and recommendations can be drawn to aid development practitioners and policymakers in promoting effective rice research and extension programmes in Sierra Leone (and similar developing countries globally)?

1.5 Approach used in the Study

The study targets two key categories of respondents, research and extension professionals and smallholder farmers, for reasons highlighted in Section 1.3 above. Research and extension professionals were nationally identified and included professionals from both government and non-government institutions. The key Government Institutions were MAFFS and SLARI; non-government institutions were mainly Agriculture Sector NGOs that have developed/promoted rice innovations to smallholder farmers. Smallholder farmers were selected from four districts (Kambia, PortLoko, Koinadugu, and Tonkolili) in Northern Sierra Leone for reasons identified in Chapter 4. The study used a mixed-methods approach, employing both qualitative and quantitative techniques for the generation of data. TPB was used to address Objective 2 of the study; the remainder of the objectives were addressed using AIS theory. Workshops, FGDs, KIIs, structured questionnaires, and document reviews were used to collect data.

The qualitative data were mainly collected by the researcher; however, four enumerators were employed to aid the data collection from smallholder farmers in the four districts. To ensure quality data on this front, thorough training was provided to the enumerators and a daily monitoring of the process was conducted by the researcher. All data management processes were conducted by the researcher including entry and transcription, cleaning and analysis. Data were analysed using Microsoft Word and UCINET (qualitative), and Microsoft Excel and IBM SPSS version 24.0 (quantitative). Further details on methodologies used are provided in Chapter 4.

1.6 Structure of the Thesis

The thesis comprises a total of nine (9) chapters. The results chapters have been presented in the sequence of the research objectives and questions. Thus, Chapter 5 presents results relating to Research Objective 1, two result chapters were generated for research Objective 2 (Chapters 6 and 7), and Chapter 8 presents results of Research Objective 3. The organisation of the contents of the chapters is as follows.

Chapter 1 introduces the study and presents the case for its undertaking. It specifically comprises the background information, the statement of the problem and justification for the study, research objectives and questions, the approach used, and it concludes with this section, the structure of the thesis.

Chapter 2 reviews the relevant literature relating to the study. It specifically explores literature on the evolution of the AIS as a theoretical framework for the provision of research and extension services, the use it has been put to in research, and its limitations. It also explains the conceptual framework adopted in the study. Further, literature on behaviours, beliefs, and attitudes of innovation actors and on the TPB, used in the investigation for Research Objective 2, is presented.

Chapter 3 highlights the key background information on agriculture in Sierra Leone. It specifically covers the trends of agricultural development in the country, its agricultural policies, the role of NGOs in the agriculture sector, and the trajectories of agricultural research and extension.

Chapter 4 outlines the methodology adopted in the study. It describes the research design and strategy, study area, sampling unit and techniques, and methods of data collection and analysis used for both quantitative and qualitative techniques. It explains the variables of the TPB used to address Research Objective 2, and highlights the key ethical considerations taken.

Chapter 5 presents findings on Research Objective 1, where the innovation system with respect to rice in Sierra Leone was examined from perspectives of research and extension professionals. It specifically presents results on the key rice innovations and their perceived benefits which have been promoted in the country in the ten years from 2005 to 2015, the actors involved and their roles, and the linkages existing among those actors. It presents findings on the factors which constrain the effectiveness of the innovation system of rice in the country, as viewed by research and extension professionals.

Chapter 6 presents findings on the first research question of Research Objective 2 where the TPB was used to investigate research and extension professionals' beliefs and attitudes towards the use of an AIS approach.

Chapter 7 similarly presents findings on Research Question 2 of Objective 2. It provides results on the TPB used to understand beliefs and attitudes of research and extension professionals which influence their willingness to facilitate complex and dynamic interactions among diverse actors.

Chapter 8 presents results of Research Objective 3, i.e., results and analysis regarding the influence of research and extension programmes on smallholder farmers' rice innovation processes.

Chapter 9 is the final chapter of the thesis. It discusses the findings of the study under each objective and draws conclusions based on these findings. It further contains the policy implications of the findings and makes recommendations on the basis of the overall study approach and findings.

CHAPTER 2 : REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter reviews the relevant literature which relates to the study. Firstly, it explores the various definitions of agricultural extension put forward by various authors over time, as well as the role of research and extension in the promotion of agricultural development. The transition in the provision of research and extension services from the public sector to a pluralistic system is discussed. The chapter also considers the theoretical development of agricultural extension by highlighting the key stages that have elapsed, and the key agricultural extension models that have been used by different actors over time. Further, the shift in perspectives in the provision of agricultural research and extension services is highlighted. The different AIS frameworks that have been advanced and adopted by a number of scholars, together with the conceptual framework adopted in this study, are reviewed in this chapter. Exploration of the behaviours, beliefs, and attitudes that influence the effectiveness of an AIS approach is undertaken and, finally, the TPB and its variables, used to address Objective Two of the study, is also presented and discussed. These areas are explored as the basis of an understanding of the key concepts surrounding agricultural research and extension, and also to present the case for the research objectives, questions, and methods adopted in the study.

2.2 The Concept of Agricultural Extension

The concept of agricultural extension has had diverse meanings for various agricultural development practitioners and agencies and has changed gradually over the years. Definitions of the concept have evolved over time as its design has moved away from a top-down, technology-driven system, to more innovative demand-driven and gender-sensitive approaches (Davis, 2009). The traditional view of extension focused heavily on increasing production, improving yields, training farmers, and transferring technology (ibid); hence, definitions of extension were skewed in this direction. Rogers (1962, 1993) defined extension as a basic diffusio*n* process in which innovations are communicated through certain channels over time, and among members of a social system. Similarly, Anderson (1972) and Axinn (1988) defined agricultural extension as a service, or system, which assists farmers, through educational procedures, to improve farming methods and techniques, increase production and income, enhance their levels of living, and lift the social education standards of rural communities. It has also been broadly defined as that branch of agriculture which focuses on the delivery of information inputs to farmers, ranging from estimates of future prices for farm products to new research products (Byerlee, 1998, cited in Anderson and Feder (2004). Similarly, Van Den Ban and Hawkins (1988) generally perceive extension as the conscious communication of information to help people form sound opinions and make good decisions. Systematically, they define agricultural extension as that branch of agriculture which:

- helps farmers to analyse their present and expected future situation;
- helps farmers to become aware of problems that arise in such an analysis;
- increases knowledge and develops insight into problems, and helps to structure farmers' existing knowledge;
- helps farmers acquire specific knowledge related to certain problem solutions and their consequences, so they can act on possible alternatives;
- helps farmers to make a responsible choice which, in their opinion, is optimal for their situation;
- increases farmers' motivation to implement their choices; and,
- helps farmers to evaluate and improve their own opinion-formation and decision-making skills.

Rangsipaht (2013) also defined extension as a "non-formal process of education given to persons in rural communities involving the transfer of information, skills and values for the attainment of individual, communal or national goals".

However, Birner et al. (2009:2), defined extension as a broad range of service providers that support and facilitate people engaged in agricultural production to solve problems and to obtain information, skills, and technologies to improve their livelihoods and well-being. Their definition considers the evolving nature of agricultural extension beyond transfer to facilitation, from training to learning, and also assistance to farmer groups to deal with marketing issues and partnering with a broad range of service providers and other agencies. These institutions can include Government and Non-Government agencies and organisations, producer organisations, other farming organisations, and private sector actors. In fact, many academic and development fora use the expanded term Extension and Advisory Services (EAS)[2] to depict the breadth and complexity of the function of extension beyond the traditional paradigm. Christoplos (2010) defines Agricultural Extension to include:

- all systems that facilitate access of farmers, their organisations and other market actors to knowledge, information, and technologies;
- facilitation of farmers' interaction with partners in research, education, agri-business, and other relevant institutions; and
- assistance to farmers to develop their own technical, organisational and management skills and practices.

[2] This thesis will use the term "extension" to encompass the length and breadth of all extension services

Further, Rivera and Alex (2004) indicate that "extension means development and strengthening of farmer organisations; improving farmers' abilities to find solutions to technical, credit related and marketing problems; sourcing better technical knowledge available with other organisations; and strengthening capability of farmer organisations to negotiate with the state, traders and banks for changes in policy and practice". It could also mean "the delivery of a wide range of services that address all system deficiencies in farming; namely poor-quality inputs, low productivity, low prices, too many market intermediaries, and lack of proper field-based advice on technology use" (Rivera and Alex, 2004).

It is evident from these definitions that the concept of agricultural extension is perceived differently by many authors and has evolved over time, with recent definitions taking into account the complexity of the extension system and the many important changes in the way research and extension has been perceived over time.

2.3 The Role of Research and Extension in the Promotion of Agricultural Development

The role of research and extension in the promotion of the development of agriculture in any nation cannot be over emphasised. It is not uncommon for Governments (particularly in developing countries) to have a government research and extension service for agriculture, but rarely for other branches of the economy – why? A number of reasons for this are noted by Shah (2013), such as: the percentage of people dependent on agriculture for their livelihoods; the contribution of agriculture to economic growth; the achievement of food security; and, agriculture's role in ecosystem services. Additionally, Van Den Ban and Hawkings (1988) noted that a further reason for this drive by governments is that agriculture usually comprises a large number of small enterprises, each of which is unable to employ its own research workers. Hence, findings from governmental research institutions will only be useful if they reach the farmers, and if the government organises extension services to ensure this. However, this view is linked to the TOT model where farmers are perceived as mere recipients of technologies developed by scientists. Further, agricultural research and extension services are also viewed to be important in a number of ways, ranging from reducing rural poverty and improving livelihoods for rural households, to increasing overall production and contributing to foreign exchange earnings from exports (Haug, 1999; World Bank, 2006). Similarly, Mulhall and Garforth (2000) maintained that agricultural extension provision is a valuable component in the overall development of any country's agriculture sector, contributing to both national wealth and national food security. Contado (1997) gives examples of policy goals to which extension is seen as contributing, these include: the production of quality food which is locally available for all at reasonable prices; conservation and upgrading of the agricultural environment; sustainability of food security and agricultural and rural development through the promotion and application by farmers of environment-friendly techniques and technologies. Rivera and Alex (2004) mentioned that agricultural research and extension has two main priorities: 1) to help poor people cope with their vulnerability; and 2) to help them to escape from poverty and thrive with profitable enterprises. Further, Van Den Ban and Hawkings (1988) advocated that agricultural extension is essential due to the recognition of the rapid increase in the quantity of knowledge available to farmers; without extension assistance it is impossible for farmers to ascertain what knowledge they need to farm efficiently and to cope with rapid changes in our society.

Further, effective extension services enable farmers to take up innovations, improve production, and protect the environment, they also show positive effects on knowledge, adoption, and productivity (GFRAS, 2012). Oladele (2011) claims that farmers see research and extension as a form of assistance to help improve their know-how, efficiency, productivity, profitability, and contribution to the good of their family, community, and society. Meanwhile, the politicians, planners, and policy makers consider it to be a policy instrument to increase agricultural production, to achieve national food security, and at the same time, to help alleviate rural poverty.

Additionally, the development of agriculture is, to a large extent, a function of the proper communicating and networking of information related to improving agricultural practices and technologies. This requires agricultural extension to ensure the linkage of information in the conventional or in the modern form (Shah, 2013). Agricultural research and extension is, therefore, a vital tool relevant to the engagement of farmers and other stakeholders in agricultural innovation programmes/processes and employed by Government and Non-Governmental institutions.

2.4 Agricultural Research and Extension in the Public Sector

Agricultural research and extension services started through government institutions and agricultural associations/societies in Europe and America. Agricultural extension was predominantly run by agricultural societies who were mostly providing funding to agencies, very few of them being service providers. Until the early 1980s, the public extension system was predominantly used globally, particularly by universities in Europe and North America and in the ministries of agriculture of most developing countries (Van Den Ban and Hawkins, 1998; Garfroth et al., 2003). The system was mainly based on the diffusion tradition, developed and advanced by Rogers (1962), and utilised the adoption process as a mechanism to diffuse the innovations to intended beneficiaries (Rogers, 1995). Subsequently, the technology-driven models have formed the bases of these systems. Here, the functional utility of the technology and ease of application were considered important for its wider adoption (Davis, 1989). Five characteristics of an innovation were considered important for the adoption of a technology, these include: relative advantage; compatibility; complexity; divisibility; and, communicability (observability) (Rogers, 1995).

The reduction in the role of public extension organisations in the provision of extension services came into play for a number of reasons, key among those include: a) structural adjustment programmes, which reduce public spending, and the large number of extension agents, which has contributed to the malfunctioning of public extension programmes in many countries (Haug, 1999); b) evolvement and recognition of different types of extension service providers and the developmental state of countries' agricultural development; c) and, the different criticisms of public extension (Chapman and Trip, 2003; Farrington, 1994). Haug (1999) reported that an evaluation of public extension services revealed a number of issues: inefficiency and lack of impact; unclear objectives; extension agents without a clear sense of what they are expected to accomplish; poorly motivated workers and management; no incentives to produce results; top-down approaches; no accountability to farmers; inappropriate messages; no funds for running costs; lack of supervision; no in-service training; lack of linkage with research; and so on. This has induced organisational diversification and initiated multiple sources of service provision.

As a result, public sector extension and advisory services have been gradually commercialised and privatised in many developed countries (Garforth et al., 2003), while developing countries have a mixed picture with some privatisation, some cost recovery schemes, different forms of partnerships, and public extension programmes (Jones and Garforth, 1997; Leeuwis, 2004). The diversity in service provision and policies has been attributed to the diversity of farmers and their needs and capacity, as well as the philosophy that scholars and policy makers hold regarding the effectiveness of different extension service providers (Shah, 2013).

2.5 Pluralistic Research and Extension System

There has long been the belief among some scholars and policy makers that the support of public extension is necessary to safeguard the public good nature of some of the services and the tendency for sustainability. For example, according to Farrington (1995), the public sector's role can be justified on the basis that:

- *much of the information relevant to technological innovation is public good in character;*
- *agricultural production is a risky business;*
- *access to information is often poorer in areas beyond the immediate radius of administrative and commercial centres;*

- *regional imbalances in service distribution suggest that public action is needed to enhance the incomes of people on the periphery;*
- *the quality of agricultural inputs and information needs to be maintained and assured.*

Others argue that private sector service delivery is more effective for the provision of benefits to the farmers (Anim, 2010). However, there are many who consider the need for judicious use of different service providers, or a combination of them, according to the farmers' level of need and expertise, and the comparative advantage of the service provider in the developing country context (Feder et al., 2011, Birner and Anderson, 2007; Chapman and Tripp, 2003). Hence, pluralism regarding institutional structure, financial viability, programmatic strategies, controlling mechanisms, communication technology, decentralisation, participation, and local knowledge systems is currently being promoted (Christoplos and Nitsch 1996; Pretty, 1997; Picciotto and Anderson,1997; Chambers et al., 1989; Farrington, 1994). This has seen the role of the private sector in the provision of extension services increase considerably. Mulhall and Garforth (2000) indicated three potential providers of extension services (see Table 2.1), including the public, private for-profit[3], and private non-profit[4] sectors. The difference between these various providers is important because of the range of services each typically offers, and the incentives they have for the delivery of these services.

Table 2.1: Providers of agricultural extension services

Public Sector	**Private Sector (non-profit)**	**Private Sector (profit)**
• Ministries and Departments of Agriculture • Agricultural Research Centres	• Local and international NGOs • Bilateral and Multilateral aid projects • Universities • Community Boards, Associations and Foundations (including Farmers' groups) • Other non-commercial associations	• Commercial farmer, or farmer group operated enterprises (including co-operatives) where farmers are both users and providers of agricultural information • Commercial production and marketing firms (such as input manufacturers and distributors) • Agro-marketing and processing firms • Trade associations

[3] The private (profit) sector includes all agents whose objective is to generate profits directly or indirectly for their owners, members, or shareholders.

[4] The private non-profit sector differs from the profit sector in one important respect: rather than distributing the residual earnings (if any) to individuals who exercise control, it reinvests profits to finance future activities (Muhall and Garforth, 2000)

- Private consulting and media companies (publishing and telecommunication firms)

Source: Adapted from Mulhall and Garforth (2000): Equity implications of reforms in the financing and delivery of agricultural extension services.

The diversity in the effectiveness and efficiency of the provision of extension services has seen the need for collaboration and partnership between the public and private extension providers. In fact, Haug (1999) noted that public or private extension is not necessarily an either/or choice, but perhaps both together resemble the ideal– the important question is "what might be most effective, where, and for whom"? While private extension services might be more effective and better provided by, for example, NGOs, private consulting firms, or agri-businesses (Haug, 1999), the role of the public sector (government) in a pluralistic extension system would be to provide the appropriate regulatory framework to ensure smallholder farmers have access to appropriate and low-cost extension services, to ensure fair competition, and to maintain quality standards (Umali-Deininger, 1997; Carney, 1998).

However, Haug (1999) noted that despite this diversification in agricultural extension provision, public agricultural extension services are still a leading extension service provider in most developing countries.

2.6 The Theoretical Development of Agricultural Extension

The theory of agricultural extension has progressed through different stages. Four of these have been identified, by Pretty and Chambers (1993) and Schoones and Thomson (1994), which are dependent on approach and major disciplinary influence. These stages are:

a) **The Classical or Conventional top-down, one-way Transfer of Technology Model (TOT) (1900-1975):** During this period, the leading disciplines were crop and animal breeding and genetics, and farmers were seen as recipients of technology.
b) **Transfer of Technology in a two-way Communication mode (1975-1985):** This stage is regarded as the economic stage in which farming systems research was pioneered by economists and agronomists, and farmers were seen as sources of information and technology design.
c) **Ecological Stage (1985-1995):** This is the stage in which anthropology, agro-ecology, and geography were pioneer disciplines, farmers contributed their traditional knowledge and were seen as both victims and causes of environmentally unsustainable development.

d) **Institutional Stage (1995- onwards):** This is the stage in which the pioneers are psychologists, organisational sociologists, political scientists, training specialists, and educators; farmers are seen as full collaborators in research and extension; and alliances will be developed between different institutions.

The ecological and institutional stages challenge the conventional view which regards agriculture solely as a technical income-generating activity. The approach these two stages promote locates farmers, researchers, and extensionists as social actors within the social practice of agricultural production. This approach includes a recognition of farmers as experimenters who continuously conduct their own trials, who partially adopt and adapt technologies to their own particular circumstances, and who spread innovation through their own networks. The AIS approach, the current theory in the provision of research and extension services, perceives farmers as partners and entrepreneurs who can exert demand for research and extension services (Klerkx et al., 2012). However, despite the perceived theoretical progress of extension provision, many extension services, projects, and programmes appear to continue to operate within a TOT model (Haug, 1999).

2.7 Models/Approaches of Agricultural Extension

There is a wide range of agricultural extension models in the literature, put forward by different authors, agricultural practitioners, and organisations. It is worth noting that the term "model" is used interchangeably with "approaches" or "system" by some authors; in this thesis the term "model" is used. Apparently, there exist a huge number of different agricultural extension models used by different types of organisations who employ varied strategies and techniques for reaching their target clientele. As in many development efforts, a model of agricultural extension forms the basis of the extension system.

2.7.1 Definition of an Agricultural Extension Model

An extension system may, apparently, comprise organisational structure, leadership, resources (personnel, facilities, and equipment), programmes with goals and objectives, as well as techniques for implementation and linkages with other organisations - the public and clientele. Yet, the model is basically the style of action of that extension system (Axinn, 1988); it contains the philosophy of the system. It functions as a doctrine which informs and guides the structure, leadership, programme, resources, and linkages of the system, as well as stimulating the extension system. Axinn (1988) identified the following seven dimensions normally characterised by an agricultural extension model:

- the dominant identified problems to which the model is applied strategically as a solution;
- the basic assumptions of the model;

- the purpose it is designed to achieve;
- the way in which the control of programme planning is carried out, the nature of the field personnel, including their density in relation to clientele (ratio), levels of training, required system, origin, genders, and transfers;
- the resources required, and various cost factors;
- the typical implementation techniques used; and,
- how it measures its success.

It is clear from this that the functionality and operationalisation of any agricultural extension effort is a function of a well thought-through model. Apparently, it can be deduced from the foregoing that various models can be adopted by organisations or practitioners due to the variation in the objectives, resources, target clientele, and nature of the problems they set out to remedy.

2.7.2 The Different Agricultural Extension Models

A wide variety of agricultural extension models have been developed and used by many practitioners around the world (Axinn, 1988; Mose, 2013). Axinn (1988) advanced eight models commonly used in a number of countries. However, he noted that a few of them currently have limited practical utility, even though the majority are still in use in many countries. These include the following models: the General Agriculture Extension; Commodity Specialised; Training and Visit; Agricultural Extension Participatory; Farming Systems Development; Cost Sharing; Educational Institution; and, finally the Project model. Similarly, other scholars have put forward a number of models which are similar to Axinn's, but differ in some way. For instance, Eicher (2007) identified six different models of agricultural extension, which include the following models: the National Extension; Commodity Extension and Research; Training and Visit Extension; NGO Extension; Private Extension; and, Farmer Field School. Further, Gemo et al., (2005) classified extension models into: Public; Commodity; Training and Visit; NGO; Private Sector; and, Farmer Field Schools. Oladele (2011), in his study of the features of agricultural extension models and policy in selected SSA countries, came up with a number of extension models in different African countries, as can be seen in Table 2.2 below. Anderson and Feder (2014) noted three extension models including: Training and Visit; Fee-for-Service; Privatised Extension; and, the Farmer Field School. A detailed explanation of these is made in Section 2.7.3.

It is evident from the literature that there are a vast majority of models in use for the delivery of agricultural development programmes around the world. Some models are more popular than others, and some programmes are a combination of two or more of them. There has been a shift in the use of certain models in the delivery of agricultural programmes due to the belief that some are more effective than others. A number of reasons could be responsible for this, including the perceived effectiveness of the model, the cost associated with it, and the appropriateness of the model in certain contexts.

Table 2.2: Features of Agricultural extension models and policy in selected Sub-Saharan African Countries

Countries	EXTENSION MODELS
Angola	*Rural Development and Extension Programme; Farmer Field School (FFS)*
Benin	*Participatory management approach; decentralized model; FFS*
Burkina Faso	*FFS*
Cameroon	*National Agricultural Extension and Research Program Support Project*
Ethiopia	*Participatory Demonstration and Training Extension System; FFS*
Ghana	*Pluralistic Extension System including, Ministry, private Companies, NGOs and Farmer Field School*
Kenya	*Pluralistic Extension System including Ministry, private Companies, NGOs*
Malawi	*Pluralistic Extension system, Farmer Field School*
Mali	*Participatory Demonstration and Training Extension System, Farmer Field School, Modified Training and Visit Extension System*
Mozambique	*Farmer Field School, Government led Pluralistic Extension*
Nigeria	*Unified Agricultural Extension system, Pluralistic Extension System including Ministry, private Companies, NGOs and Farmer Field School*
Rwanda	*Pluralistic Extension System, Farmer Field School*
Senegal	*Pluralistic Extension System, Farmer Field School*
Tanzania	*Farmer Field School, University based Extension System, and Pluralistic Extension System*
Uganda	*Pluralistic, National Agricultural Advisory Services and Farmer Field School*
Zambia	*Participatory Extension System, Farmer Field School*
Swaziland	*Participatory Extension System, Farmer Field School*
Lesotho	*Unified Agricultural Extension System, Pluralistic Extension System including Ministry, private Companies, NGOs*
South Africa	*Ministry based approach, University based, Commodity based approach, community extension and Cyber Extension system*

Botswana	*Farming System Approach, National Master plans for Arable Agriculture and Diary Development*
Cote d'Ivore	*Ministry of Agriculture (MINAGRA) led pluralistic system and Farmers Field School*
Namibia	*Ministry based, Community based approach, Community participation approach,*
Madagascar	*Ministry based approach, Training and Visits Extension System , Commodity based approach*
Zimbabwe	*Ministry based approach, Commercialized extension system, Community participation approach*
Mauritius	*Ministry based approach, Training and Visits Extension System, Commodity based approach, The community extension type*

Source: *Oladele (2011): Features of agricultural extension models and policy in selected Sub - Saharan Africa countries*

2.7.3 Description of Key Extension Models

It is clearly unrealistic, and almost impossible, to discuss or highlight the features or characteristics of all the extension models identified in the preceding section. However, an effort is made to discuss the features of the key models as advanced in the literature.

Axinn (1988) described eight models of agricultural extension as follows.

i) The General Agricultural Extension Model: This model is based on the assumption that useful information and technology are available, but are not being used by farmers, and that communicating this to farmers would improve their agricultural practices and, subsequently, farm production. Programme planning is controlled by central government and changes in priority are made on a national basis.

ii) The Training and Visit Model (T&V): Promoted by the World Bank from 1975-95 in more than 30 countries, this model contains a strict predetermined cycle of visits over a two-week period with the extension agents serving as transit belts between agricultural research centres and the farmers. In this model, the planning of the programmes is centrally controlled and reflects interaction between research and extension personnel. It is based on the assumption that extension workers under the Ministry of Agriculture are poorly trained, lack supervision and logistic support, they do not visit or have contact with farmers, and that the subject matter specialists are poorly trained and do not provide a link with research and training functions. The purpose is to induce farmers to augment the production of particular crops. Extension workers disseminate the "technological package" sequentially by focusing on one timely technological message at each visit (Evenson and Siegel, 2003). Picciotto and Anderson (1997) indicate that the rationale of the T&V is that new, high-yielding, fertiliser-responsive crop varieties were available for dissemination and, coupled with the high prices of food stuffs due to food shortages, was perceived necessary to make the new technologies profitable for smallholder farmers.

iii) The Commodity Specialised Model: The grouping of all functions related to the production of a particular commodity is a fundamental assumption of this approach. Such functions may include extension along with research, input supply, output marketing, and often prices. The extension programme planning is controlled by a commodity organisation, which uses its staff for implementation.

iv)The Agricultural Extension Participatory Model: Here, the assumption is that farming people have much wisdom regarding production of food from their land, but their level of living could be improved by learning more of what is known outside. This is also based on the assumption that effective extension cannot be achieved without the active participation of the farmers themselves, as well as of research and related services.

v) The Project Model: This approach assumes that rapid agricultural and rural development is necessary and that the large government bureaucracy in the regular Ministry of Agriculture Extension Services is not likely to have a significant impact upon either agriculture production or rural people within an appropriate time frame. Thus, it is assumed that better results can be achieved by taking a project approach in a particular location, during a specified time period, with large infusions of outside resources. This is mainly done to demonstrate what can be done over a few years. Again, the planning of the programme is controlled by central government, often with inputs from international development agencies.

vi) Farming Systems Development Model: The assumption with this approach is that the technology which fits the needs of farmers, particularly small farmers, is not available, and needs to be generated locally. The purpose is to provide extension personnel (and through them farm people), with research results tailored to meet the needs and interests of local farming system conditions. Field personnel tend to be highly specialised, relatively expensive, and from outside the area being served. Implementation is through a partnership between research and extension personnel, each other, and local farmers, taking a "systems approach" to the farm, and sometimes involving several different scientific disciplines to carry out analyses and field trials in farmers' fields and homes.

vii) The Cost Sharing Model: The assumption here is that the programme is more likely to fit local situations, and personnel are more likely to serve local people's interests if part of the cost of agricultural extension is paid locally. It also assumes that farmers are too poor to pay the whole cost, so central and regional governments typically provide most of it. The control of programme planning is shared by the various levels paying the costs but must be responsive to local interests in order to maintain "cooperative" financial arrangements.

viii) The Educational Institution Model: In this approach, the assumption is that faculties or colleges of agriculture have technical knowledge which is relevant and useful to farmers. The purpose is to help those people learn about scientific agriculture. Programme planning tends to be controlled by those who determine the curriculum of the education institution. Implementation is through non-formal instruction in groups, with individuals, and with other methods and techniques, sometimes conducted by a college or university with agricultural extension personnel of another agency as the main audience.

In addition to these models, the following is a key model that has been hugely promoted in delivery of agricultural extension programmes in the developing world, including Sierra Leone.

ix) The Farmer Field School Model: The Farmer Field School (FFS) model is a participatory, learning-centred, technology development and dissemination service based on adult-learning principles, such as experiential learning (Davis, 2009). The Farmer Field School (FFS) emerged out of a concrete, immediate problem in the late 1980s in Indonesia where farmers were putting their crops, environment, and health at severe risk through the massive use of toxic pesticides promoted by private industry and government (Braun and Duveskog, 2008: 3). The FFSs were introduced to educate farmers to become "experts" in the ecological management of their fields, and to thus bring better yields, fewer problems, increased profits and less risk to their health and the environment, mainly through reductions in the use of pesticides (Dilts, 2001). As a concept, the FFS approach weaves together reinforcing elements of adult education, agro-ecology, and local organisational development. Operationally, the FFS are organised around a season-long series of weekly meetings which focus on biology, agronomic and management issues, and where farmers conduct agro-ecosystem analysis, identify problems, and then design, carry out, and interpret field experiments using IPM and non-IPM approaches (Simpson and Owen, 2000). A successful FFS model is composed of six basic elements, including the Field, Group, Finance, Curriculum, Leader, and Facilitator elements (Gallagher, 2003:3), and each activity has a procedure for action, observation, analysis, and decision making. Each FFS consists of a group of 20-30 farmers who meet regularly in the field during a cropping season to learn about particular topics/issues (Anderson and Feder, 2014).The FFS aims to improve farmer knowledge and strengthen decision-making capacity and has been identified as a promising approach for training and organising farmers (David and Asamoah, 2011). Though originally designed as a capacity building investment, rather than an extension approach, it is currently the most widely used model for the training of farmers on such diverse topics as soil management, livestock production, integrated production, gender awareness, and

HIV/AIDS (David and Asamoah, 2011). Farmers are facilitated to conduct their own research, diagnose and test problems, and come up with solutions. Furthermore, FFS programmes encourage cost sharing, both to ensure sustainability and to enhance the sense of ownership and responsibility (Davis, 2009).

The models discussed above are among the key ones adopted by research and extension agencies/organisations in their engagement of farmers on agricultural innovation programmes. The use of certain models also tends to shift as research and extension perspectives shift from top-down, supply driven to participatory, demand-driven perspectives.

2.8 Shifts in Perspectives in the Provision of Agricultural Research and Extension Programmes and Emergence of AIS

The traditional model of extension views the course of agricultural knowledge and information as a hierarchical flow where innovations come from the scientists to be diffused to farmers through extension services – a system characterised as a top-down and linear process (Gervacio, 2012). The change agent is basically perceived as a "messenger" whose function is to transfer and disseminate the ready-made research knowledge to farmers. This linear process of technology transfer has been criticised for not recognising the roles of different actors in the generation, dissemination, and use of knowledge and information in agriculture. There are gaps and missing links associated with the research-extension-farmer system in this model as universities and research institutes innovate in isolation, and this can result in dysfunctional coordination among the actors and poor linkage to the productive sector (Gervacio, 2012). In addition, farmer innovations have not been included in the knowledge system (Agwu et al., 2008). Leading world institutions, such as the World Bank (2008), who earlier supported TOT models, now emphasise that extension should shift away from technology transfer toward the creation of connections to outlets, institutions, and people. There is the need for extension to provide a wider range of support to a diverse clientele to improve their capacity to access, adapt, and use knowledge, inputs, and services – extension agents being intermediaries and knowledge brokers. In fact, the Global Forum for Rural and Advisory Services (GFRAS) (2012) currently promotes what they call the "New Extensionist" as a global view of extension and advisory services which reinvents, and clearly articulates, the role of extension and advisory services in the rapidly changing rural and agricultural context. It argues for an expanded role of extension and advisory services within agricultural innovation systems and the development of new capacities at different levels to play this role. Christopolos (1997) notes that there is a need to move beyond thinking about platforms for projects, to focus more on mobilising platforms within a pluralistic institutional environment. Similarly, Klerkx et al., (2009) maintain that, in place of a linear approach, what is needed is a systems approach in which innovation is the result of a process of networking, interactive learning, and negotiation, among a heterogeneous set of actors (Klerkx et al., 2009).

These considerations have led to the emergence and promotion of innovation system thinking in the delivery of research and extension services. Van Den Ban and Hawkings (1988) define innovation as “an idea, method, or object which is regarded as new by an individual, but which is not always the result of recent research”. Biggs et al., (2004:1) define an innovation system as a “set of interconnected actors and institutions that contribute to the development and diffusion of innovations and constitutes the key social factors affecting the revealing, acknowledgement, generation and diffusion of technical and institutional knowledge over time”.

The innovation system is based on the performance of the individual players and the way they interact with each other as elements of a collective system (Hall et al., 2003; Fagerberg et al., 2005). It is also seen to encompass the agents involved in the innovation process, their actions and interactions, and the formal and informal rules that regulate their practices and behaviours (Dosi et al., 1988; Freeman, 1987). The World Bank (2007) maintains that an innovation system embeds technological change within a larger, more complex system of actions and interactions among diverse actors, social and economic institutions, and organisational cultures and practices.

It can be deduced from these definitions that the main components in an innovation system are the “actors” and “institutions” whose interactions largely determine the innovative performance of the economy (Spielman, 2005). This points to the importance of adopting an innovation system perspective for the sustainable development of agriculture, and is consistent with the belief that firms, farms, regions, and countries which are successful in innovation have higher productivity and income than those who are less innovative (Fagerberg, 2005). For this reason, development practitioners and agencies have been pushing towards an innovation systems approach in the development and implementation of agricultural development projects where relevant actors and institutions are considered. This has seen the shift from top-down, linear approaches, to more interactive and participatory approaches, including the AIS approach. The following sections offer a detailed explanation of the various perspectives that have emerged over the years in the design and promotion of agricultural innovation programmes. These include: Diffusion and Adoption (Rogers, 1962); Farming Systems Research (Norman, 2002); Agricultural Knowledge and Information Systems (Roling, 2009); and most recently, the Agricultural Innovation Systems (Pound and Essegby, 2008) approach.

2.8.1 Diffusion and Adoption Approach

Emerging in the 1960s, this approach involves a linear process in the dissemination of innovations from research institutions. It involves five sequential steps in the innovation-decision process, as suggested by Rogers (1993), which includes, "knowledge awareness, persuasion, decision choice, implementation and confirmation". The key goal of these theories is to ensure the adoption and uptake of agricultural technologies and innovations developed in research centres by farmers, who are seen as either adopters or laggards (Klerkx et al., 2012). This became the prominent way of thinking for the development of programmes intended to promote innovations in the National Agricultural Research Systems (NARS) and Training and Visit Systems (Assefa et al., 2009; Roling, 2006). However, these theories have received wide criticism as their application is mainly social, with no regard for institutional and policy factors, or for the difference between interventions and innovations (Assefa et al., 2009; Roling et al., 1997; Chambers and Jiggins, 1987). Further, they are criticised for developing technologies that are inappropriate and for not being able to understand the complexity of knowledge generation and use, farming systems, or the diversity of the needs of smallholder farmers (Gabb, 2013). Despite such criticism, Roling (2006) maintains that technology transfer continues to dominate innovation theory in SSA and the design and operation of research and extension services.

2.8.2 Farming Systems Research (FSR)

This system emerged in the 1970s and 1980s in response to constraints of the linear, top-down technology transfer approach. The FSR diagnoses constraints and needs within the farming system and provides packages to increase efficiency using a multidisciplinary approach. It is strongly dependent on the effective partnerships between key stakeholders, including farmers, technical and social scientists, and more recently, extensionists and policy makers (Klerkx et al., 2012; Norman, 2002). Despite the fact that this system involves on-farm testing and modification of technologies, decision-making remains largely with the scientists who use information from the farmers and their farms to decide what should be done or attempted (Gabb, 2013). The common key weaknesses identified with the FSR are: the lack of focus on resource poor farmers; poor dialogue between researchers and farmers; difficulties associated with the coordination of multi-disciplinary teams; and, difficulties with the communication of the knowledge gathered (Chambers and Jiggins, 1987).

2.8.3 Agricultural Knowledge and Information Systems (AKIS)

The Agriculture and Knowledge Information System (AKIS) emerged as a more sophisticated and less linear approach in response to the shortfalls of the adoption and diffusion of innovation models which were the solid concepts for NARS. AKIS boundaries are broader than FSR, and focus on a wider set of information sources, as well as on the importance of strengthening systems which assist in the generation and dissemination of knowledge (Röling, 1994). It refers to a set of agricultural organisations and/or persons, and the links and interactions between them, who are engaged in the generation, transformation, transmission, storage, retrieval, integration, diffusion, and utilisation of knowledge and information, and who work together to support decision making, problem solving, and innovation in agriculture (Rolling and Engel, 1991). AKIS has been seriously criticised for its disregard of the historical and cultural contexts in which innovation processes take place (Engel, 1997). Additionally, AKIS sees the agricultural research system as the centre of innovation, as opposed to the concept of multiple knowledge-bases, and that its capacity to analyse systems beyond the sphere of the public sector is limited, hence, it lacks an understanding of the different kinds of actors involved (Hall et al., 2001). The AKIS framework has a limited perspective of the heterogeneity among agents, the institutional context that conditions their behaviours and the learning processes that determine their capacity to change (Gervacio, 2012). These shortcomings led to the emergence of the AIS perspective (Spielman, 2005, World Bank, 2007, Agwu et al., 2008).

2.8.4 The Agricultural Innovation System (AIS)

The AIS was pioneered by Hall et al., (2006, 2007) in response to increased demands for research and technology and a shift in focus to the improvement in capacity to innovate (Gabb, 2013). The AIS focusses on obtaining a better understanding of the innovation processes and looking at them as multidimensional and complex interactions which consist of novel and interdependent practices implemented by diverse actors (Gervacio, 2012). Temel et al. (2002), define an AIS as a "set of agents (i.e.farm organisations, input supply, processing and marketing enterprises, research and education institutions; credit institution, extension and information units, private consultancy firms, international development agencies and the government) that contribute jointly to the development, diffusion and use of new agricultural technologies, and who influence, directly or indirectly the process of technological change in agriculture". In other words, it is a system of interconnected institutions for the creation, storage, and transfer of the knowledge, skills, and artefacts that define new technologies (ibid). It is clear from these definitions that an AIS approach recognises the role and existence of a huge cadre of actors who contribute in diverse ways to technology development, transfer, adoption, and adaptation, and the promotion of better knowledge flows to improve the performance of the overall system.

For an AIS, Temel (2002) indicated the following to be key actors: famers; research institutes; farmers' associations; private consultants; training and education institutions; public service delivery organisations; credit organisations; input suppliers; NGOs; processors; transporters; and, policy and regulatory bodies. Moreover, Arnold and Bell (2001), identified a number of actors in the innovation system, which include: a) The Research domain, formal research organisations producing mainly codified knowledge, public and private sectors, and NGOs; b) The Demand domain, domestic and international markets for products, policy actors, and consumers; c) Enterprise domain, firms and farmers using and producing mainly codified and tacit knowledge; d) Intermediary domain, organisations that may not necessarily be involved in the creation and use of knowledge, but who play a part in the flow of the knowledge from one part of the system to another. The World Bank (2008), indicated that the concept of AIS has serious implications for extension and advisory services. This is because the system requires a fundamental shift of extension from technology transfer toward creating connections to outlets, institutions, and people, as well as supporting diverse clientele to augment their capacity to access, adapt, and use knowledge, inputs, and services. That is, a shift from TOT models towards an Agricultural Innovation perspective.

Table 2.3 below shows the shift in theoretical perspectives in the design and provision of agricultural research and extension services over time. It can be seen that the four perspectives (discussed earlier) are markedly different across various dimensions. For instance, while the Diffusion and Adoption theory sees farmers as either adopters or rejecters, the FSR sees them as sources of information, AKIS sees them as experimenters, while AIS sees farmers as partners, entrepreneurs, and innovators who exert demand.

Table 2.3: Shifts in theoretical perspectives on agricultural innovation

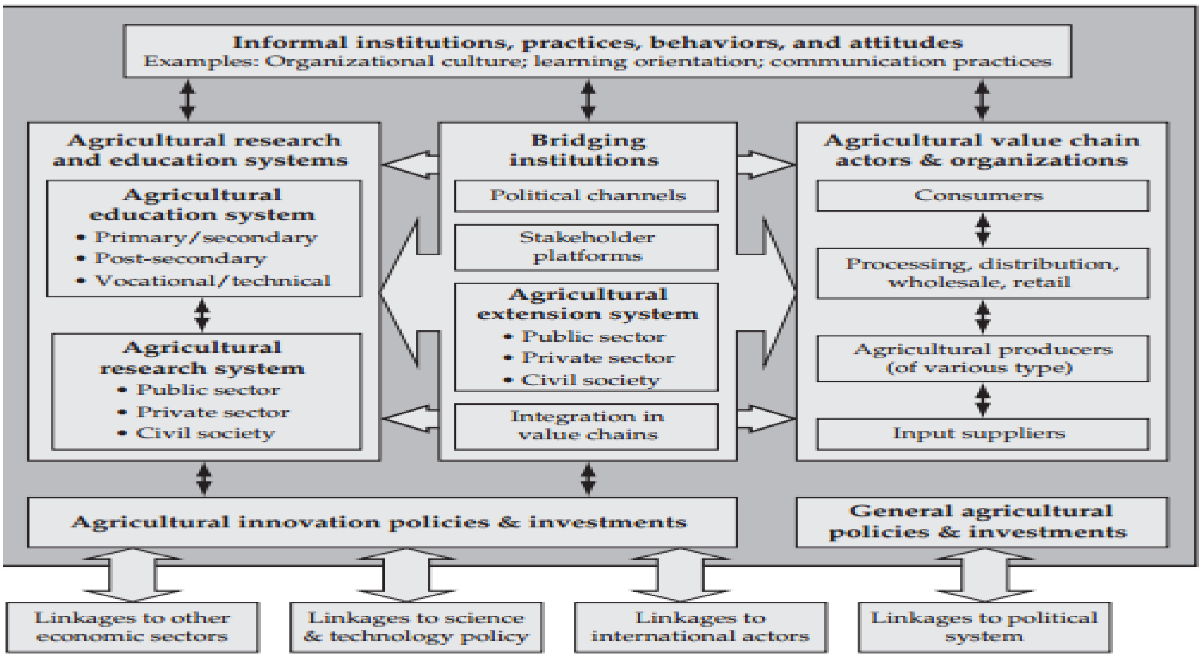
	Diffusion and Adoption	**Farming Systems Research**	**Agricultural knowledge and Information Systems**	**Agricultural Innovation Systems**
Time period	Since 1960s	Started 1970s	From 1990s	2000s
Mental model and activities	*Supply technologies through pipeline*	*Learn farmer's constraints through surveys*	*Collaborate in research (participatory research) and extension*	*Co-develop innovation involving multi-actor processes and partnerships*
Knowledge and disciplines	*Single discipline driven (breeding)*	*Multidisciplinary (agronomy plus agricultural economics)*	*Interdisciplinary (plus sociology and farmer experts)*	*Trans disciplinary, holistic systems perspective*
Scope	*Productivity increase*	*Efficiency gains (input-output relationships)*	*Farmer based livelihoods*	*Value chains, institutional change*
Core elements	*Technology packages*	*Modified packages to overcome constraints*	*Joint production of knowledge and technologies*	*Shared learning and changes, politics or demand, social networks of innovators*
Drivers	*Supply push from research*	*Diagnose framers' constrains and needs*	*Demand-pull from farmers*	*Responsiveness to changing contexts, patterns of interaction*
Relation with policy and institutional environment	*Science and technology are relatively independent of political and other social partners – institutional factors as external conditioners of the adoption process*	*Science and technology are relatively independent of political and other social partners – institutional factors as external conditioners of the adoption process. Agro-ecological and farm-economic context*	*Science and technology develop and are embedded within a historically defined social, political, economic and agro-ecological context*	*Science and technology develop and are embedded within a historically defined social, political, economic and agro-climatic context. Institutional change is considered 'sine-qua-non' for innovation*
Innovators	*Scientists*	*Scientists and Extensionist*	*Farmers, scientists and Extensionist together*	*Multiple actors, innovation platforms*
Role of farmers	*Adopted or laggards*	*Source of information*	*Experimenters*	*Partners, entrepreneurs, innovators exerting demand*
Role of Scientists	*Innovators*	*Experts*	*Collaborators*	*Partners, one of many responding to demands*
Key changes sought	*Farmer's behaviour change*	*Removing farmer's constraints*	*Empowering farmers*	*Institutional change, innovation capacity*
Intended outcomes	*Technology adoption and uptake*	*Farming system fit*	*Co-evolved technologies better fit to livelihood systems*	*Capacities to innovation, learn and change*

Source: Klerkx et al. (2012)

2.9 The Use of Agricultural Innovation Systems Framework

It has already been noted that the AIS approach has become increasingly popular as a framework to analyse and explore solutions to complex agricultural problems (Schut et al., 2014). Although the AIS concept is generally thought to be at its nascent stage, some practitioners have advanced and used this framework for the design/assessment of national agricultural innovation processes and outcomes. For instance, in their drive to identify indicators that can be used to measure innovation inputs, processes, and outcomes, Spielman and Birner (2008) adapted an AIS framework originally developed by Arnold and Bell (2001). This framework consists of three essential elements, which include: (a) a knowledge and education domain; (b) a business and enterprise domain; and (c) bridging institutions which link the two domains, as shown in Figure 2.1 below. In addition to these elements, this framework also makes reference to conditions that support or impede innovation, including: public policies on innovation and agriculture; informal institutions that establish the rules, norms, and cultural attributes of a society; and the behaviours, practices, and attitudes that condition the ways in which individuals and organisations within each domain act and interact. Further, the framework emphasises linkages beyond the borders of the system, such as those which involve international actors, and other sectors of the economy.

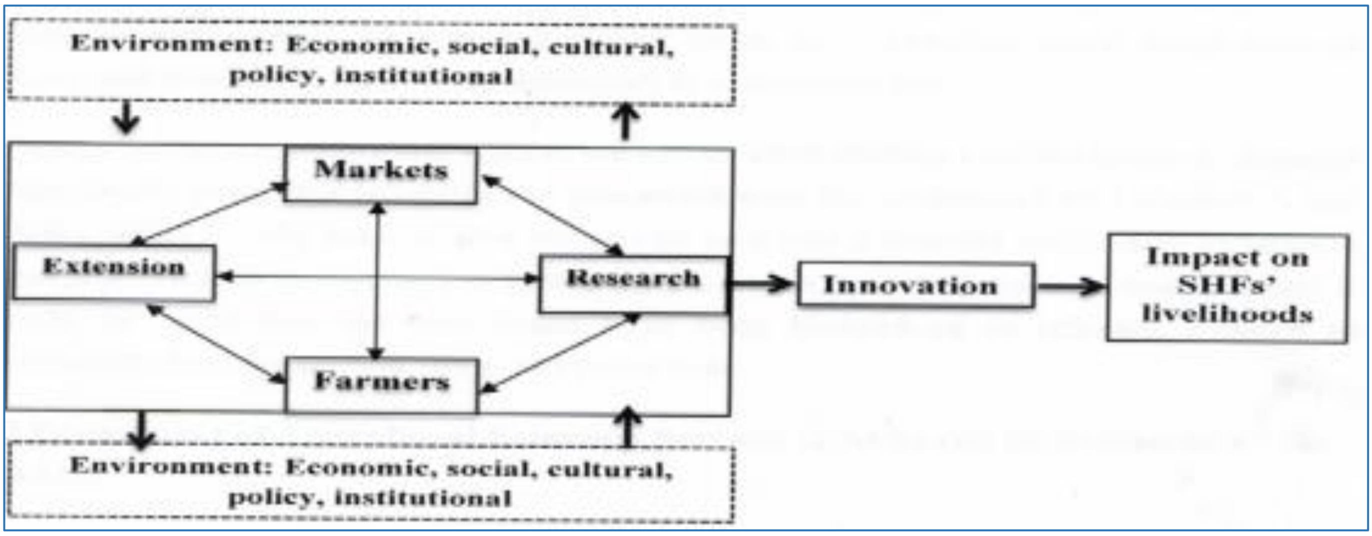
Figure 2.1: Conceptual Framework of National Agricultural Innovation System



Source: **Spielman and Birner (2008).**

The AIS framework is now gaining wide use in the assessment of agricultural innovations in many nations. Temel et al., (2002) assessed institutional linkages in Azerbaijan from an innovation system framework. Their study assessed the AIS in the country by characterising the patterns of innovation activities of different organisations, the patterns of interactions between them, and factors which constrain their interactions. The study considered policymakers, research and education institutions, extension and information units, farming organisations, and external assistance organisations as the main actors in the innovation system and examined the linkages between and among them. The scope of this study was narrowed to focus only on the interactions and links between actors in the innovation system. Other aspects of the system, such as the support system, were not examined. Similarly, Gabb (2013), in his study of agricultural innovations and innovation processes of smallholder farmers in central Uganda, reviewed the development of the AIS framework and applied it to explain the processes in which smallholder farmers engaged when making changes at farm level. Gabb (2013) indicated that the AIS framework can provide an analysis of the interactions between numerous actors – farmers, researchers, extension officers, trader service providers, processors, and development organisations – and the influence of technology, infrastructure, markets, policies, rules and regulations, and cultural practices on these actors. Gabb (ibid) applied the AIS framework to partly fill a gap by examining the processes in which smallholder farmers are engaged when making changes at farm level, as opposed to other studies that provide insights at project, sectoral, and national levels. The AIS framework has also been used by Mambo (2014) to analyse how farmer-to-farmer extension supports and contributes to agricultural innovation, particularly in the generation, dissemination, and utilisation of innovations, among smallholder farmers. Mambo (2014) adapted the AIS and perceived it to constitute linkages among four key actors, markets, researchers, farmers, and extensionists, influenced by their economic, social, cultural, political, and institutional environments, to determine agricultural innovation and, hence, the impact on smallholder farmers' livelihoods (See Figure 2.2 below). While this provides a basis that could be useful to analyse innovation, it does not consider the practices and behaviours of actors which could enhance or constrain innovation.

Figure 2.2: AIS Conceptual Framework for farmer-to-farmer extension



Source: Mambo (2014) study on Famer-to-Farmer extension in Malawi.

Furthermore, Schut et al., (2014) used an AIS perspective to study complex agricultural problems through analysis of: 1) the innovation capacity in the agricultural system by examining the constraints within the institutional, sectoral, and technological subsystems of the agricultural system; and, 2) the existence and performance of the agricultural innovation support system as key components in AISs. The innovation capacity of the agricultural system, according to Schut et. al., (2014), is defined as the ability of the actors and organisations to develop new, and to mobilise existing, competences for the continuous identification and prioritisation of constraints and opportunities for innovation in a dynamic system context. They describe the support system as a collection of structural conditions whose presence and functioning contributes to a better understanding of the innovation capacity in the agricultural system. The following are the key structural conditions advanced by Schut et al., (2014) as adapted from various sources that may enable or constrain innovation systems (left), and the key actors/stakeholders in the innovation system (right).

Structural conditions that enable or constrain innovation in systems (based on Klein Woolthuis et al., 2005; van Mierlo et al., 2010; Wieczorek and Hekkert, 2012).

Structural conditions for innovation	Description
Infrastructure and assets	Knowledge, research and development infrastructure; physical infrastructure including roads, irrigation schemes and agricultural inputs distribution; communication and financial infrastructure.
Institutions	Formal institutions including agricultural policies; laws; regulations; (food) quality standards; agricultural subsidies; Monitoring and Evaluation (M&E) structures; organisational mandates; market (access) and trade agreements; informal institutions such as social-cultural norms and values.
Interaction and collaboration	Multi-stakeholder interaction for learning and problem-solving; development and sharing of knowledge and information; public-private partnerships; networks; representative bodies (e.g. farmers association); power-dynamics.
Capabilities and resources	Agricultural entrepreneurship; labour qualifications; human resources (quality and quantity); education and literacy rates; financial resources.

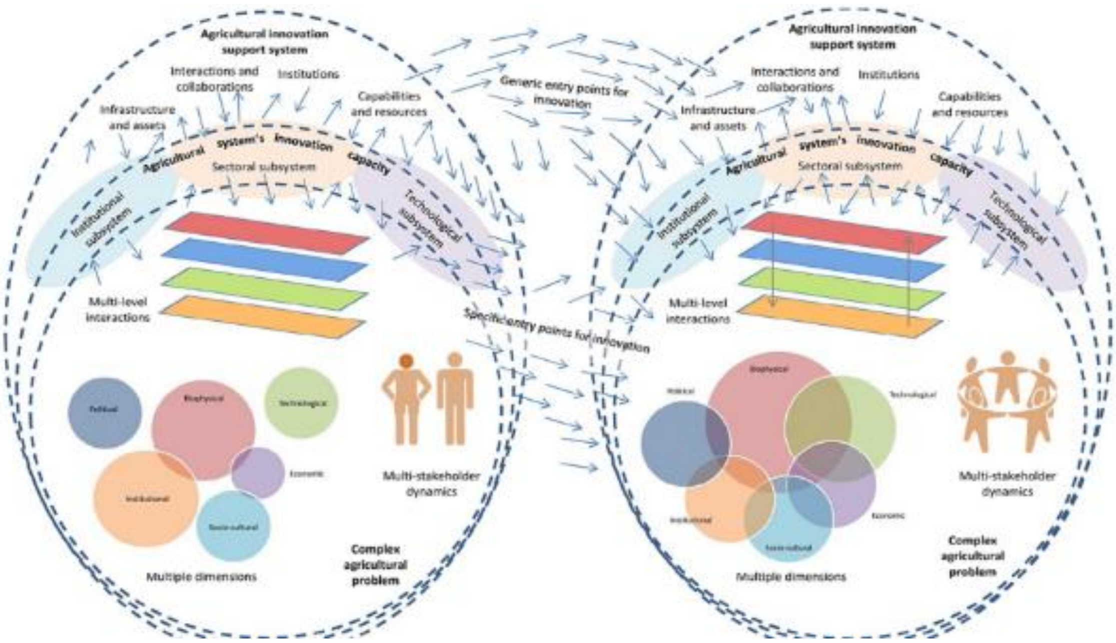
Examples of stakeholder groups and diversity within stakeholder groups.

Stakeholder groups	Diversity within stakeholder group
1. Farmers	Smallholder farmers, agro-industrial farmers
2. Non-governmental organisations (NGO) and civil society organisations	(Inter)national agricultural networks and associations, cooperatives, development organisations, donors
3. Private sector	Input and service providers (e.g. seed and agro-dealers, private extension services), agricultural entrepreneurs (e.g. processors, traders, retailers, transport companies)
4. Government	Politicians, policymakers, extension and crop protection officers
5. Research and training	National agricultural research institutes, agricultural education and training institutes, universities, international research institutes

Source: Schut et al., (2014)

Schut et al., (2014) adopted a framework which focuses on analysing the innovation support system, the innovation capacity of the actors in the innovation system, and complex agricultural problems, to provide specific and generic entry points for innovation. The framework below was adopted by Schut et al., (2014).

Figure 2.3: Schematic representation of the dynamic interactions between complex agricultural problems, innovation capacity of the agricultural system and the structural conditions within the agricultural innovation support system



Source: Schut et al. (2014)

It can be seen from the foregoing that a number of academics have advanced/adopted the use of an AIS framework/perspective to better analyse and understand some basic concepts and issues related to agricultural development in different contexts. There has been an emphasis on the use of various concepts to provide insights into the study of agricultural innovation processes. While some academics (e.g. Temel et al., 2002) focus on the interactions and linkages among the actors, some frameworks (e.g. Schut et al., 2014) have focussed analysis on the innovation support system and the innovation capacity of actors. Other frameworks (e.g. Spielman and Birner, 2008) have indicated that the importance of the attitudes and behaviours of the actors is relevant in the promotion of agricultural innovations and development. The framework adopted in this study is, therefore, informed by the existing AIS frameworks and literature. It draws its strength from the combination of these key perspectives of different AIS frameworks, and in doing so fills a gap by providing a holistic view of the AIS perspective to understand the effectiveness of research and extension programmes in the study area.

However, it is worth noting that the AIS approach is viewed by many to have a number of limitations or challenges which can thwart its utility and/or effectiveness. One of the key weaknesses of the AIS perspective, as indicated by Klerkx et al., (2012) is the assumption that all actors have a common goal related to the enhancement of innovation. Little recognition has been given to the fact that interdependent actors may have different interests, goals, and perspectives which are likely to diverge and conflict within the system. This needs to be taken into account when assessing participation, and the roles and behaviours of certain actors in the innovation process. Further, although the innovation system concept promotes the collaboration and interaction of different actors, Hall (2007) observed that there lies a challenge in the selection of who to work with as the selection of too few actors will miss the point of the innovation system concept, while too many may become unmanageable. It can be deduced from this that, although it is important to engage diverse actors in the innovation process, there is a need to consider the role that each actor may play, and whether or not their participation may influence the desired results. In fact, Hall (2006) posited a number of key attitudes and practices that can affect innovation processes and relations, as shown in Table 2.4 below.

Table 2.4: Typology of attitudes and practices affecting key innovation processes and relationships

Innovation processes and relationships	Restrictive attitudes and practices	Supportive attitudes and practices
Interacting, knowledge flows, learning	• Mistrust of other organizations • Closed to others ideas • Secretiveness • Lack of confidence • Professional hierarchies between organizations and disciples • Internal hierarchies • Top-down cultures and approaches • Failures are covered up • Limited scope and intensity of interaction in sector networks	• Trust • Openness • Transparency • Confidence • Mutual respect • Flat management structure • Reflection and learning from successes and failures • Proactive networking
Inclusiveness of poor stakeholders and the demand side	• Hierarchies • Top-down cultures and approaches	• Consultative and participatory attitudes
Risk-taking and investing	• Conservative	• Confidence • Professional incentives

Source: Hall et al 2006

2.11 Conceptual Framework Adopted in this Study

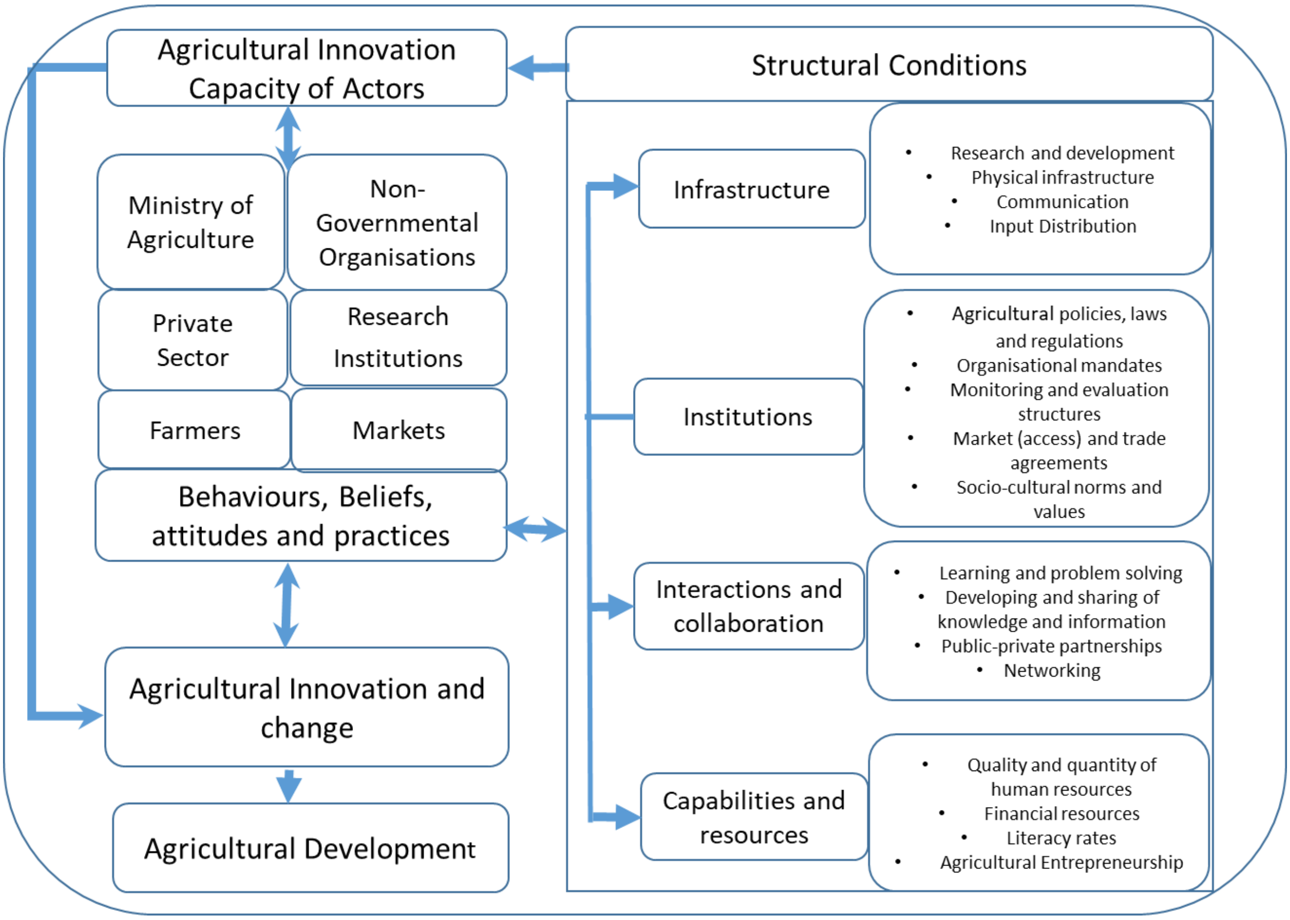
Miles and Huberman (1994) define a conceptual framework as a written or visual presentation that explains, either graphically or in narrative form, the main areas to be studied, including the key factors, concepts, and variables, and the presumed relationship which exists among them. A conceptual framework, according to Dyer et al., (2003), builds a structure of what has been learned in a given area of study; it usually combines high-level theory, seminal, and recent literature, as well as field level experience and practice (Moore, 2014). The conceptual framework of this study is, therefore, motivated and informed by the existing literature on AIS and is mainly anchored by that of Speilman and Birner (2008). The AIS framework has largely illustrated, particularly in recent studies, the key concepts/variables that provide the basis for successful innovation systems in agriculture. Taking into account the shortfalls of some of the frameworks, as discussed in the preceding section (3.2), the framework provides a clear and holistic view of what constitutes an effective innovation system to guide the assessment of research and extension programmes. As can be seen from Figure 2.0 below, the framework proposes that the success of agricultural innovation processes/programmes is a function of the strong linkages and influence of the innovation actors, their innovation capacity, their behaviours, beliefs, attitudes, and practices, and the innovation support system. Consistent with Schut et al., (2014), this study proposes that structural conditions (infrastructure, institutions, interactions and collaboration, and capabilities and interactions) can constrain or enable the innovation capacity of the actors (farmers, NGOs, research institutions, private sector, markets, and government/ministries of agriculture) in an innovation system if they are absent or available respectively. This innovation capacity of actors, in turn, influences the magnitude and extent of agricultural innovations and change in a society and the subsequent development of agriculture. Further, the framework consistently proposes that within the agricultural innovation support system, institutions are considered the key determinants to influence the effective functioning of the other variables[5] within the system. In addition, the framework acknowledges that the behaviours, beliefs, attitudes, and practices of innovation actors can constrain or enable the innovation support system, as well as their capacity to innovate, and can, subsequently, impact the overall agricultural innovation system and change and finally on the development of agriculture at national level.

Agricultural innovation and change, which impacts on the overall development of agriculture, is perceived as the ultimate product of the interaction and linkages among the innovation actors, the innovation support system, innovation capacity of the actors, and the behaviours, beliefs, attitudes and practices of the actors. This provides a holistic perspective, comprised of the key variables/concepts necessary for the assessment of innovation systems that is not distinct in the existing frameworks. Further, conceptualising innovation processes and systems in this way provides the researcher with a clearer idea for the formulation of the research objectives and questions.

However, given the scope and limited time associated with this study, it will only focus on identifying and analysing rice innovations promoted by research and extension actors, focussing mainly on the actors involved, their roles and interactions, the results of their interactions, as well as the factors which constrain them. It will also identify and analyse behaviours, beliefs, attitudes, and practices of research and extension actors that influence the functioning of the innovation systems approach in rice innovation processes. Finally, it will be used to examine the influence of research and extension programmes on smallholder farmers' innovation processes, with a particular interest in the extent to which they have influenced smallholder farmers' innovative capacity. The selection of these variables is based on the premise that they will generate information that will provide clear insights into, and understanding of, the effectiveness of the rice research and extension programmes from an innovation systems perspective in Sierra Leone.

[5] These include the infrastructure, the extent of collaboration and interaction among actors, and the capabilities of, and resources available to, the actors.

Figure 2.4: Conceptual Framework Underpinning this Study



Source: *Author (informed by the AIS literature*

2.12 Behaviours, Beliefs, and Attitudes of Innovation Actors

The behaviours, beliefs, and attitudes of innovation actors have been identified as essential in their influence on the functioning of agricultural innovation systems, and in conditioning the way actors interact in research and extension programmes. The following sections identify and explore some of the key behaviours, beliefs, and attitudes elicited from the literature and also based on the researcher's experience of working in the agriculture sector for the past few years.

2.12.1 Behaviours

A **behaviour** is defined as the observable actions and conduct of a person (Niemirowski et al., 2002). In Table 2.5 below, a summary of behaviours identified as being essential in influencing the functioning of agricultural innovation systems from various sources, as indicated, is given. These behaviours have been disaggregated by type of actor, however, those that are considered to be common to a number of actors are merged under those actors, as shown.

Table 2.5: Key behaviours of agricultural innovation actors influencing an AIS approach

	Innovation Actors				
	Research Institutions/Researchers	**Ministry of Agriculture (Public Extension and Policy makers)**	**NGOs**	**Private Sector (Input and Service Providers, Agricultural Entrepreneurs)**	**Farmers**
Behaviours	Engaging in joint[6] development, processing, adaptation, or marketing/dissemination of new agricultural technologies, policies and knowledge (Temel, 2002; Spielman et al, 2008; World Bank, 2007; 2012)				Demanding, developing/adapting/using new agricultural production, processing, marketing and natural resource management practices, techniques and knowledge (Gabb, 2013; Spielman and Birner, 2008; World Bank, 2007)
	Strengthening individual and collective capabilities to innovate (Speilman et al, 2008)				Open to other actors ideas, interactions and partnerships (Hall et al, 2006; Spielman and Birner, 2008)
	Engaging in periodic priority setting, strategic planning, and reform exercises (Spielman and Birner, 2008)				Participating in local innovation networks and partnerships (Spielman and Birner, 2008)
	Promoting learning for innovation (Speilman et al, 2008)				Participating in different types of value chain arrangements e.g membership in producer organisations, preproduction contracts with firms, market based sales of output (Spielman and Birner, 2008)
	Undertaking periodic training and skills upgrading for staff or extension agents (Spielman and Birner, 2008)				
	Decentralized management of innovation processes (Spielman et al, 2008)				
	Open to indigenous or foreign knowledge sources (Spielman and Birner, 2008)				

Source: Author (informed by AIS literature)

[6] This could be through networking, partnering or collaborating with other actors beyond the agriculture environment

Table 2.6 below shows the researcher's experience of the actors' behaviours which are likely to influence the functioning of agricultural innovation systems.

Table 2.6: Behaviours influencing the functioning of AIS

Researchers/Research Organisations	**Extensionists/Extension Organisations**	**Farmers**	**Private Sector (Input and Service Providers, Agricultural Entrepreneurs etc)**
Formulate agricultural research policies and programmes in line with the objectives of the agriculture sector taking into account the views of all relevant stakeholders	Continuously identifying the extension service needs of farmers and other value chain actors.	Actively sharing knowledge and information on new agricultural technologies or methods with other farmers.	Understanding constraints, opportunities and priorities of the agriculture sector.
Conducting research on major crops from a value-chain perspective	Sharing of experiences and lesson learning.	Seeking information from relevant sources to help solve their farming constraints/problems.	Collaborating closely with the public sector and farmers in identifying the priority needs of various stakeholders including smallholder farmers.
Seeking new and sustainable ways of addressing farmers constraints/needs		Adapting/developing new techniques or methods to meet their farming needs and contexts.	Providing services consistent with farmers' needs and priorities.
Continuously identifying farmers needs by engaging them and all relevant stakeholders	Establishing common mechanisms for lesson learning and sharing knowledge and information.	Working with research, extension and the private sector to identify key constraints and opportunities for improving productivity.	Establishing effective market opportunities for smallholder farmers.
Providing useful research information on agriculture that will assist the Government and other stakeholders in the development of agricultural policies/interventions	Promoting market-oriented extension and advisory services with a commodity value-chain orientation.	Providing timely and adequate feedback on external innovations to the relevant actors.	Ensuring access to proven agricultural technologies by smallholder farmers in a cost-effective way.

Establishment of strong working relationships with extension agents in the public and private sectors, agro-dealers and farmers	Implementing joint projects and programmes using MOUs or other means of engagement.		Developing common mechanisms to support innovation at all levels and at all times.
	Developing common mechanisms to support innovation at all levels.		
Producing and sharing of annual reports on their activities/innovations to all stakeholders	Mobilizing resources for supporting Agricultural Extension and Advisory Services.		
Mobilizing human, financial and capital resources from donors and the private sector	Influencing policies that are directed at developing national, regional and international markets.		

Source: Author (Informed by experience and the literature)

2.12.2 Attitudes

An attitude is a settled way of thinking or feeling about someone or something, typically one that is reflected in a person's behaviour. It is an opinion-based judgement that may express favour or disfavour towards a person, place, thing, or event (Niemirowski et al., 2002). Attitudes of actors can restrict interaction, knowledge sharing, learning, investment, and exploration of demand issues in innovation processes (World Bank, 2007). The following are the key attitudes of actors that can influence the functioning of AIS, adapted from Hall et al., (2006) and the World Bank (2007).

Table 2.7: Typology of attitudes affecting agricultural innovation processes/programmes

Restrictive attitudes	Supportive attitudes
- Mistrust of other organisations/actors	- Respect for partners
- Closed to others' ideas	- Transparency
- Secretiveness	- Openness to other actors ideas
- Not confident in other actors	- Openness to others feedback
- Conservativeness: unwilling to take risk and invest	- Responsiveness to others needs/constraints
- Indifference to constraints/needs of others	- Supportive of innovative opportunities identification
- Inconsistency of actors	- Open to market-oriented innovations
- Closed to others feedback	- Supportive of information sharing and lesson learning
- Closed to market-oriented approaches	- Consistency in policy implementation
- Unwillingness to identify innovative opportunities	
- Indifference to the formulation and adoption of agricultural innovation policies	
- Unsupportiveness of lessons and information sharing with other actors	

Source: Adapted from Hall et al., (2006) and World Bank (2007).

2.12.3 Beliefs of Innovation Actors Influencing an Agricultural Innovation System Approach

Beliefs are personal statements based on assumed personal knowledge or facts (Niemirowski et al., 2002). The beliefs of innovation actors in relation to the functioning of an agricultural innovation system are diverse. They include both positive and negative beliefs regarding agricultural innovation processes. Table 2.8 below shows the common beliefs associated with the functioning of innovation processes and AIS.

Table 2.8: Typology of beliefs of innovation actors influencing AIS

Positive beliefs	***Negative beliefs***
AIS related beliefs	
- Enhances innovation capacity of actors - Promotes interactive learning and change among actors - Enhances responsiveness to changing contexts and needs of smallholder farmers - Enhances productivity, profitability and incomes of smallholder farmers - Increases smallholder farmers access to financial and technical resources and markets - Strengthens linkages among agricultural innovation actors - Increases awareness on relevant priorities and policies in the agriculture sector	- Mobilisation of diverse actors with differing interests and goals is difficult - Identifying the appropriate partners is difficult
Innovation processes related beliefs	
- Increases practical usefulness of research findings - Enhances resource mobilisation from donors - Promotes sustainability of agricultural innovation programs - Aids inclusion of resource poor smallholder farmers - Enhances community ownership of innovation programs - Enhances problem identification capacity of smallholder farmers	- Engaging diverse actors is time consuming - Illiteracy of some actors (smallholders) could impede the innovation/decision-making processes - Smallholder farmers are reluctant to change

Sources: World Bank (2007); Spielman and Birner (2008), Klerkx et al., (2012); Mose (2012)

It can be seen from Table 2.8 that a wide range of beliefs, attitudes, and behaviours can be identified from the literature that can influence the functioning or use of AIS. Some of these can constrain or enhance the functioning of an innovation system. This further supports the usefulness of examining behaviours, beliefs, and attitudes of research and extension professionals in relation to the functioning of an AIS approach. Little, if any, literature exists on the extent to which these behaviours, beliefs, and attitudes are exhibited by research and extension professionals. This study therefore seeks to understand the extent to which the study subjects' beliefs, attitudes, and behaviours influence the use of an AIS approach.

2.13 Behaviours and Attitudes of Actors and the Relevance of Socio-Psychological Models

Research and extension professionals' decision-making processes about the choice of the approaches and methods used in technology development and delivery mechanisms are largely influenced by their attitudes, behaviours, and perceptions (Mose, 2013). Madon (1993), in his study on the impact of comprised information systems on rural development, found that on many occasions national goals of efficiency and improved management practices were subverted by priorities of status, hierarchy, and local culture. A number of other studies have also explored the relationship between the process of innovation in organisations and the context within which the innovation is implemented (Walsham and Han 1991; and Leeuwis, 2004). According to Nicolls (1999), the decision-making is based on past experience and largely influenced by personal beliefs, community values and commitments, and economic capacity, among other factors that guide an individual's decision-making.

It is against this backdrop that this research required a framework that would allow attitudes of agricultural research and extension professionals to be researched in relation to their behaviours. Though there is a vast body of literature on attitudes, much of it reports on approaches that do not enable researching them (attitudes) in relation to behaviours. Further, the behaviour of individuals who work in a given organisation is largely influenced by other people, such as their colleagues, peers, and supervisors, and their perceptions of whether their circumstances enable them to, or constrain them from, exhibiting the behaviour. The TPB, which was derived from the Theory of Reasoned Action, enables this, and therefore provides a theoretical framework upon which Objective 2 of the study is based and researched.

2.14 The Theory of Planned Behaviour

TPB is a psycho-sociological model which was developed by psychologists for understanding and predicting human behaviour (Ajzen, 1991; McKemey&Sakyi-Dawson, 2000). The TPB was preceded by the Theory of Reasoned Action (TORA) which was first put forward by Fishbein in 1967, and developed further in the early 1980s by Azjen and Fishbein to form the TPB model. The TORA was extensively used in many studies to link attitudes and behaviours, and a considerable body of empirical evidence has led to its explanatory and predictive powers becoming widely recognised (McKemey and Rehman, 2005). It is one of the "expectancy-value" models of human behaviour and its terminology, according to Lynne (1995), is not very different form that of the well-established subjective expected utility model used by economists. It assumes that human beings can behave in a sensible manner, meaning they can take account of available information and implicitly consider the implications of their actions (Ajzen, 1988).

The TORA explores an individual's strength of intention to perform an action, i.e., behaviour, and the contribution of factors by which it is influenced. These are the individual's 'attitude' to the behaviour under evaluation and 'subjective norms'. Attitudes are primarily determined by beliefs about the outcome of performing the behaviour and the evaluation of these expected outcomes. On the other hand, the subjective norm is dependent on beliefs about how others feel the individual should behave. and the individual's motivation to comply with these 'important others' (Ajzen & Fishbein, 1980).

The strength of the relationships between the various constructs within the theory is measured using correction coefficient analysis. The correction coefficients are treated as the analysis index of the extent to which behavioural intention can be predicted from the simultaneous consideration of attitude and subjective norm. When the correlation coefficients between attitude and behavioural intention, and subjective norm and behavioural intention are computed, weights (w) are produced that represent the relative contributions of attitude and subjective norm towards the prediction of the behavioural intention (Ajzen & Fishbein, 1980). Thus, a basic relationship between attitudes and behaviour becomes:

$$\mathbf{A} = \sum_{i=1}^{n} \boldsymbol{b}_{\mathrm{i}}\, \mathbf{e}_{\mathrm{i}}\,;\ \mathbf{SN} = \sum_{i=1}^{n} \boldsymbol{sb}_{\mathrm{j}}\, \mathbf{m}_{\mathrm{j}}\,;\ \text{so that } \mathbf{B} \cong \mathbf{BI} = \mathbf{Aw_1} + \mathbf{SNw_2}$$

Where **A** is attitude toward the behaviour, $\mathbf{b_i}$ is a belief about the likelihood of outcome **i,** $\mathbf{e_i}$ is the evaluation of outcome **i, n** is the number of salient beliefs, **SN** is the subjective norm, $\mathbf{sb_j}$ is a normative belief (that the reference group or individual, **j,** thinks the person should or should not perform the behaviour), $\mathbf{m_j}$ is the motivation to comply with referent **j, B** is the behaviour, **BI** is the behavioural intention and $\mathbf{w_1}$ and $\mathbf{w_2}$ are the empirically determined weights.

Based on the behavioural context and the individual involved, the relative contribution of attitudes and subjective norms may vary. This means a change in either attitudes or subjective norms will lead to a change in behavioural intention. The relative weights will indicate which changes (i.e., in specific attitudes and subjective norms) will have the most effect on behavioural intention, thereby increasing our understanding of their relative influence. They can also be focused on to influence behaviour.

The TPB used in this study includes another variable, 'Perceived Behavioural Control' – the person's belief about how easy or difficult the performance of the behaviour is likely to be. TPB is therefore more appropriate for use in conditions where behaviour is considered to be less under volitional control, that is, it is more contingent on the presence of appropriate opportunities or access to adequate resources (Ajzen, 1985, 1988; Ajzen, 2002; Ajzen & Madden, 1986). This is likely better to reflect conditions in which actors in innovation systems operate, including research and extension professionals in organisations. It is against this backdrop that the TPB has been used in this study. In addition, if there is adequate actual behavioural control e.g., presence of sufficient knowledge, skills, and capital, then the individual will act on their intention. Ajzen (2005) has suggested that it is possible to substitute actual behavioural control for perceived behavioural control. For this study perceived behavioural control is taken as a proxy for actual behavioural control. A schematic representation of the TPB is shown in Figure 2.5 below.

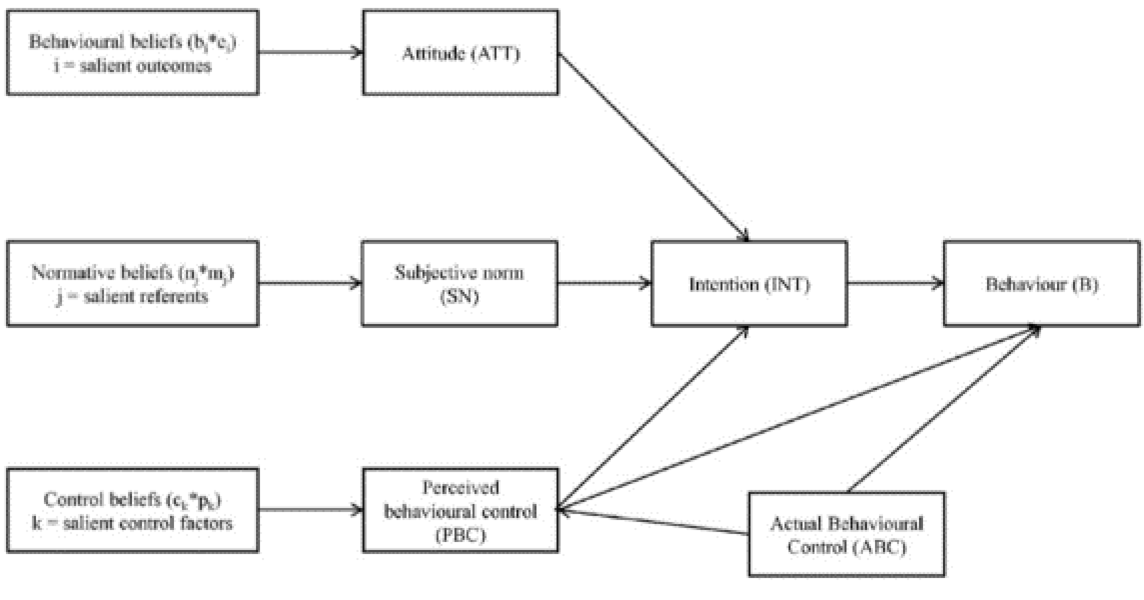


Figure 2.5: Theory of Planned Behaviour (adapted from Ajzen, 1991).

By incorporating PBC, the relationship becomes:

$$\mathbf{A} = \sum_{i=1}^{n} b_i\, \mathbf{e}_i\,;\ \mathbf{SN} = \sum_{i=1}^{n} sb_j\, \mathbf{m}_j;\ \mathbf{PBC} = \sum_{k=1}^{n} c_k \mathbf{p}_k \text{ so that } \mathbf{B} \cong \mathbf{BI} = \mathbf{A}\mathbf{w}_1 + \mathbf{SN}\mathbf{w}_2 + \mathbf{PBC}\mathbf{w}_3$$

The inclusion of the additional variable, PBC, makes it become the **Theory of Planned Behaviour (TPB).** The TPB is the perceived behavioural control, $\mathbf{c}_k$ represents the control belief strength, and control belief power $\mathbf{p}_k$**,** while **n** is the number of control beliefs.

The TPB/TORA has been used due to its explicit recognition of the importance of the influence of the actions and behaviour of others, and the attitudes and perceptions of the decision maker. This model has been used largely on a broad range of behaviours to understand the relative strengths of different influences, and to develop means for their change via policy or specific activities e.g., through training and provision of information. It has been reported in the literature that the TPB/TORA has been extensively used to study relationships between attitudes and behaviours in different disciplines, including health (e.g., smoking, drug and alcohol abuse). Further, findings from the literature show that the TPB/TORA has also been applied extensively in agriculture to explore attitudes and behaviours in: environmental conservation management (Carr & Tait, 1991; Beedell, 2000; Martinez Garcia et al., 2013; Borges et al., 2014; Greiner, 2015; Baqir et al., 2016): soil and water conservation (Lynne & Rola, 1998); knowledge and technology transfer (Garforth et al., 2004; Rehman et al., 2007), etc. McKemey & Rehman (2005) noted that the TPB/TORA has been largely recognised due to its wide-ranging explanatory and predictive powers. However, there is currently little or no evidence of TPB/TORA being used in researching AIS. The closest study is that by Mose (2013), who looked at the willingness of research and extension staff to specifically undertake behaviours which support participation and empowerment of farmers.

On this basis, this study used the standard TPB variables: attitudes (A); Subjective Norm (SN); and Perceived Behavioural Control (PBC). These were measured using a standard structured questionnaire that uses scales (bipolar/Likert) to rate the likelihood of agreement with given belief statements about the behaviours studied.

2.14.1 The Importance of Behavioural Intention (BI) in TORA/TPB

Behavioural intention (BI) basically refers to the conscious process of deciding whether to engage a specific behaviour or not, and it is primarily used within the TPB model to predict a particular behaviour (Ajzen, 1991, 2002; Ajzen & Fishbein, 1980). BI is an indication of how hard one is willing to try, or how much effort is planned in order to perform the behaviour. Therefore, BI is the control factor used to determine an individual's performance of a given behaviour in the TORA/TPB model. According to Ajzen (2002), the BI plays an important role in guiding human action and captures factors that influence a particular behaviour. In this study, BI signifies a person's willingness or reluctance to use an AIS approach in research or extension programmes, as well as their willingness to facilitate complex and dynamic interactions among diverse stakeholders in agricultural innovation processes. Studies have shown that when properly measured, BI are considered the closest measure of a social behaviour. In the TPB, BI is predicted using the TPB variables seen above (Ajzen, 1991; Manstead & Parker, 1995; Sheeran, Conner, & Norman, 2001). As a rule of thumb, the stronger the intention to engage in a behaviour, the more likely it is that the behaviour will be performed, and vice-versa (Ajzen, 1991; Ajzen & Fishbein, 1980).

In the TPB, the level of influence of each variable construct (strength) is computed by analysing the correlation coefficients. BI may be predicted using the multiple-correlation coefficient (r), which is derived from consideration of all the variables simultaneously.

2.14.2 The Key Limitations of the Theory of Planned Behaviour

The TPB has been widely acknowledged as one of the most robust and reliable theoretical framework/models for understanding the cognitive constructs which underpin an individual's decision-making processes, and the relationships between attitudes and behaviours in various disciplines. However, a number of limitations of the theory have emerged over time. Key among its criticisms have been its assumptions and the sufficiency of the constructs to measure behaviour.

The TPB has been largely criticised in the literature for its failure to incorporate emotions in its theoretical framework as one of the constructs, and also the measure of perceived behavioural control. This has, therefore, led to the proposition by a number of authors to extend the TPB with additional variables, such as the descriptive norm, moral norm, anticipated affective reaction, self-identify, and past behaviour (Conner & Armitage, 1998). Some studies have added Self Identity as a construct in their studies (e.g. Mose, 2013). Similarly, with regard to PBC, some authors (e.g., Armitage & Conner, 2001; Trafimow et al., 2002) have argued that it is a multi-dimensional construct comprised of two conceptually distinct constructs, perceived control and self-efficacy. They contend that, although perceived control is about whether behaviour is considered to be under the individual's voluntary control, self-efficacy is about the perceived difficulty or ease of performing that behaviour. This is corroborated by Ajzen (2002) who considers the idea that PBC may consist of self-efficacy and controllability, however, Ajzen disagrees that self-efficacy and controllability are distinct constructs.

Other limitations of the TPB are based on its assumption, for example, that behavioural, normative, and control beliefs represent information people have about a given behaviour, and that it is ultimately on this basis that they make a decision (Ajzen & Manstead, 2007). It also assumes that intention is equal to behaviour, although in the literature this has been widely validated (Sharifzadeh et al., 2012; Kautonen et al., 2013; Zeweld et al., 2016). Other studies have shown that intention is not always the best predictor of actual behaviour (Ajzen, 1991; Aarts et al., 1998); while others, e.g., Armitage & Conner, (2001) report that TPB accounts for only a small percentage of intention and behaviour. For example, they showed that TPB only accounted for 39% of intentions and 27% of variance in behaviour. Further, the TPB has been criticised for its assumption that there is a direct relationship between attitude and behaviour (Ajzen, 1991). However, the validity of this assumption has been supported by researchers, such as Ehrenberg (1997), who found a direct relationship between the two. Some other concerns raised by a number of scholars include the assumption of the TPB that decision-making is a rational process. However, some scholars (e.g., Conner and McMillan, 1999; Richard, van der Plight, & de Vries,1996) argue that factors such as anticipated affect and perceptions of what is personally wrong or right, and anticipated feelings of guilt or moral norms, form part of the decision-making process, yet they are not included in the TPB model.

However, regardless of all the concerns and criticisms, TPB still offers an unmatched conceptual framework for understanding the cognitive constructs underpinning an individual's decision-making processes. Furthermore, because of its strengths, a large number of researchers have acclaimed its efficacy, including Armitage & Conner (2001), Garforth et al., (2006b), McKemey & Rehman (2005), Mose (2013), Meijer et al., (2015), and Lalani et al., (2016). Indeed, Armitage & Conner, (2001) concluded that the TPB is superior for predicting intentions and behaviours when compared to other socio-psychological models that have been used for the same purpose. It is against this backdrop that this study uses the TPB to understand the attitudes and beliefs which characterise research and extension professionals' use of an AIS approach in the design and implementation of their activities. The study has used the three standard TPB variables – attitudes, subjective norm, and perceived behavioural control – based on the researcher's belief that these are very important in understanding the exhibition of the said behaviour of the research and extension professionals as they go about their activities as they are not only influenced by their attitudes towards a behaviour, but can also be influenced by others, e.g., donors or supervisors, and by their control over the exhibition of a given behaviour.

CHAPTER 3 : BACKGROUND INFORMATION ABOUT SIERRA LEONE

3.1 Introduction

This chapter provides an overview of the agriculture sector in Sierra Leone and of the changing role of research and extension. Specifically, it discusses the features of agriculture and includes the country's potential for crop production and associated current constraints. It also identifies and explains the key agricultural policies currently in place. The chapter provides an overview of the stages and approaches of agriculture research and extension in the country, and of the roles that the private sector, and particularly NGOs, have played.

3.2 Features of the Agriculture Sector in Sierra Leone

Sierra Leone is on the west coast of Africa between 6^{o} 55' N and 10 ^{o}00' N. It is bordered on the North and North-East by the Republic of Guinea, and on the East and South-East by the Republic of Liberia. The Atlantic Ocean extends approximately 340km on the West and South-West of the country. The country covers a total land area of 72,325 km^2, of which almost 75% is arable (MAF, 2004; MAFFS, 2011). Upland and lowland ecologies make up 78% and 22%, respectively, of the arable land area. The uplands are composed of forest, savannah woodlands, and grasslands, while the lowlands comprise 690,000 hectares (ha.) of inland valley swamps, 145,000 hectares of 'bolilands' (large, saucer-shaped basins), 130,000 hectares of riverine grasslands, and 200,000 hectares of mangrove swamps (MAF, 2004; Bangura, 2006).

It is a relatively small country when compared to other African countries, with a total population of 7,092,113, and 59% of the population lives in rural areas (Sierra Leone Population and Housing Census, 2015).Agriculture is the backbone of Sierra Leone's economy, accounting for about 46% of the country's GDP and employing about 75% of the population (MAFFS, 2011; RSL, 2009). Being an agrarian economy, agriculture is the main source of livelihood for over 75% of the total population (Conteh, 2003; MAFFS, 2004; Bangura, 2006). As can be seen in Table 3.1 below, the crop sub-sector contributes the highest to national GDP, followed by fishery.

Table 3.1: Contributions of major Agricultural sub-sectors to Agricultural GDP (Percent)

Sub-sector	Year							
	2001	**2002**	**2003**	**2004**	**2005**	**22006**	**2007**	**2008**
Crops	25	29	28	30	32	32	31	32
Livestock	2	3	3	3	3	3	3	3
Forestry	6	5	5	4	4	4	4	3
Fishery	7	7	8	9	9	8	8	8
Agriculture's Contribution to GDP	40	44	44	46	48	47	46	46

Source: MAFFS, 2009: National Sustainable Agricultural Development Plan.

The 'bush fallow' system is the most predominantly practised system among farmers, and thus occupies 60% of the total arable land; smallholdings usually range from 0.4 - 2.0 ha of cultivated land under food crops (MAFFS, 2004). This system is used for the cultivation of all major crops in the country, and normally up to 15 different crops are traditionally grown in mixed stands in one season, with rain-fed rice dominating.

The cultivation of rice in the country suffered serious drawbacks which contributed greatly to a persistent declining trend in the overall rice production system. There had been a drastic fall in domestic rice production far below its consumption requirements, which consequently led to huge rice importation (Bangura, 2006; WARC, 2013). As shown in Table 3.2 below, rice has suffered from a serious, but gradual, decrease in its levels of production from the 1980s through to 2001. This is also evident for almost all the major food crops grown in the country, with the exception of cassava and groundnut. This decrease in the production of the major food crops, particularly rice (paddy), resulted in a food deficit in the country and impacted negatively on the country's hunger situation, as rice is the staple food for a vast majority of Sierra Leoneans.

Table 3.2: Major Food Crops Production

YEAR	CROPS							
	Paddy (*000Mt)	**Maize (*000Mt)**	**Millet (*000Mt)**	**Sorghum (*000Mt)**	**Cassava (*000Mt)**	**Sweet Potato**	**Groundnut (*000Mt)**	**Beans (*000Mt)**
1987/88	549.9	11.0	22.0	19.0	133.0	32.6	21.7	35.0
1988/89	493.1	11.4	22.0	19.0	147.7	33.6	25.7	35.0
1989/90	517.8	11.7	22.0	20.0	174.2	35.6	28.5	37.0
1990/91	543.7	12.3	24.0	21.0	182.4	38.8	30.0	38.0
1991/92	411.1	11.0	22.0	22.0	163.4	40.8	34.0	39.0
1993/94	486.3	9.6	21.0	21.0	240.5	39.5	37.8	37.0
1994/95	445.3	8.6	28.0	25.0	243.5	43.9	39.8	40.0
2000/2001	310.6	10.0	8.7	15.4	314.4	21.2	48.9	-

Source: Ministry of Agriculture, Special Programme for Food Security, National Programme Document, 4 October 2001 and MAFFS Crop Survey of 2001 *cited in* Allieu, 2005.

In addition, various factors, such as low yields resulting from low soil fertility and the decade-long civil war in the country between 1992 and 2002, exacerbated the decline in rice production as farmers' agricultural activities in most rural areas came to a standstill, and farmers lost virtually all their seed stocks; they were either used for consumption or sold to buy other non-food items during the rebel incursion (MAFFS, 2004).

However, the end of the war in 2002 brought about some progress in the agriculture sector, including increases in rice productivity, as well as other crops. FAO CountrySTAT for instance, reports that rice production in Sierra Leone increased from 445,633 tons in 2003 to 888,417 tons in 2009. This is possibly due to the revitalisation of public agricultural institutions, such as the Sierra Leone Agricultural Research Institute (SLARI) (formerly known as the National Agricultural Research Coordinating Council), and the increased funding from diverse multilateral agencies, such as the World Bank, FAO, and the EU, for the development of the agriculture sector through MAFFS. Many NGOs emerged with key priorities to develop the agriculture sector (MAF, 2004; MAFFS, 2011) due to its role in the overall development of the country. The increased prioritisation of the agriculture sector (after the war) led to a corresponding increase in the number of actors providing research and extension services, mostly geared towards augmenting the productivity of major crops, including rice, among smallholder farmers in the country. However, little is known regarding the adoption of an AIS approach in the design and implementation of research and extension programmes by these actors.

3.2.1 Crop Production Potential

The climate is monsoon type humid tropical with two distinct seasons. The rainy season spans from May to October and the dry season from November to April. The annual rainfall averages about 3,000 mm, ranging from a low of 2,000 mm in the North to a high of 4,000 mm in the South. The average monthly temperature ranges from 23^{o}C to 29^{o}C, but can rise to an average maximum of 36^{o}C in the lowlands towards the end of the dry season, while in the highlands the average monthly temperature could be as low as 15^{o}C at the beginning of the dry season. Humidity is high all year, especially in the coastal areas (MAFFS, 2011; MAFFS, 2009).

Sierra Leone is endowed with two main crop production ecologies, namely Uplands and Lowlands. The lowlands constitute Inland Valley Swamps, Riverine Grasslands, Mangrove Swamps, and Grassland depressions locally known as "Bolis". Fortunately, rice is grown in all these ecologies, although more than half of the total land area (64%) under rice cultivation is carried out on uplands (Allieu, 2005; Mahmood, 2005). Table 3.3 below shows the area of arable and cultivated land in each of these ecologies and their respective average rice yields in tonnes per hectare.

Table 3.3: Arable and cultivated land by ecology

Ecology	Specific Area (hectares)	% of Arable Area	Area Cultivated	% of Total Area	Average yields (in tonnes)/Hectare
Upland	4,200,000	78.0	286,000	58.1	2.0
Inland Valley Swamp	690,000	12.9	114,000	9.5	3.2
Mangrove Swamp	200,000	3.6	25,000	2.7	3.5
Bolilands	145,000	2.7	10,000	2.0	2.8
Riverine Grassland	130,000	2.4	20,000	1.8	2.4
Total Arable Land	**5,365,000**	**100.0**	**455,000**	**74.1**	-
Other Land	1,870,000	-	-	25.9	-
Grand Land	**7,235,000**	**-**	**-**	**100.0**	-

Source: Ministry of Agriculture, Special Programme for Food Security, 4 October 2001; *cited in* Allieu, 2005.

UPLANDS: The uplands, as shown in Table 3.3 above, is the most dominant of the rice growing ecologies in Sierra Leone and constitutes 64% of the total land area under rice cultivation. Cultivation in this ecology is mainly under rain-fed conditions which limits cultivation to once a year and, with the limited irrigation schemes in the country, rice cultivation in this ecology is possible only during the rainy season. Cropping in uplands is possible for two consecutive years in cases where fallow periods are over 10 years before a move to a new site, but in cases where fallow periods are between five to six years, cultivation is limited to only one cropping season, otherwise yields can be very low in subsequent years (Allieu, 2005). Yields in the uplands are comparatively low, ranging between 1.0 to 2.0 tonnes per hectare, but, interestingly, it is the dominant ecology under rice cultivation in the country. One possible reason for this, in addition to the limitation of available local lowland, is that it gives farmers the opportunity to practice mixed cropping/farming where a number of crops are cultivated on the same piece of land by the same farmer at the same time.

LOWLANDS: This ecology, as indicated earlier, is divided into four different ecologies, including Mangrove Swamps, Riverine Grasslands, Inland Valley Swamps (IVS), and Bolilands. Lowland ecologies are characterised by a high-water table in the rainy season which makes them suitable for rice cultivation (Kamara, 2009; Mahmood, 2005). Cultivation in lowlands in the rainy season is predominantly rice due to its ability to survive waterlogged conditions and is normally replaced by other crops in the dry season. Rice seeds are normally nursed on uplands and the seedlings transplanted to lowlands around July. Rice yields in lowlands are generally higher than in the uplands, although a vast area of these ecologies is not currently under cultivation (Mahmood, 2005; IFAD/FAO, 2003). As shown in Table 3.3 above, two main ecologies, Inland Valley Swamps and Mangrove Swamps, constitute the greater part of the lowland ecology in the country. The IVS are found in every part of Sierra Leone. Traditional paddy yields in this ecology are between 1.4 to 1.9 metric tonnes per hectare, but potential yields are between 3 to 4 metric tonnes in improved IVS (IFAD/FAO, 2003). This potential yield in IVS could be higher with good management practices (Allieu, 2005). However, despite this potential, crop production in this ecology (IVS) is negatively affected by inadequate drainage and flash flooding, irregular flooding due to limited water management, low fertility levels due to iron and aluminium toxicity, and inadequate residual moisture and water supply during the dry season (Allieu, 2005).

Mangrove swamps are highly concentrated on the coastal regions, particularly in the north-west of the country. Mangroves are normally salty in the dry season, but can be highly productive once the salt is flushed during July to August when rice is cultivated for harvest between November and December. With proper salinity management, yields could be maintained at 3.0 metric tonnes per hectare (Allieu, 2005; IFAD/FAO, 2003).

Bolilands (grassland depressions) are generally low in cation exchange capacity and organic content, and consist mainly of heavy clay or silt. Yields in this ecology are generally low, about one metric tonne per hectare (MAF, 2004). However, roots and tubers are normally cultivated during the dry season in this ecology, which also contributes to crop diversification in the country (IFAD/FAO, 2003). Riverine grasslands are mostly found around the Sewa and Wanjei rivers in the Southern part of the country. They could be highly productive, with a yield of between three to four metric tonnes per hectare, especially if accompanied by proper management and application of pesticide and fertiliser.

Sierra Leone is generally blessed with natural endowments for a thriving agricultural sector, however, the sector has not been able achieve its full potential and meet the national food requirement of the country's population due to a number of constraints, these are discussed in the following sub-section.

3.2.2 Crop Production Constraints

Despite the relatively large area of arable land in the country, only 15% of it is currently being cultivated, mostly by resource-poor small farmers who are severely affected by labour, resource, and input constraints (MAFFS, 2011; Allieu, 2005; IFAD/FAO, 2003). This has been one of the major reasons for low agricultural productivity in the country as farming is heavily dominated by resource-poor farmers who lack financial resources to acquire the required inputs. Also, their farming practices are heavily subjected to poor timing and low intensity of necessary tending operations. Additionally, the declining soil fertility, high weed competition, pest and disease damage, high post-harvest losses, small farm holdings (usually between 0.4 to 1.0 hectare), the overdependence on the use of crude tools, and the use of low yielding rice varieties are among the core constraints faced by smallholder rice farmers in the country (Allieu, 2005). Further, Sierra Leone has not been able to reach its full potential in the agriculture sector due to challenges such as lack of expertise, weak producer organisations, low access to technology, weak infrastructure, institutional and financial obstacles to private sector development, and overall low levels of government capacity (MAFFS, 2009). Consistently, the absence of irrigation infrastructure significantly constrains agricultural productivity as the distribution of rainfall water is not uniform, with a water surplus in the rainy season (i.e., May – October), and a water deficit during the dry season (i.e., November – April). About 20-50 percent of the total annual rainfall is "lost" to runoff, resulting in water deficits of as much as 500mm per annum in some agro-climatic regions. The persistence of such deficits in some areas limits crop and animal production activities, particularly in the dry season (WARC, 2013; MAF, 2004). It is against the backdrop of ameliorating these constraints among smallholder farmers that has seen the emergence of various actors, policies, and strategies geared towards augmenting agricultural productivity in the country by introducing agricultural innovations/projects nationwide, mostly with smallholder farmers.

3.3 Government of Sierra Leone's Agricultural Policies

As the major sector promoting the economic development of the country, national development policies have always laid premium on the development of agriculture nationally. Drawing on the country's post-independence era (1962-82), a number of policies/strategies have been developed and implemented with a strong aim to promote the development of the sector. For instance, the National Ten-Year Plan for Economic and Social Development: 1962 to 1971, the National Development Plan: 1974 – 1978, the Integrated Agricultural Development Projects (IADPs), and the Agricultural Sector Support Project, were all adopted immediately after the country's independence from colonial rule, and were all geared towards bolstering the development of the agriculture sector (RSL, 2010). The development and implementation of these policies showed a slight improvement in the early 1960s, but stagnated by the close of the decade and most of the gains made in the 1950s were lost in the process. The Sierra Leone Produce Marketing Board, which was established for the exportation of local produce, struggled during this period and other Cooperative Societies collapsed. The financial ramifications for farmers became evident – prices of produce fell, which watered down the spirit of farmers to engage in extensive farm operations (RSL, 2010).

This stagnation led to the development and/or adoption of what was called agricultural policies of the "New Order", spanning from 1985 to 1991. During this period, the country faced enormous economic challenges including foreign debt and inflation, a drop in foreign exchange, and increased unemployment. As a result, the new administration at the time declared 'a new economic order' and the country implemented the Structural Adjustment Programme leading to the removal of subsidies for gas, rice, electricity, an end to price control and government incentives to farmers (RSL, 2010; MAFFS, 2012). This contributed to a retraction in production by farmers and an influx of grains and semi-processed grains brought about by the open market conditionality. Several other policies and programmes were implemented following the SAP, and within the New Order period, to promote economic growth through increases in agricultural productivity. Programmes such as the Green Revolution, the PL480 Agricultural Schemes, Economic Emergency, and Rice Specific projects were all implemented during this period, all geared towards, among others, increasing the area of cultivated land through mechanised farming, increasing rice production, income and living standards of the rural population, and introducing new rice varieties among local farmers (RSL, 2010; MAFFS, 2009). Unfortunately, these projects could not survive the harsh economic conditions of the decade, so did not bring about the expected benefits in terms of sustained growth and human development. This was followed by the interregnum (civil war) from 1991 to 2001, during which agricultural activities and other development agendas were significantly stalled. The official declaration of the end of the war in 2002 led to a speedy recovery in stabilising the economy and removing many of the structural impediments to growth, despite continuously higher than programmed, security-related spending.

This brought the realisation of a need for a fresh approach to the post-conflict development agenda. Policy liberalisation was the vogue of the new millennium, and therefore the country's development drive followed this pattern through the Interim Poverty Reduction Strategy Paper (I-PRSP), National Recovery Strategy (NRS), Vision 2025, and the Poverty Reduction Strategy Paper (PRSP) I and II. Both the PRSPs had strong food security policies focused on ensuring the attainment of food self-sufficiency in the country. In its most recent PRSP (i.e., PRSP II), for 2009-2012, the Government of Sierra Leone (GoSL) identified agriculture as a "key strategic sector with the potential for improving revenue generation and food security" (World Bank, 2009). Pursuant to the goals outlined in the PRSP, the GoSL created the National Sustainable Agriculture Development Plan for 2010-2030 (NSADP) as a framework to guide the strategic push to strengthen the agriculture sector. The overall objective of the NSADP is to increase agricultural sector growth from two to six percent per year by 2015, and increase incomes of producers. Additionally, the programme aims to eradicate poverty and promote food security in line with the targets of the first Millennium Development Goal and the World Food Summit (MAFFS, 2009). In pursuance of the NSADP, the Smallholder Commercialisation Programme (SCP) has been developed with a focus on commercialising agriculture by smallholder farmers through intensification and diversification of crop production, value addition, rural financing, small-scale irrigation, safety nets, and coordination of activities.
Consistently, the Decentralisation Policy has also been revised and the Local Government Act (2004) approved into law, to accelerate the transfer of power to local councils, and enhance service delivery to smallholder farmers through an ongoing process of devolution of technical and financial resources aimed at supporting smallholder farmers to make the transition toward commercialisation (MAFFS, 2012). The Government's Private Sector Development Strategy has been put in place, focusing on: improving access to finance; improving the legal and regulatory framework; promoting and supporting entrepreneurship; making markets work better; and improving physical infrastructure. Agriculture is also one of the key target growth sectors in the National Export Strategy 2010-2015 for which the Sierra Leone Investment and Export Promotion Agency (SLIEPA) has been established.

The recent National Agricultural Extension Advisory Services Policy of Sierra Leone, published by MAFFS in 2015, supports the pluralisation and use of an AIS lens in the design and implementation of extension activities by all actors – public and private. Among other propositions of the policy are: decentralisation of decision making among stakeholders and empowering of extension clientele; and promoting stakeholder collaboration and networking. In fact, section 3.4 (iii) of the same policy states: “farmer participation in the development, design, and implementation and evaluation of extension programmes should be incorporated in all extension programmes”. Similarly, SLARI, the national agricultural research institution, has adopted into policy the use of an AIS approach in the design and implementation of their research activities. Their Strategic Plan for 2012 – 2021 states: “SLARI has adopted the Product Value Chain (PVC) approach within the framework of Integrated Agricultural Research for Development (IAR4D) and the Agricultural Innovation Systems (AIS) approaches… by creating and operationalising a mechanism for establishing flexible alliance frameworks/innovation platforms that allow different SLARI centres to form temporary PVC teams with other organisations including farmer organisations, universities and the private sector to solve priority PVC problems in a specified period” (SLARI, 2011:75).

It can be seen from this strategic plan that Sierra Leone has never lacked good policy intentions, neither has there been a dearth of policy for the agriculture sector. The key problems that have impeded past agricultural policies mainly stemmed from two broad angles (RSL, 2010): (a) policies lacked the necessary stakeholder support (both financial and moral) or commitment and ended up being poorly and inconsistently implemented; and (b) the inadequate and poor capacity of the agriculture sector to absorb and sustain policy implementation activities and control exogenous factors. In general, the failure of agricultural policies emanated largely from policy parody, inconsistency, limited financial and material support and administrative management, inadequate administrative capacity, limited research and extension services, and pest and crop failures.

3.4 Agricultural Research and Extension in Sierra Leone

The earliest research and extension efforts in Sierra Leone date back to the colonial era during which agricultural policies were geared towards the production and supply of tropical crops to countries of the colonial masters. A botanical garden was therefore established for the multiplication of cocoa, coffee, rubber, pineapple, and citrus planting materials in Freetown in 1898 (MAFFS, 2012). These planting materials were later supplied to chiefdom nurseries for distribution to farmers and an operational extension system was borne. With time, the botanical garden could not keep pace with the demand for the planting materials, leading to the establishment of the Njala Experimental Station in 1910 (MAFFS, 2012).

The Department of Agricultural Extension became functional by 1911 and was primarily responsible for: the provision of research and extension services in swamp rice production; seed selection and distribution; improved livestock management; propagation of cash crops; arresting deforestation; encouragement of cooperative farming; linking education to agriculture; and setting up effective extension systems. Basic adaptive research, through seed selection, was linked to extension with the aim of ensuring that farmers got the most appropriate planting materials for enhanced production (ibid).

The Rice Research Station, which was established at Rokupr, Northern Province in 1934, was devoted to research into mangrove and swamp rice; in 1953 this was transformed into the West African Rice Research Institute. In the same year, the oil palm research programme at Njala became the West African Institute for Oil Palm Research.

Up to 1961, research and extension activities were planned and managed at the headquarters of the Department of Agriculture based in Njala, Southern Sierra Leone. In each of the three provincial regions, North, South, and East, it was the responsibility of the Principal Agricultural Officer to supervise on-station demonstration plots and the extension programmes, while at the district level the Senior Agricultural Officer was in charge of the station's farms and extension activities. On-station demonstration plots and extension were inseparable, except at the village level where the function of demonstration plot development and that of the itinerant instructor were separated. However, a number of constraints that limited the effectiveness of the colonial research and extension system, as highlighted by MAFFS (2012), include:

- little attention paid to local food crops, such as rice, cassava, potatoes, yams, maize, beans, and livestock extension delivery services;
- poorly incentivised grass-roots extension staff;
- inadequate support services and infrastructure to enhance effective communication;
- weak supervision, control, and monitoring.

After the country's independence from colonial rule in 1961, the Njala University College was established in 1964 to train teachers and agriculturists so as to increase staff capacity. It was during this period that emphasis was placed on Agricultural Extension Education to include food crops and livestock (RSL, 2010). Also during this period (after independence), various outreach programmes were conducted by Njala University College, the Rice Research Station at Rokupr, Kambia District, the Ministry of Agriculture, and a few NGOs. In 1985, the National Agricultural Research Coordinating Council (NARCC) was established to coordinate research and harmonise research activities (SLARI, 2011). The mission of NARCC was to support the promotion of pro-poor sustainable growth for food security and job creation as part of Sierra Leone's Poverty Reduction Strategy Paper. Its mandate was confined to annual crops. The two constituent institutes of NARCC were the Rice Research Institute dealing with rice, millet, sorghum, banana, plantain and vegetables, and the Institute of Agricultural Research dealing with cassava, sweet potato, yam, maize, cowpea, groundnut, soybean, and sesame (ibid). Njala University and the University of Sierra Leone also carry out agricultural research in addition to these institutions. Agricultural research infrastructure was devastated during the war, including as a result of the departure of well-trained scientists, and this brought agricultural research to a halt (MAFFS, 2009).

The GoSL established the Sierra Leone Agricultural Research Institute (SLARI) through the SLARI Act of Parliament of 2007, after a period of coordination of agricultural research under NARCC. SLARI is the technical arm of MAFFS, and is the agricultural research and technology generating body for the benefit of farming, fishing, and forestry sectors, and for provision of other related matters. With seven research centres in different parts of the country, key among SLARI's role is to address the many challenges facing the agriculture, fishery, and forestry sub-sectors in the country. As the national agricultural research institution, it conducts research to obtain knowledge, information, and technologies needed for sustainable development of the country's agricultural sector (SLARI, 2011). Agricultural research is also carried out in universities, particularly Njala University in Southern Sierra Leone. The country also benefits from participation with international research institutions, such as IITA, and a few from the private sector, including NGOs.

Research and extension services before, and to a reasonable period of time after, the post-colonial era (from the 1960s to early 1970s) were mainly provided via the TOT model (MAF, 2004). This was based on the general belief that scientists in these institutions best know the needs of the farmers. There was also limited private sector participation in the research and extension services during this period (ibid). Subsequently, there was a shift in perspective, at least in theory, from top-down approaches to more participatory approaches, again in theory, due to the recognition of the shortcomings of the TOT model. Given the country's dependence on donors, such as the FAO and the World Bank, for funding of agricultural research and extension programmes, decisions on approaches to follow in the implementation of these programmes are largely dictated by them (the donors). The Government's research and extension policies have always striven to align with the World Bank's and other major donors' terms, conditions, and requirements.

Currently, the country's agricultural policies, including MAFFS' National Agricultural Extension Advisory Policy gazetted in 2015, and SLARI's Strategic Plan 2012-2021 developed in 2011, support the use of agricultural innovation systems. This is borne out of the recognition of the importance of the contributions of the other players in the private sector, and the increasing relevance of farmers' participation in development planning and implementation (GoSL, 2010). Innovation platforms and the use of participatory methods, such as Farmer Field Schools and Participatory Varietal Selection, are among those claimed to be currently used by research and extension actors.

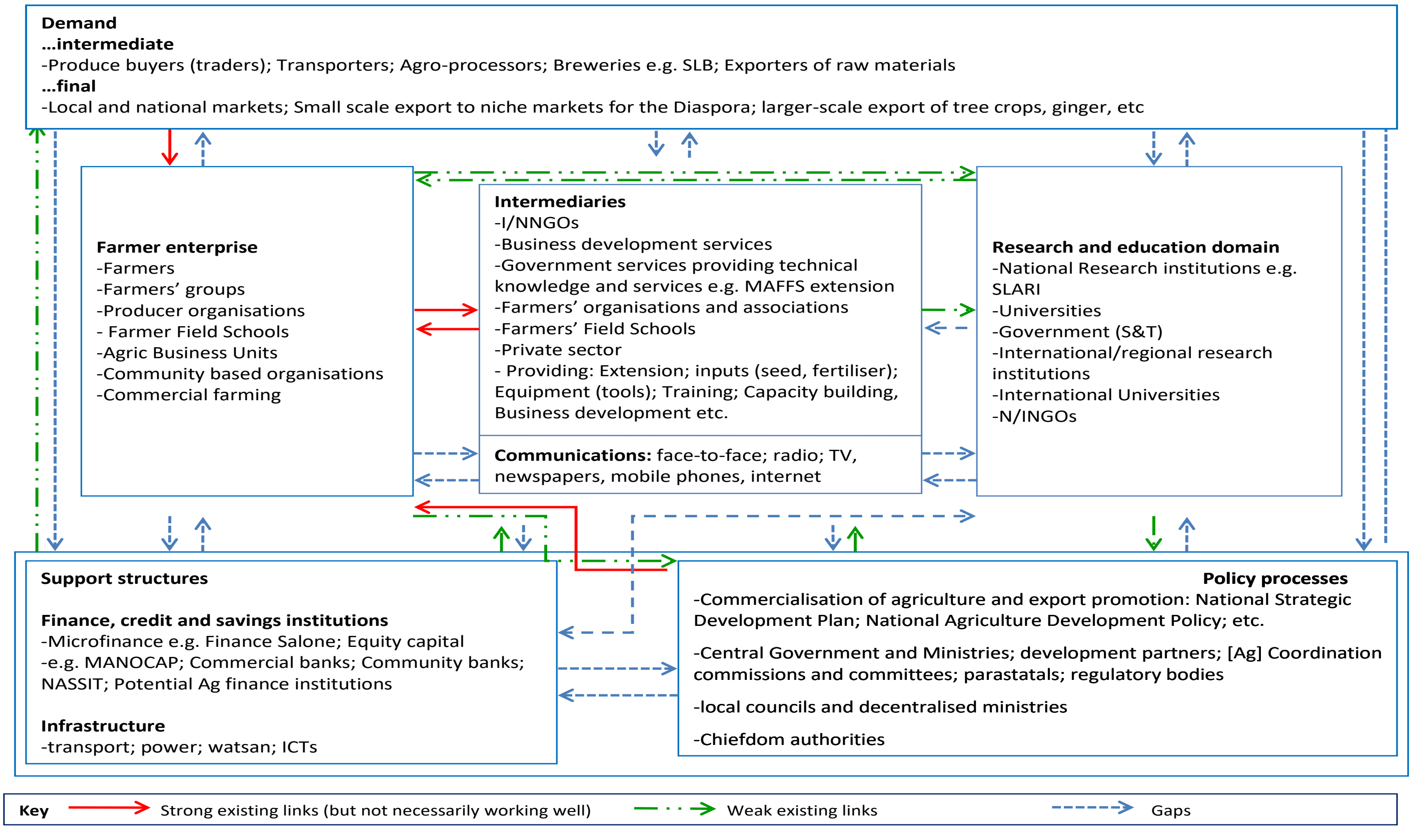
Given the importance attached to rice as the staple food crop of the country, the government, through MAFFS, NGOs, and other private sector actors, have always been developing, adapting, and disseminating rice innovations to smallholder farmers in an effort to boost the production of rice nationwide. SLARI, MAFFS, NGOs, and the private sector have been promoting rice innovations among smallholder farmers in varying contexts, scales, and capacities (MAFFS, 2009). SLARI, for instance has been developing and disseminating, through extension, new varieties of rice for more than five decades. Improved rice varieties, popularly known as the "ROK" series, together with the accompanying management practices, were among the earliest rice innovations of SLARI to be promoted among smallholder farmers in the country through MAFFS (SLARI, 2011). Fertility maintenance techniques for rice production, such as the use of inorganic fertilisers and swamp development, have also been promoted by both the public and private actors, geared towards augmenting rice production among farmers. From the mid-90s to the early 2000s, MAFFS, through SLARI, introduced New Rice for Africa (NERICA) as a measure to achieve food security in the country by increasing smallholder farmers' productivity per unit area. In 2005/06, MAFFS launched the NERICA Dissemination Project, known as the Multinational NERICA Dissemination Project – Sierra Leone. The main objective of the project was to attain food security through the rapid dissemination, adoption, and widespread cultivation of NERICA varieties by small-scale farmers (Bangura, 2006). These were initially promoted through the Participatory Varietal Selection method where farmers are given the opportunity to evaluate varieties in demonstration plots and choose the "finished" varieties offered by researchers/extensionists based on the qualities they prefer (Bangura, 2006). MAFFS also launched, in 2010, the Smallholder Commercialisation Programme for improvement in production, value addition, and marketing of agricultural produce, particularly rice. Among the innovations was the construction of Agricultural Business Centers (ABCs) across the country with the aim of improving smallholder access to input and output services, particularly rice processing, storage, and marketing facilities for smallholder farmers (GoSL, 2010). Similarly, NGOs, such as Catholic Relief Services, Concern Worldwide, World Vision, and CARE, have been playing key roles in the adaptation and promotion of rice innovations among smallholder farmers. A key innovation recently promoted by NGOs among smallholder farmers is the System of Rice Intensification which is seen to have the advantage of maximising output with minimum inputs, and is accompanied by a number of rice innovations, including soil and water management (CRS, 2012; Concern Worldwide, 2013). NGOs and other private service actors are very active in the promotion of improved rice varieties among smallholder farmers (GOSL, 2010). It is claimed in the literature that participatory methods, such as the FFS, are being used by research and extension actors with smallholder farmers in the innovation process.

However, despite the many actors in the agriculture sector providing research and extension services to smallholder rice farmers, the sector still lags behind in terms of meeting the national food requirement of the population as productivity remains low (WARC, 2013). Ironically, SLARI (2011) indicated that the low productivity is attributed to, among other factors, the inappropriate production practices by farmers due to lack of awareness or low adoption of improved technologies, and the lack of access to credit. It is also due to poor quality and high cost of inputs and inappropriate policies on cereal investment, as well as the lack of suitable varieties with desirable traits and established seed systems to service the sector. A study by Kamara (2009) on the adoption of NERICA rice varieties in Kambia District showed that the adoption of NERICAs was relatively low (taken up by only about half of the respondents) considering the perceived advantages as promoted in the literature, and that all farmers growing NERICAs also grow their traditional varieties.

Similarly, GoSL (2009) highlighted that SLARI continues to operate in a conventional research-driven model as it has limited capacity at present to work with more interactive farm-based methodologies. This is contrary to claims of a shift to supply-driven models due to an AIS approach. Also, a study conducted by Research Into Use (cited in MAFFS, 2012) shows that there exists many weak linkages, and in some cases gaps, in interaction between innovation actors and support systems, which suggests the existence of a weak innovation system. As can be seen in Figure 3.1 below, gaps do exist between various units of the system, including farmers and intermediary organisations such as NGOs, and support structures, and links are weak between farmers and the research and education domain.

The foregoing discussion motivates this study to critically examine the rice innovation processes promoted by research and extension actors and how they have influenced smallholder rice farmers' innovative capacities.

Figure 3.1: Analysis of Sierra Leone Agriculture Innovation System



Source: Ministry of Agriculture, Forestry and Food Security (2012).

3.5 NGOs in the Agriculture Sector

NGOs have been major development partners in Sierra Leone since the 1970s and 80s; they emerged as a result of the perceived failure of state-led development efforts (Fowler, 2000; Lewis, 1998). NGOs engage in diverse sectors of development in the country, including improvements in agriculture, health, education, human rights, gender, and environmental issues (Lewis, 1998). Given the importance attached to the agriculture sector in the country, the sector has benefited from the participation of almost all key NGOs operating in the country. Over thirty (30) NGOs (national and international) currently participate in the agriculture sector (MAFFS, 2012; researcher's experience from attendance at agric-sector NGO coordination meetings in Freetown, 2014). Their activities range from the conduct of agricultural research, though to a limited scale, to providing extension services to smallholder farmers, particularly in rural Sierra Leone where the majority of farmers live. NGOs have been largely seen to have a positive influence on the societies in which they operate, they engender people-centred social development and build local capacity, they act as watchdogs of the public good and safeguard the interests of the disadvantaged and marginalised (Nishimuko, 2009). NGOs are perceived to have the ability to do what other actors (such as states and donor agencies) cannot, and can fill gaps which result from inadequate government delivery services, they are also less autocratic and hierarchical compared to government institutions (Nishimuko, 2009).

Additionally, NGOs are believed to have comparative advantages in the areas of cost effectiveness, reaching the poor, flexibility, popular participation and innovation (Hudock 1999 cited in Nishimuko, 2009). It is for these reasons that it is largely believed that the participation of NGOs in the development of a given sector can make significant contributions to the development outcomes of that sector. However, in Sierra Leone, particularly in the agriculture sector, the impact of NGOs remains questionable to many. They are largely accused of lacking coordination with other actors, and with each other, and hence, they often duplicate efforts in a few easily accessible areas and shy aware from those areas in dire need of their services. MAFFS has established a unit for coordinating all activities of NGOs working in agriculture to ameliorate this shortfall (MAFFS, 2012). The extent to which this has been successful still remains questionable.

3.6 Conclusion

This chapter reveals important information regarding the agriculture sector of Sierra Leone, and supports the need for this study. Key conclusions include: the substantial agricultural potential of the country, which is not currently realized to the fullest due to a number of constraints; the existence of a pluralistic agricultural extension system with a plethora of research and extension innovations designed and implemented by public and private sector actors; the key role of NGOs played in the development of the agriculture sector; and the existence of a wide variety of policies supporting the sustainable design and implementation of agricultural research and extension programs by all stakeholders, the most recent of which being the Agriculture Innovation Systems Approach. However, there is currently limited (if any) information on the extent to which an AIS approach is functioning or integrated into activities of research and extension actors.

It is against this background that this study focuses on understanding the effectiveness of agricultural innovations by examining the following: the innovation processes and extent to which the AIS approach has been effected by research and extension professionals; the attitudes, beliefs, and behaviours which influence research and extension professionals' use of an AIS approach; and the influence of research and extension programmes on smallholder farmers' innovation processes. This will help a better understanding of the consistency between national policies and practices of research and extension professionals and provide insights with respect to AIS relevant to Sierra Leone and beyond.

CHAPTER 4 : METHODOLOGY OF THE STUDY

4.1 Introduction

This chapter presents the methodological framework used in the study. Specifically, this chapter contains the philosophical basis underpinning the study as well as the research design. In this respect, the study proposes to align itself with the pragmatic epistemological approach and a sequential multi-strategy design involving the use of qualitative and quantitative research approaches. A brief description of the study area is presented and is followed by the research strategy in which the researcher outlines the proposal to conduct the study in four districts in the north of the country with a four-stage research strategy. Further, the sample size, sampling technique, and sampling unit are introduced. Finally, the data collection and analysis procedures, and measurement of the TPB variables are explained and discussed.

4.2 Epistemological Basis Underpinning this Study

The epistemological question relating to the philosophy of the study is; "what the ways of are knowing and how can we acquire knowledge about reality?" To answer this question, a pragmatic epistemology is required in which precision is given to the evidence required to make sense of phenomena to develop a greater and complete understanding (Creswell & Piano Clark, 2011). This study will therefore adopt the pragmatists' epistemology that argues that reality may best be understood by comprehending both qualitative and quantitative data. The truth according to this approach is 'what works', and that various methodological approaches that work best for the particular research problem can be adopted to conduct research (Robinson, 2011:28). For pragmatism, knowledge arises from examining problems and determining what works in a particular situation (Creswell, 2013). The key assumption of pragmatism is that finding answers to research questions is the most important aspect of the study (Tashakkori & Teddlie, 2013, Creswell & Piano Clark, 2011; Robinson, 2011). The pragmatic approach focuses on the research problem rather than research methods as all possible approaches may be used to derive knowledge about a problem (Creswell, 2013). This episteme allows consideration of different types of reality; responding to the question "what evidence do we use to make sense of our social world". Pragmatism is flexible, does not subscribe to the paradigm divide, and embraces the 'mixing' of the quantitative and qualitative research designs (Bryman, 2012; Creswell, 2013; Robinson, 2011). Ways of knowing the social reality relating to the assessment of the effectiveness of agricultural innovations from an innovation systems perspective incorporates complex interconnected structural and agential issues that require the application of various and rigorous research methods. The use of mixed method approaches involving the use of qualitative and quantitative research methods provides an opportunity to effectively achieve this. Moreover, given that these two methods will be used at different stages of the research, triangulation of findings through the generation of different data types will provide a more comprehensive and holistic understanding of the research problem (Mose, 2013). It is against this backdrop that this study aligns itself with the pragmatic paradigm as the fundamental epistemological basis underpinning the overall study.

4.3 Research Design

The study adopts a sequential multi-strategy (also called sequential mixed-method) research design in which qualitative and quantitative research methods are used to generate data for the study. A mixed-methods approach is a procedure for collecting and analysing both quantitative and qualitative data within a single study to understand a research problem more completely (Creswell, 2014; Robinson, 2011). Data collection may involve collecting data either simultaneously or sequentially to best understand research problems (Creswell, 2003: 18). Qualitative methods, such as KIIs, workshops, and FGDs were used to address Objective 1 of the study which focuses primarily on describing the agricultural innovation system on rice from a research and extension perspective, and also to inform the design and finalisation of questionnaires used for the generation of quantitative data for the second and third objectives of the study.

4.4 The Study Area

The target country of this study was Sierra Leone. As indicated in chapter 1, Sierra Leone like most SSA countries, is highly dependent on agriculture as a source of economic growth, and the sector employs more than half of the national workforce (about 75%). While the study is generally considered a national study, specifically to address Objectives 1 and 2, it focused on four districts in the Northern Province to address Objective 3, i.e., to assess the influence of research and extension programmes on smallholder farmers' innovation capacity. Objectives 1 and 2 targeted research scientists and extension personnel in MAFFS, Agriculture-Sector NGOs, and SLARI, nationwide. Objective 3 focussed on smallholder rice farmers in Kambia, Tonkolili, Port Loko, and Koinadugu Districts in the Northern Province. The Northern Province is the most suitable for achieving the objectives of the study because, when compared to other provinces, it constitutes the major rice growing district (National Population and Housing Census, 2003; World Bank, 2013). In addition to agriculture being the main source of livelihood for the population in the selected districts, Kambia (78.4%), Koinadugu (84.2%), Port Loko (80.5%) and Tonkolili (76.4%), food insecurity in these districts is among the highest in the country (WFP, 2011; World Bank, 2013). Indeed, the selected districts constitute three[7] of the five most food insecure districts in the country, according to the World Food Programme's Comprehensive Food Security and Vulnerability Assessment Report 2011, and the two most poverty-stricken provinces (61.0%), thus these four selected districts are among the poorest in the country (World Bank, 2013).

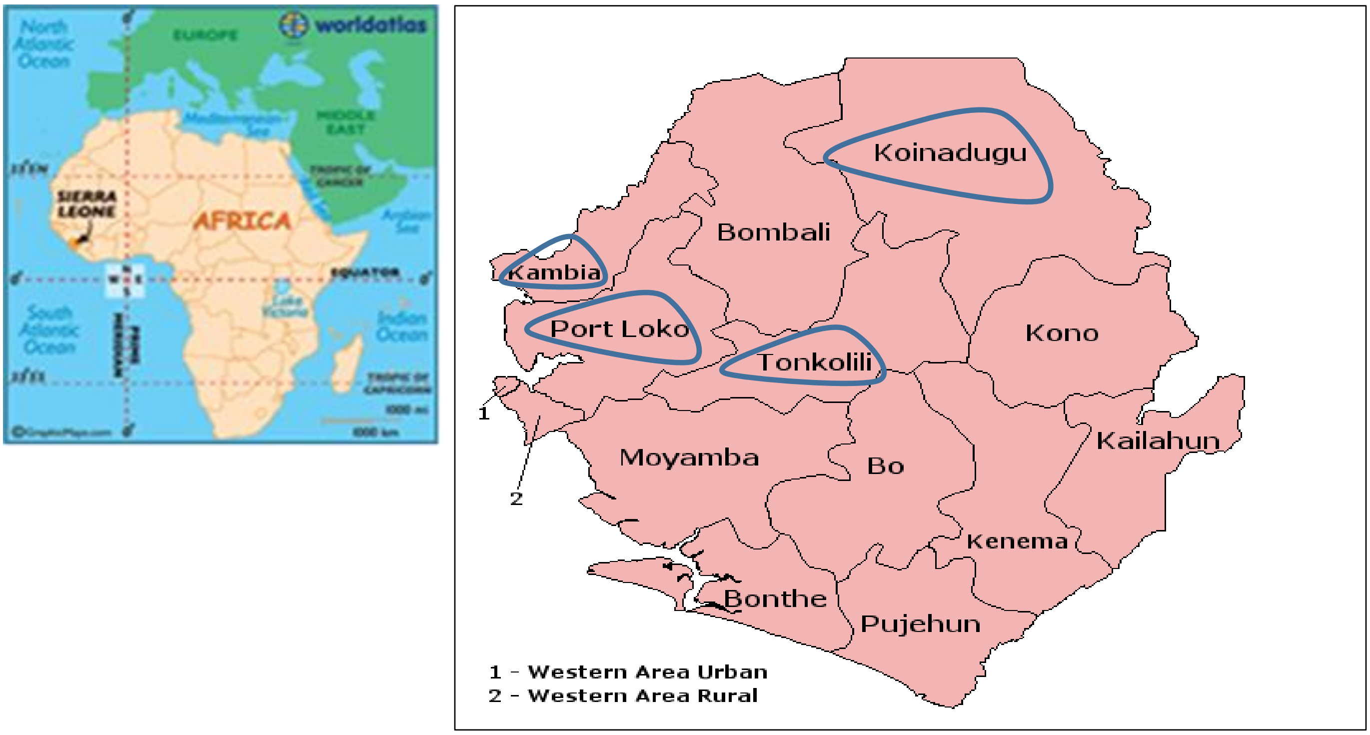


Figure 4.1: Map of Sierra Leone showing study area (districts)

The high prevalence of poverty/food insecurity in the study districts, coupled with the high dependence of the population on agriculture for their livelihood, has led to many actors in the agriculture sector focussing their operations, particularly in relation to rice, in Northern Sierra Leone. In addition to Government line ministries, the study districts host the operations of many NGOs, both local and international, with most having an agricultural component (MAF, 2004). The Northern Province hosts four of the seven constituent centres of SLARI, and three of the study districts each host a centre. The Rokupr Agricultural Research Centre (RARC), whose primary mandate is to conduct research on rice and other cereals, is located in the Kambia District (SLARI, 2011), one of the target districts of the study. The above reasons, in addition to time and financial constraints of the study, led to the selection of these districts to address Objective 3.

[7] These districts are Kambia, Tonkolili, and Port Loko. The prevalence of food insecurity in these districts exceeds 70%, based on WFP's food consumption score report, 2011.

4.5 The Research Strategy

As indicated earlier, the study seeks to assess the effectiveness of rice research and extension programmes from an AIS perspective. It specifically aims to: describe the agricultural innovation system on rice in Sierra Leone from a research and extension perspective; identify and analyse the key behaviours, beliefs, and attitudes of research and extension actors that influence the functioning of rice innovation systems; assess the influence of research and extension programmes on smallholder rice farmers' innovations. The study used both qualitative and quantitative techniques for the generation of data to address the stated objectives and was conducted in four phases.

Phase 1

This was completed from January to March, 2016. At this stage, the researcher conducted two multi-stakeholder national workshops with key stakeholders in the agriculture sector, including MAFFS, SLARI, and Agriculture Sector NGOs. KIIs were also conducted at this phase and included relevant stakeholders from the target institutions who were not able to attend the workshops, as well as those who attended, but who were considered particularly relevant to be interviewed individually based of their positions and knowledge. This phase of the study was primarily geared towards generating information for critically describing the rice innovation systems from a research and extension actor's perspective (Objective 1). Two workshops were conducted. The first was in Freetown, the capital city, and included mainly policy makers and senior management level staff from the target institutions. The other was conducted in Rokupr town where one of the key subsidiaries of SLARI, RARC, is situated, and included mainly front line extension staff and researchers based outside the capital, Freetown. The workshops were complemented by KIIs to further enrich the information collected and to adequately address Objective 1 of the study.

Phase 2

This phase included the rest of the qualitative data collection process. In this phase, FGDs and KIIs were conducted to generate information that addressed Objectives 2 and 3. The FGDs and KIIs with the research and extension professionals were conducted first, followed by those with smallholder farmers. A preliminary analysis was then conducted to inform the next phase of the study, particularly the development of questionnaires for the quantitative component.

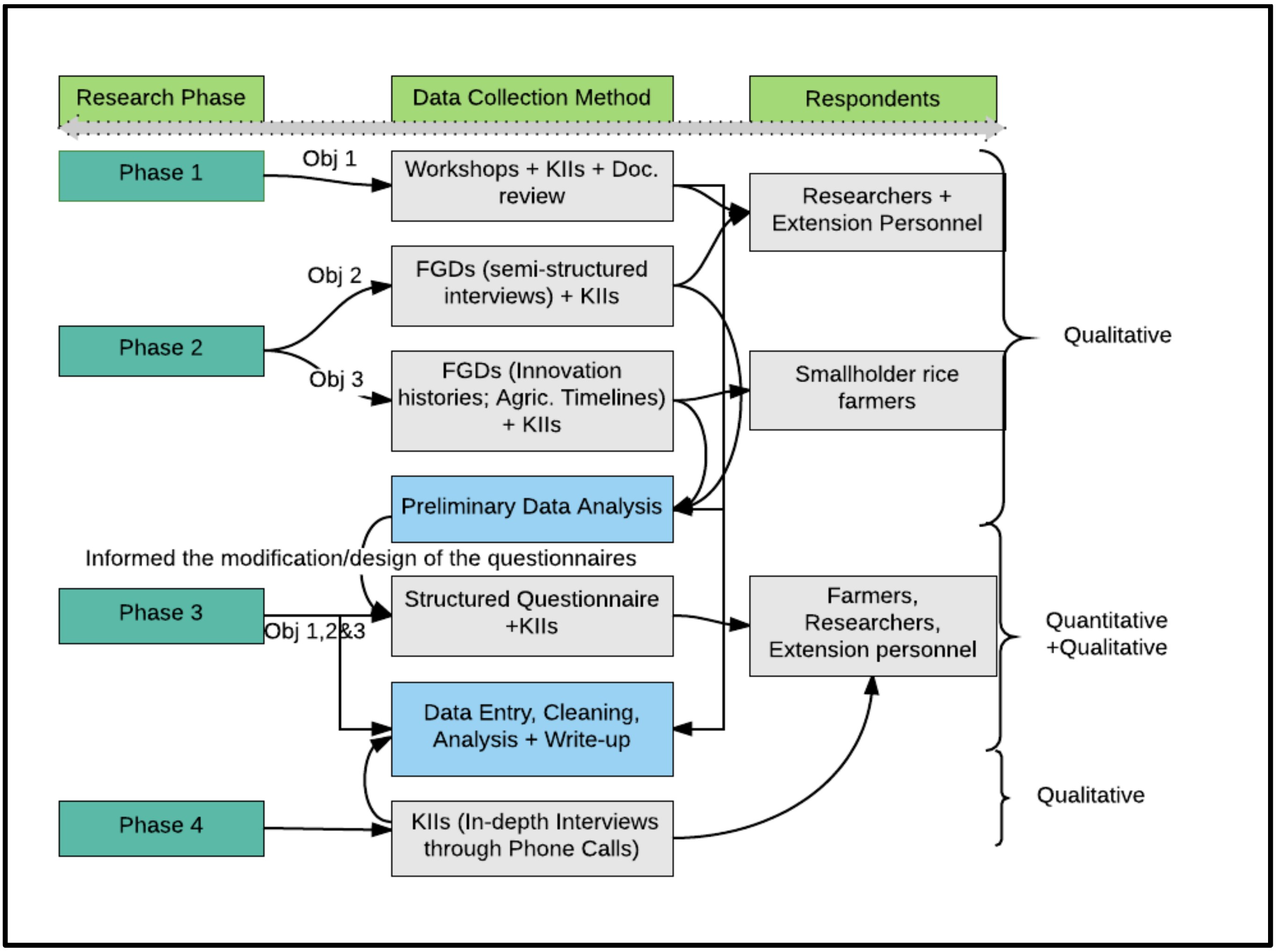
Phase 3

This phase primarily comprised the quantitative aspect of the study. Questionnaires were developed to address Objectives 2 and 3 and were administered among the target respondents, they included, a) research and extension personnel for Objective 2, and then, b) farmers for Objective 3. This phase included the selection and training of enumerators, pretesting, and administration of the questionnaires among target respondents. In this phase, additional KIIs were conducted to inform the analysis of data obtained for addressing Objective 1 in phase 1.

Phase 4

The fourth phase of the study involved making phone calls to selected respondents/participants in Sierra Leone from the UK during the data analysis and write-up stages. This was necessary to ask more in-depth questions, as they emerged from the data, to verify and probe for information. The diagram below provides a visualisation of the different phases of the study, the data collection methods used in each phase, and the target respondents/participants.

Figure 4.2: The research strategy of the study



4.6 Sample Size for the Questionnaire

Sampling in social research is done to produce reasonably accurate findings without the need to collect data from each and every member of a research population (Denscombe, 2014:32). A sample is that segment of the population that is selected for investigation, it is simply a subset of the population to be studied (Bryman, 2012: 187). The number of units that need to be studied from a given research population to get precise and reliable findings is called a sample size (Konthari, 2004). De Vaus (2002, 2001) suggests that one needs to strike a balance between accuracy, cost, and assurance of the selection of sufficient numbers for a useful subgroup analysis to be performed. Other scholars, such as Bulmer and Warwick (1993), posit that the determination of a sample is a matter of convenience in situations where there are limited resources. The sample size for this study is consistent with De Vaus' (2002, 2001) suggestion, i.e., a sample size large enough to enhance accuracy of the findings, the cost associated with the research, and the time available to the researcher, were all considered. The quantitative survey initially targeted a total of 140 respondents – 40 research scientists from SLARI and 100 extension professionals (50 each from MAFFS and NGOs). However, only 122 questionnaires were returned by the target respondents (87% response rate) – 35 from research scientists (87.5%), 42 from NGO extension professionals (84% response rate), and 45 from MAFFS extension professionals (90% response rate). This sample size is within the range advised for most TORA/TPB studies (fewer than 50 to 750 respondents) (Davis et al., 2002; Rashidian et al., 2006; Mose, 2013; Lalani, 2016). With respect to farmers, 25 rice farmers per community in eight communities were sampled, resulting in a total of 200 sampled farmers. Overall, the study sampled a total of 322 respondents for the quantitative study – 200 smallholder farmers and 122 researchers and extension professionals.

4.7 Sampling Unit

A sampling unit, according to Konthari (2004), constitutes an individual, group, or other entity that is selected for a survey. The sampling unit for this study are Research Scientists, Extension Personnel in the Ministry of Agriculture, and agriculture-sector NGOs in the study area, as well as rice farmers.

4.7.1 Extension Personnel: These included staff of MAFFS and those of key NGOs working in the rice sector. They include senior and frontline officials in the agriculture extension departments based in Freetown and in the target districts for the study. They were targeted to address Objectives 1 and 2.

4.7.2 Research Scientists: SLARI is the major institution conducting research in the agriculture sector in the country. Other institutions, such as the International Institute for Tropical Agriculture

(IITA) and BRAC International, also conduct research activities on agriculture. However, the key respondents for this study primarily came from SLARI as it is the national agricultural research institute. That notwithstanding, one senior research staff member from BRAC agreed to participate and was included in both the workshop and the questionnaire survey.

4.7.3 Smallholder Farmers: The study targeted smallholder rice farmers in the target districts. These are farmers who live in the target communities who have been actively participating in rice cultivation for at least the past five years before the study. They were targeted to address Objective 1.

4.8 Sampling Technique

The quality of a research output is, to a large extent, a function of the sampling technique used. Factors such as cost, time, and accessibility, among others, usually constrain researchers from interviewing the entire population in a given study area (Bryman, 2012). This limitation necessitates the adoption of a sampling technique for the selection of respondents. For this study, both probability and non-probability sampling techniques were adopted. Agriculture research scientists and extension personnel were purposively selected from the relevant institutions to address the first and second objectives. This was to ensure that both junior and senior level staff were targeted. A list of all Agriculture Sector NGOs registered with MAFFS was obtained from the NGO Desk Officer. NGOs implementing, or who have implemented, programmes on rice from 2005 to 2015 were identified by the researcher with assistance from the NGO Desk Officer. As a result, invitation letters were extended through the NGO Desk Officer at MAFFS whereby one senior and one junior member of staff from each organisation who were engaged directly in agriculture programmes were invited to participate in the workshops. For the quantitative survey, the questionnaires were distributed to professionals of the selected NGOs by the researcher, making conscious efforts to target senior, middle, and frontline professionals in all the institutions targeted. Similarly, the selection of farmers was conducted by first using a stratified random sampling technique to select communities in the districts well known for rice cultivation. At community level, respondents were then selected through a systematic random sampling of houses based on the total number of houses in the community. Respondents were selected by constantly skipping a given number of houses, determined by the total number of houses available. This was to ensure a fair selection of respondents at community level which a purposive or accidental sampling method would not provide.

4.9 Data Collection Methods

The data collection process started in January, 2016, and was completed in January, 2017, with periods of preliminary data analysis taking place in between. The first and second phases of the data collection took place from January to March, 2016, and the third phase from October, 2016 to January, 2017. The fourth phase was undertaken during the data analysis and write-up stage from March to May, 2017. The following sections introduce the data collection methods employed.

4.9.1 Workshops

Workshops are group interviews that do not only constitute a spontaneous exchange of views but include a careful questioning and listening approach with the purpose of obtaining thorough and tested knowledge (Alasuutari et al., 2008). Similarly, Kvale and Brinkmann (2009) point out that group interviews could bring forth more spontaneous and emotional expressions of different viewpoints which may be limited in individual interviews. Two workshops were conducted to help elicit information to describe the AIS on rice in Sierra Leone from a research and extension perspective. One workshop was held in Freetown, and the other was held in the provinces in the north. The workshops were specifically used to address Objective 1 by eliciting information from research and extension professionals on the key innovations on rice that have been promoted in the country over the past ten years (2005-15), their perceived benefits, the key actors involved, their roles in the generation, adaptation, dissemination, and utilisation of these innovations, as well as the patterns of interactions that exist among them. Further, factors influencing the effectiveness of the innovation system on rice in the country were also elicited during the workshops.

To obtain maximum contributions from participants, efforts were made to divide groups into exclusively one category of participants i.e., researchers or extension professionals, and to structure the workshop into three sessions. Extension professionals were further divided into NGOs and MAFFS and each workshop was then divided into three groups. Before the start of the sessions, the researcher gave a presentation which explained the objectives of the study and the emergence of the AIS perspective, as well as the expected outputs of each session and the corresponding templates/matrices to be completed by participants in their various groups. In each session, participants from each group presented their findings, and then all the groups collectively merged their findings in a plenary through open discussion in order to clarify issues and achieve consensus. The following are details of each session.

Figure 4.3: MAFFS officials preparing their presentation for plenary session

Session 1: In this session, a modified Actor sheet, following that used by Gervacio (2012), was provided to each group with the aim of generating information about the key rice innovations promoted by their organisation in the past 10 years and their perceived benefits, and about the actors involved and their roles. The outputs of each group were presented by a nominated member of the group. These were then merged through a general consensus from all participants in a plenary session.

Table 4.1: Sample Actor Sheet Matrix used in the study

Organisation	Innovations Promoted	Perceived Benefits	Actors	Key Role of Actors
	1.	1. 2. 3. 4. 5.	1. 2. 3.	1. 2. 1. 2. 1. 2.
	2.			
	3.			

Session 2: This session focused on identifying the key constraints associated with the innovations identified in Session 1, and the general constraints limiting the effectiveness of the innovation

system. A constraints matrix designed by the researcher was also presented to participants for their use. Similarly, the group outputs were presented in a plenary by each group and then merged by participants through open discussion to clarify issues and achieve consensus.

Table 4.2: A sample Constraints Matrix used in the study

Organisation	Innovations Promoted	Constraints in Innovations	General Constraints Limiting Innovation
	1.	1. 2.	1. 2. 3

Figure 4.4: A cross-section of NGO professionals preparing their presentation for the plenary session

Figure 4.5: A cross-section of research professionals preparing their presentations in Freetown and Rokupr

Session 3. This focused on eliciting information on the strengths and purpose of linkages among actors in the innovation system on rice as perceived by research and extension professionals. An Actor Linkage Matrix, following that used by Gervacio (2012) and proposed by the World Bank (2007), prepared by the researcher, was provided to participants during this session for their use. Information that was generated in this process was complemented by KIIs (including the timelines for the innovations), to fill any gaps and to triangulate the findings.

Table 4.3: Example of an Actor Linkage Matrix

Actors	A	B	C	D
A	ST*: P*:	ST: P:	ST: P:	ST: P:
B	ST: P:	ST: P:	ST: P:	ST: P:
C	ST: P:	ST: P:	ST: P:	ST: P:
D	ST: P:	ST: P:	ST: P:	ST: P:

* ST: Strength of Linkage; P: Purpose of Linkage

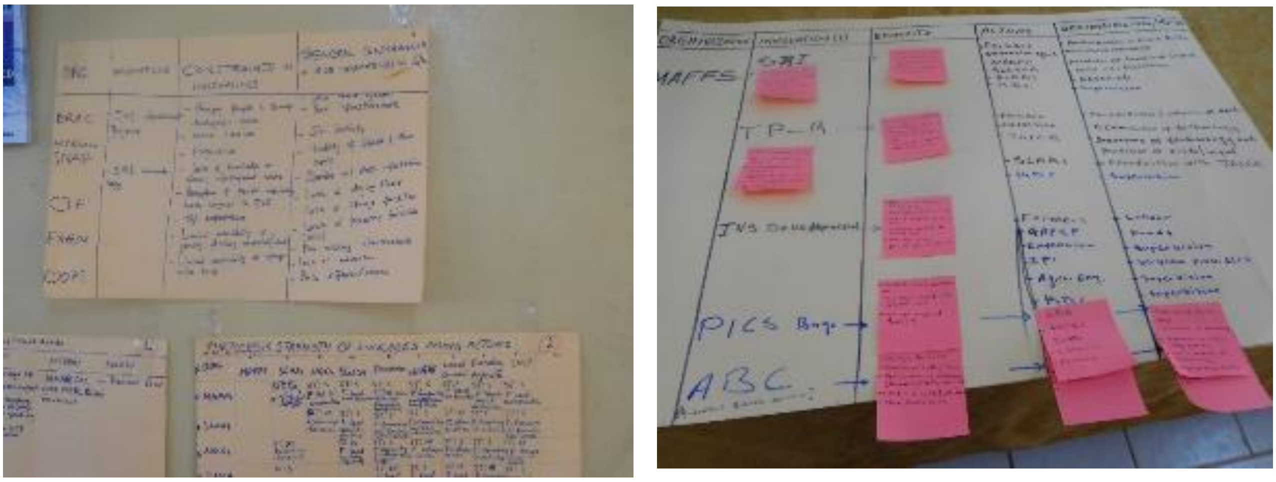


Figure 4.6: Samples of outputs from the various sessions of the workshop

Figure 4.7: Researcher explaining the Actor Linkage Matrix to participants in Freetown

The researcher was assisted by a moderator/research assistant. This was an experienced development worker currently heading the agriculture department of Sierra Agribusiness Business Initiative (SABI) who facilitated the discussions while the researcher took notes during the groups' presentations. The research assistant also played a similar role in the conduct of the FGDs.

4.9.2 Focus Group Discussions (FGDs)

The use of FGDs in qualitative research is regarded as a powerful tool. It gives voice to those who may be reluctant to be interviewed individually, or those who initially feel they have nothing to say (Robson, 2011: 293). This study therefore adopted the use of FGDs for addressing two objectives of the study: Objective 2 – the identification of behaviours, beliefs, and attitudes of rice research and extension personnel influencing the functioning of rice innovation systems in Sierra Leone; and Objective 3 – the influence of research and extension programmes on smallholder farmers' innovative capacity. FGDs have been widely used in the elicitation stage of the TORA/TPB constructs (e.g. McKemey, K., and Rehman, T., 2005; Mose, 2013; Lalani et al., 2016), hence they were adopted in this study.

For Objective 2, agricultural research scientists from SLARI, agricultural extension professionals from MAFFS, and key agriculture-sector NGOs were selected and engaged in the FGDs. The FGDs were used to elicit information on research and extension professionals' outcome, control and normative beliefs (social referents) used in computing TPB variables. For Objective 3, smallholder farmers in eight communities were selected and engaged in FGDs across the four target districts. During these FGDs, the researcher used tools including agricultural timelines and innovation histories to understand the farmers' agricultural enterprises, and the innovations therein, which occurred within the study timeframe.

Though opinions vary on a suitable group size and composition for FGDs, Stewart and Shamdasani (1990) suggest eight to 12, whereas Morgan (1998) opts for six to 10, Robson (2011) highlighted the use of convenience samples and pre-existing groups by most researchers. This study aligned itself with both Robson (2011) and Morgan (1998). That is, it used a convenient sample size of at least four participants for the FGDs for research and extension professionals since it was difficult to gather many participants at once due to their official duties/engagements. The FGDs were conducted at two levels, senior management and junior level staff of the participating organisations. This was to ensure that perspectives from the 'top' and 'bottom' cadres of the target organisations were fully captured so as to provide a complete picture to reflect the views of all categories of respondents. A total of 12 FGDs were conducted among research and extension professionals at the elicitation stage to generate data for the beliefs used in computing the TPB variables. Three FGDs were conducted with SLARI personnel – one at senior and two at junior staff levels; five FGDs were conducted with MAFFS personnel – one at national/senior staff level and four at junior level in each district; and four FGDs were conducted with NGO personnel – one at national/senior level and three at junior staff level in each district. During the FGDs, participants were asked to:

a) individually list the key behaviours that characterise a functioning AIS in research and extension;

b) individually list the advantages and disadvantages of using an AIS approach in research and extension programmes;

c) list people or organisations that would approve or disapprove of its use;

d) list conditions that would make it easy and/or difficult if they were to use an AIS approach in their work.

After completion of this exercise, participants shared their responses in a plenary session. The responses were listed on a flip chart and the number of people who had listed each was recorded (frequencies). This was repeated in all FGDs conducted for research and extension professionals. Responses with the highest frequencies were then compiled by the researcher and they formed the basis for the elicitation stage of the TPB variables, including outcome beliefs, salient referents, and control beliefs.

A minimum of eight farmers participated in all the FGDs conducted in the eight communities. A total of 16 FGDs were conducted in all the eight communities (two FGDs per community). In each community, male and female farmers were interviewed separately using Agricultural Timelines for one group and Innovation Histories for the other, in every two communities per district. *Agricultural timelines* is a participatory tool that was used with farmers to record changes that have occurred in their communities, as well as smallholder rice farmers' innovations and how they have adapted to these changes over time. Participating farmers were encouraged to identify key agricultural events that have occurred in their communities, and when they occurred. To help farmers put these events in a historical perspective, these events were recorded in a horizontal line on a vanguard, by the researcher, specifying a defined time period, while the research assistant helped with facilitation. The aim was to provide general information about farmers' key agricultural events in their communities, the innovations that have occurred, and the key enterprises they have undertaken. They were encouraged to select the most important changes that had occurred in their communities and to discuss where these ideas had came from and why, and how they were diffused and adapted among them. This helped to understand the key enterprises in which farmers engage, and the key changes they have effected in their rice farming systems over a given period of time. This information was then used to design the quantitative survey administered in the second phase of the study.

Innovation histories provide a comprehensive analysis of innovation through the recording and comparison of innovation processes and the identification of factors and approaches that support or constrain innovation (Gabb, 2013). An "innovation history" is a history of a given innovation told in the order in which the events of its creation and adoption occurred. It is a method of recording and reflecting on an innovation process where actors construct a detailed account based on their recollection and on available documents (Gervacio, 2012). In this study, innovation histories were used to identify the key changes that farmers have affected in their rice farming systems in the past ten years, and to identify the drivers and the key actors of those changes. Guided by the full list of rice innovations that have been promoted by the key research and extension actors in the country, completing this exercise with the farmers helped gather the information that guided the design of questionnaires for the collection of quantitative data, subsequently used to understand the extent to which research and extension programmes have influenced smallholder farmers innovative capacity in the target communities.

Figure 4.8: Researcher posing with male smallholder farmers after a FGD in Konta Line, Kambia District (photo credit: Researcher)

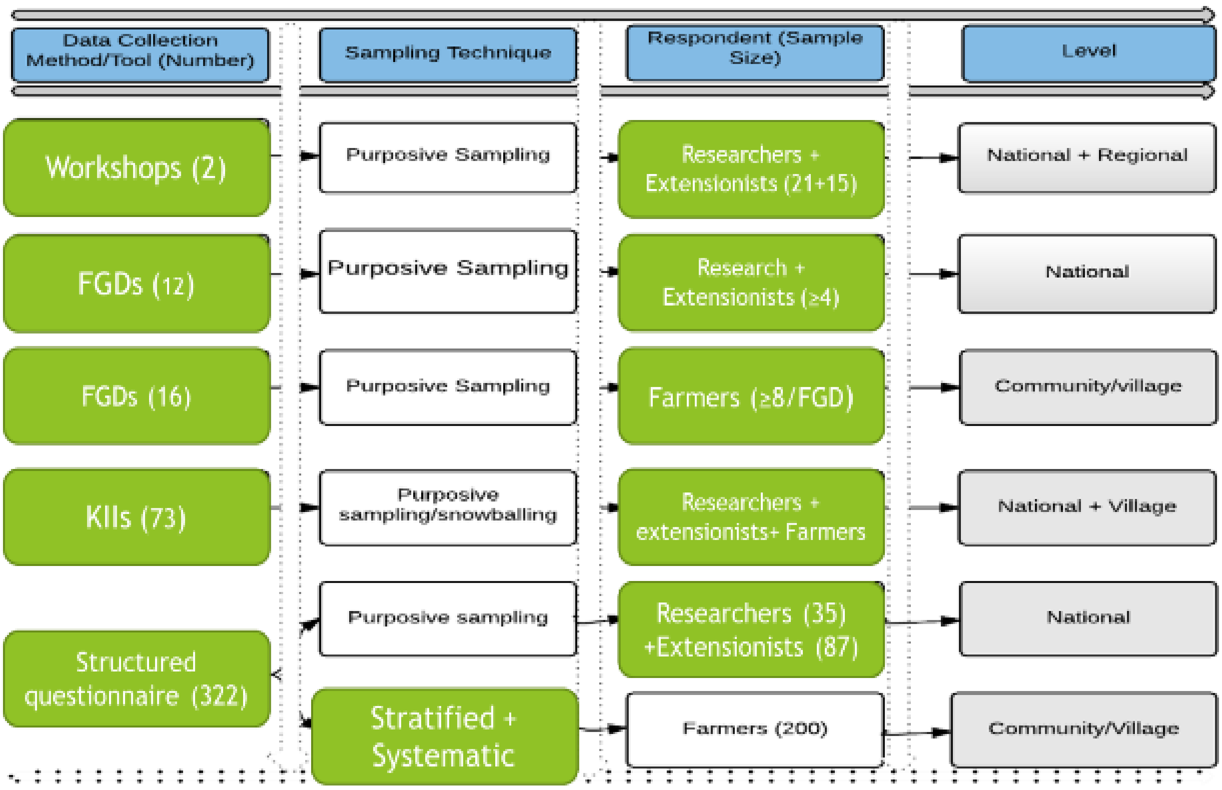
Figure 4.9: Female FGD participants in Petifu Line, Tonkolili District (photo credit: Researcher)

Figure 4.10: Female farmers demonstrating increased spacing of seedlings in their farms before and after participating in TP-R activities (respectively) in Koinadugu District (photo credit: Researcher)

4.9.3 Key Informant Interviews (KIIs):

KIIs were used to collect information from all categories of actor as a means of validating and augmenting the information collected from the FGDs and the quantitative analysis. These were used for all objectives of the study and served as a good strategy for triangulation of findings from the other methods. A total of 73 KIIs were conducted, 49 with research and extension professionals to address Objective 1, and 24 with smallholder farmers to generate information that informed the design of the questionnaires to address Objective 3. Three KIIs were conducted in each community. Figure 4.11 below summarises the data collection methods, sampling techniques, target respondents and the level at which the respondents were targeted. Also, audio recordings were made by the researcher, these data were transcribed, analysed, and used to fill gaps that were not captured by the researcher during note taking.

Figure 4.11: Summary of the data collection methods, sampling techniques and the corresponding respondents



4.9.4 The Structured Questionnaire

The structured questionnaires focussed on collection of data to address Objectives 2 and 3 with separate questionnaires for research and extension professionals and for farmers. The structured questionnaires were drafted by the researcher and then reviewed by his supervisor before being pretested and the final version determined and used. For Objective 3, a total of 200 smallholder farmers were selected, made up of 50 from each of the four districts. The questionnaire (see Appendix II) included sections to determine: farmers' socio-economic characteristics, this incorporated questions to measure poverty levels in the target communities using PPI indicators (as presented in Chapter 8); farmers innovations over the past 10 years; drivers of innovation, actors involved and their roles; constraints faced as a result of the current innovations; and the constraints which limit the farmers' ability to innovate.

Similarly, a structured questionnaire was administered to research and extension professionals to meet Objective 2 of the study. This questionnaire was divided into four sections which covered: the socio-economic characteristics of the respondents; their awareness of the AIS perspective in agricultural research and extension; and questions using TPB with respect to AIS (see Appendix I). This last section (focussing on TPB and AIS) differed between the senior and the middle and frontline research and extension professionals as it explored two behaviours of a functioning AIS. For senior research and extension professionals, the section focussed on innovation platforms as a behaviour for a functioning AIS; while for middle and frontline professionals, it focussed on the facilitation of complex and dynamic interactions among diverse actors in the innovation system. The section on the TPB model followed a process described in Ajzen (1991), Francis et al., (2004), and Rehman et al., (2007) where information elicited from FGDs were used to create the specific questions i.e., statements on attitudes, PBC, and subjective belief in the TPB questionnaire (see Appendix I, section D). A final total of 122 professionals were sampled: 35 Research Scientists from SLARI and NGOs; 87 Extension professionals from MAFFS and NGOs; and 33 senior, 32 middle, and 57 front line professionals.

4.10 Pre-testing of the Questionnaires

Pre-testing of questionnaires is important in many ways. In addition to helping to identify the strengths and weaknesses of the questionnaire, pre-testing also makes it possible to test the questionnaire under field conditions, to identify any errors or bias, and any other inadequacies (Francis et al., 2004; Stewart & Shamdasani, 2007). The pre-testing took two different stages as there were two sets of questionnaires. For research and extension professionals, the questionnaires were pretested among six (6) respondents of different cadres in the management hierarchy – two senior, two middle, and two frontline. The questionnaires were physically handed to these respondents, by the researcher, for them to fill out and identify any questions they found unclear. This also allowed the researcher to check that their understanding of the questions was as intended and that the information they provided would enable the researcher to address the intended research questions. The questionnaires were revised based on their comments and feedback. The revised questionnaires were then distributed individually to target respondents, by the researcher, for self-administration in the identified organisations. Senior, middle, and frontline staff were identified, based on discussions with the key senior management staff and confirmation from the target respondents themselves. The completed questionnaires were then collected at the date agreed upon at the time of distribution.

For smallholder farmers, a total of 20 questionnaires were pretested among smallholder farmers in a community similar to those targeted for the study in Kambia District. The pretesting was preceded by the selection and training of four enumerators – recent graduates from Njala University recommended by a friend of the researcher currently lecturing in the Department of Agricultural Extension and Rural Sociology, Njala University. The enumerators were trained at RARC over three days: one day for indoor step-by-step review of the questionnaire; one day for outdoor pretesting; and one day for collection, feedback, and modification of the questionnaire. The final version was then printed and used for the data collection.

Figure 4.12: Photos of indoor training of enumerators by the researcher in Rokupr

4.11 Measurement of the Theory of Planned Behaviour Variables

The following is a description of the variables used in the study and how they were measured.

4.11.1 Behaviour (B)

In this study, two behavioural domains were used. The first behaviour, henceforth known as "Behaviour 1" (B1), was "the use of an AIS approach in research and extensions programmes". This behaviour incorporated a number of behaviours, as identified during the elicitation stage of the study, typical of a functioning AIS and largely consistent with AIS literature (see Chapter 6 for results and further details). The second behaviour, henceforth referred to as "Behaviour 2" (B2), was "the facilitation of complex and dynamic interactions among diverse actors", which was one of the behaviours identified as characteristic of a functioning AIS (see Chapter 7 for results and further details).

4.11.2 Behavioural Intention (BI)

The measure of BI was determined through the use of three items to assess the strength of respondents' intent to use/exhibit the behaviours under study. Respondents were asked to indicate the extent to which they agreed or disagreed with the following statements: 1) I expect to (the behaviour) in the next 12 months; 2) I want to use (the behaviour) in the next 12 months; 3) I intend to use (the behaviour) in the next 12 months. The results were scored using a scale from one to five, where one denoted strongly disagree, and five strongly agree. These were then recoded after the data collection using a five-point bi-polar scale, ranging from +2 (very strong) to -2 (very weak) intention to use/exhibit the behaviour. The results of the three items were summed and divided by three.

4.11.3 Attitude (A)

Attitudes can be measured using two measures: the stated response (SA); and the calculated, or reasoned, response (CA) (Rehman et al., 2007). In this study, both were used. In the first measure (the stated attitude), four items were used to assess respondents' attitudes towards the use of the two behaviours studied. For B1 these included: (1) how unpleasant 2) how useful 3) how good or bad 4) how sustainable or not; and for B2, the fourth item was replaced with 4) how difficult or easy it is to use the behaviours in research and extension programmes. Using a five-point Likert scale during the data collection stage made it easier for respondents to understand, for the analysis stage these codes were changed into a five-point bipolar Likert scale, ranging from -2 to +2. The four items were then added in each case/behaviour and the result divided by four to determine the stated attitudes of respondents towards each behaviour.

The second measure of attitude was determined using the thirteen and seven outcome belief statements for B1 and B2, respectively (see boxes 4a and 4b), which were elicited during the FGDs. Respondents were asked to score their "belief strength" toward each of the belief statements using a Likert scale ranging from 1 to 5 (where 1 represents strongly disagree and 5 strongly agree). These were also recoded on a five-point bipolar Likert scale, ranging from -2 to +2. Further, respondents were asked to evaluate each of the outcome belief statements on a five point bipolar Likert scale, ranging from -2 to +2 (where -2 represents extremely bad and +2 extremely good). The resulting belief strengths and their corresponding evaluation by respondents were then used to determine the calculated attitude for each behaviour studied.

Box 4a: Identified outcome beliefs by researchers relating to the use of AIS approach in research and extension.

1. Can increase productivity and profitability of innovations for farmers
2. Can increase the attainment of food security among smallholder farmers
3. It enhances the effectiveness and sustainability of innovations on rice
4. It fosters capacity development of stakeholders including farmers
5. Can improve smallholder farmers' access to input and output markets.
6. It enhances experience sharing and best practices among different actors
7. Helps reduce burden on any one actor.
8. Increases agricultural innovation actors (including farmers) ability to innovate
9. Makes coordination of activities of the various stakeholders difficult
10. It is difficult to use due to the diversity of interests of various actors.
11. It is time consuming
12. It is expensive
13. It is difficult to use outside the organisation's policies

Box 4b: Identified outcome beliefs by researcher and extension relating to the facilitation of complex and dynamic interactions among diverse actors in research and extension.

1. Complex and dynamic interaction enhances access to knowledge sources, information and markets by smallholder farmers. 2. It enhances the effectiveness and sustainability of innovations on rice 3. It fosters capacity development of agricultural innovation actors 4. It is difficult to obtain commitment of diverse agricultural innovation stakeholders 5. Differing interests/objectives of diverse stakeholders make it difficult to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders.

In computing the calculated attitude score, the product of the individual outcome belief (b) and value (e) measures (b*e) gave the individual outcome attitudes (OAs). These were summed to give the calculated attitude score (i.e. CA = $\sum b_i * e_i$).

The Calculated Attitude was computed as follows:

Attitude (A) = $\sum_{i=1}^{n} bi\ x\ \ ei$ ………equation 1

Since there were 13 outcome belief statements used, the possible response score range for attitudes was:

= (-2x2) x 13 and (2x2) x 11

= (-52) to (52)

Where:

Very negative attitude = (-26) to (52)
Moderate negative attitude = (-1) to (-25)
Neutral attitude = 0
Moderate positive attitude = (1) to (25)
Positive attitude = (26) to (52)

These two measures were used as a means of triangulating the results. Also, the use of this approach in computing Calculated Attitudes is consistent with several TPB studies (Mose, 2013; McKemey and Rehman, 2005), hence, its adoption in this study.

4.11.4 Subjective Norms (SN)

The subjective norms (SN) that form part of the main TPB constructs measure how important others, who may be individuals or organisations, influence the respondents' behaviour. Direct and indirect measures have been proposed for this construct, both were used here. In the direct measure, four questions were asked of respondents. These included: 1) Most people who are important to me want me to adopt behaviour 1 or 2 in the next 12 months; (2) It is expected of me that I adopt behaviour 1 or 2 in the next 12 months; (3) I feel under social pressure to adopt behaviour 1 or 2 in the next 12 months; (4) People who are important to me think I should adopt behaviour 1 or 2 in the next 12 months. These were scored on a five-point Likert scale, ranging from 1 to 5 (where 1 represents strongly disagree and 5 strongly agree). During the analysis these were then recoded into a five-point bipolar Likert scale, ranging from -2 to +2 (where -2 represents strongly disagree and +2 strongly agree). The data were calculated by adding the four items and dividing them by four for the analysis.

The second measure of SN involved the assessment of the normative belief strengths of the respondents by asking them to rate how strongly each of the identified individuals or groups of individuals would likely want them to adopt the use of B1 or B2 in research or extension over the next 12 months. They were asked to score their responses on a five-point Likert scale, ranging from 1 to 5 (where 1 represents very unlikely and 5 very likely). These were also recoded during the analysis to range from -2 to +2 (where -2 represents very unlikely and +2 very likely). To determine their motivation to comply with these referents, respondents were asked to rate how motivated they were to comply with each one. Their responses were initially recorded using a five-5-point Likert scale, ranging from 1 to 5 (where 1 represents very weakly and 5 very strongly), and then re-coded into a five point bipolar scale, ranging from -2 to +2. Box 4c shows the total number of referents identified by respondents as having the ability to influence their exhibition of the behaviours studied.

Box 4c: Salient referents used for the calculated subjective norm in behaviour 1 and 2.

1. Employer
2. Supervisor
3. Professional colleagues
4. Donors
5. Farmers
6. Community leaders
7. Family members

The indirect SN was then the product of the subjective belief strength (sb_j) and the motivation to comply (m_j) as shown in the formula:

$SN = (\sum sb_j * m_j)$……………………….equation 2

Because there were seven items, the possible range of the total overall SN score is:

= (-2x2) x 7 and (2x2) x 7

= (-28) and (+28)

Where:

Very weak pressure to use/adopt the behaviour = (-15) to (-28)

Moderate weak pressure to use the behaviour = (-1) to (-14)

Neutral/or normative pressure = 0

Moderate strong pressure to use the behaviour = (1) to (14)

Very strong pressure to use the behaviour = (15) to (28)

4.11.5 Perceived Behavioural Control (PBC)

PBC was also measured using the direct and indirect methods. In collecting data for use in the direct method, respondents were asked to state how strongly they agreed or disagreed with the following statements: 1) I am confident that I can use "the behaviour" if I wanted to; 2) For me to use "the behaviour" in research and extension is easy; 3) The decision to use "the behaviour" is beyond my control; 4) whether or not I use "the behaviour" is entirely up to me in the next 12 months. These were scored on a five-point Likert scale, ranging from 1 to 5 (where 1 represents strongly disagree and 5 represents strongly agree). These were re-coded into a five-point bipolar scale, ranging from -2 to +2. The results of the four items were added to determine the direct PBC of each of the behaviours studied. For the indirect measure, six control belief items were used for B1, and three for B2 (see Box 4d and Box 4e). Respondents were asked to rate how strongly they agreed or disagreed with each of the statements using a five-point Likert scale, ranging from 1 to 5 (where 1 represents strongly disagree and 5 strongly agree). These were recoded into a five-point bipolar Likert scale, ranging from -2 to +2 during the analysis. Respondents were also asked to evaluate the power of control of each control belief. These were coded using a five-point bipolar Likert scale, ranging from -2 to +2.

Box 4d: Control beliefs used for the calculated perceived behavioural control of behaviour 2

1. Have the knowledge and skills on AIS approach
2. Have adequate financial resources (eg from donors) to use an AIS approach
3. Institutional policies of my organization discourage me from the use of an AIS approach
4. The cooperation and behaviour of other actors will discourage me from adopting an AIS approach
5. Cultural norms of smallholder farmers will discourage me from using an AIS approach

6. The lack of incentives from my organisation will discourage me from adopting an AIS approach in research and extension.

Box 4e: Control beliefs used for calculating the perceived behavioural control of behaviour 2

1.The lack of capacity to facilitate complex and dynamic interactions
2. The lack of adequate financial resources
3. The lack of cooperation from and behaviour of other actors

The indirect PBC was then calculated by multiplying the control belief (C_b) and the corresponding power of control (P_b), as shown in equation 3 below.

$PBC = (\sum C_b * P_b)$…………………………equation 3

Since there were six control belief items for B1, for example the PBC:

= (-2x2) x 6 and (2x2) x 6

= (-24) and (24)

Where:

Very weak control over the use of behaviour 1 = (-13) to (-24)

Moderate weak control over the use of behaviour 1 = (-1) to (-12)

Neutral control over the use of the behaviour 1 = 0

Moderate strong control over the use of behaviour 1 = (1) to (12)

Very strong control over the use of behaviour 1 = (13) to (24)

4.12 Data Analysis

The data were analysed using quantitative and qualitative techniques. Data for Objective 1 was mainly analysed using qualitative techniques, while for Objectives 2 and 3 qualitative techniques were used for the first stage and quantitative for the second. The process of data analysis is described below.

4.12.1 Qualitative Data

The qualitative data were generated by recording statements from respondents verbatim. In cases where the interviews were conducted in the local languages (Krio and Temne), responses were automatically translated into English by the researcher who is fluent in both languages. To ensure the adequate capture of information, all interviews were audio recorded. These recordings were used to validate information collected each day and for filling in any information gaps that occurred during the interviews. The automatic translation of interviews from the local languages into English eased the data management process and analyses. In effect the qualitative data were analysed by: 1) translation from Krio and Temne into English (where applicable); 2) coding and categorisation (using different colours) and condensation into various themes; and 3) interpretation of meaning using Microsoft Word. The categorisation was done by highlighting key themes in each interview file with specific colour codes, which were then cut and pasted into a general file containing the themes and/or research questions under study. This process made it possible to identify trends emerging from the data, thereby informing its presentation and interpretation (see Chapter 6). As noted by Miriam (1988), qualitative data analysis is best done in conjunction with data collection, suggesting that the researcher should organise the information gathered immediately after any interview. This strategy was followed by the researcher during the qualitative data collection, and this helped the researcher to adequately record all relevant information emerging from the interviews.

For Objective 1, a social network analysis (SNA) programme, UCINET, was used to facilitate the formulation of linkages among actors in the rice innovation system, as identified by research and extension professionals. The freeware programme contained in UCINET, known as NETDRAW, was used for visualising networks into a sociogram for the four key innovation packages studied. This helped to establish the underlying patterns of social relations among actors in the innovation processes.

4.12.2 Quantitative Data Analysis

All quantitative data collected for Objectives 2 and 3 were analysed using IBM_SPSS version 24 software and Microsoft Excel. For Objective 3, the data were mainly analysed using descriptive statistics, including the use of tables, bar charts, frequencies, means, and percentages. The poverty incidence among respondents was determined using the Progress out of Poverty Index (PPI) indicators and reference look-up tables (see Section 8.2, Chapter 8).

4.12.2.1 Reliability of the scales

The reliability of the scales used in the TPB constructs was analysed using the Cronbach's alpha coefficient which measures internal consistencies, i.e., how closely related a set of items are as a group (Hinton et al., 2004; Kothari, 2004). The Cronbach's alpha coefficient ranges in value from 0 to 1 (Santos, 1999) and was used to determine the consistency and reliability of the statements used in the measure of the direct SNs, PBC, and attitudes of respondents with respect to the behaviours studied. Hinton et al., (2004) noted that a Cronbach's alpha value >0.6 is accepted as evidence that the items reliably measure an underlying construct. Santos (1999) similarly noted that the higher the coefficient score, the more reliable the scale. However, when dealing with psychological constructs, lower values are expected owing to the diversity of the constructs measured (Field, 2005).

4.12.2.2 Correlation between TPB Variables

Correlation was used to determine the existence, or not, of a relationship between two or more variables, as well as their degree of relationship (Field, 2005). This measure is normally in the form of a coefficient called the *correlation coefficient (r)* and ranges from -1 to +1, interpreted as having a negative or positive relationship if the values are negative or positive, respectively. A coefficient with value zero denotes the absence of a linear relationship between the two variables measured. The more the values depart from zero, or tend to either -1 or +1, the stronger the relationship between the variables under consideration is deemed to be (Ajzen & Fishbein, 1980).

Two types of correlation exist, depending on whether the population is bivariate or multivariate. With a bivariate population, correlation can be studied using: a) Charles Spearman's coefficient of correlation; b) Karl Pearson's coefficient of correlation; and, c) cross tabulation. In case of multivariate population, correlation can be studied through: a) coefficient of multiple correlations; and, b) coefficient of partial correlation (Mose, 2013). However, in this study, having considered the nature of the data, Charles Spearman's correlation coefficient was used because Spearman's rho correlation is a non-parametric statistic and is used on occasions when the data have violated parametric assumptions, such as normal distribution (Cramer &Howitt, 2004; Field, 2005). Also, similar studies, such as Beedell & Rehman (2002), Carr & Tait (1991), Garforth et al. (2006), and Rehman et al., (2007), have used Spearman's rho correlation in preference to other parametric tests. The literature indicates that the Spearman's coefficient of correlation can either be one- or two-tailed tests, one tailed if there is a directional hypothesis to be tested, and two-tailed if it is not possible to predict the relationship. This study used a two-tailed test as it was not always possible to predict the direction of the relationship.

4.13 Ethical Consideration

Research ethics are an integral part of the research process. Ethical questions must be asked before the commencement of any research, this is particularly important when the subject of the research is people. This, in a way, prioritises their wellbeing (Bryman, 2004) by ensuring that the research does not pose any harm to them as a result of their participation. In this regard, this research strictly followed and met the ethical clearance policy of the University of Reading. The data collection instruments were submitted to the University's ethical clearance committee for their review and advice. They were thoroughly reviewed and approved, and the ethical clearance granted in October 2016. See Appendix X for the approved ethical clearance.

Further, in accordance with good research practice, and as outlined in the approved ethical clearance from the University, informed consent was obtained from all participants before the commencement of data collection at field level. For FGD and KII participants, the purpose of the research was clearly explained, including the data management process. They were also informed that any information they provided would be treated with utmost confidentiality, that their identities would remain anonymous throughout the research process, and that their voluntary participation meant they were free to withdraw at any time during the interview process. The interviews continued only after they had expressly consented to take part.

Similarly, questionnaires for research and extension professionals were each distributed with an information sheet explaining the aim and purpose of the research, the data management process, what was expected of respondents, the approximate time required to complete the survey, and the assurance of their anonymity in the research process. It concluded by emphasising that their participation in the research indicated that their participation was voluntary and that they had had the terms of their participation adequately explained. For questionnaires with smallholder farmers, enumerators were adequately trained to interpret the information sheet containing the same information as above to respondents, emphasising that they MUST only continue with the interview after gaining consent from the respondents.

CHAPTER 5 : THE INNOVATION SYSTEM ON RICE IN SIERRA LEONE – PERSPECTIVES FROM RESEARCH AND EXTENSION PROFESSIONALS

5.0 Introduction

This chapter presents findings of the first objective of the study, the primary focus of which is to describe the agricultural innovation system of rice in Sierra Leone from a research and extension perspective. In order to achieve this, the chapter primarily addresses the following research questions:

1) What are the key rice innovations and their perceived benefits promoted by research and extension actors in the past ten years (2005-2015)?

2) Who are the key actors involved in the promotion and development of these innovations and what are their roles?

3) What linkages/patterns of interactions exist among the actors of key rice innovations?

4) What factors constrain the effectiveness of the innovation system on rice in Sierra Leone?

A detailed description of the data collection methods and analysis has been provided in Chapter 4.

5.1 The Key Rice Innovations and their Perceived Benefits Promoted by Research and Extension Actors in the Past Ten Years

5.1.1 Introduction

This section contains findings from the first research question of Objective one of the study *"**What are the key rice innovations and their perceived benefits promoted by research and extension actors in the past ten years (2005-2015)?"***

Data for this question were generated via workshops and KIIs among research scientists and extension personnel from the public and private sectors. The workshop participants included research scientists from SLARI and extension personnel from MAFFS and NGOs who implement agricultural programmes in Sierra Leone. One of the workshops was conducted in Freetown and was comprised mostly of senior level management participants including Directors, Assistant Directors, Project/Programme Managers, Senior Officers, Senior Research Scientists, and a few junior level staff. The second, conducted in the provinces, comprised a mix of senior level research scientists from RARC, including the Research Coordinator and the Head of the Socio-economic Department, among others. However, the majority of participants, particularly those from the MAFFS and NGOs, were junior level field staff. This mix of staff helped triangulation of the data, which increases reliability of the findings. This is also true for the KIIs. Key documents from MAFFS, SLARI, and NGOs were also accessed and reviewed.

During the workshops, participants were divided into three groups, each one comprised participants of similar professional background. For example, a group could only contain research scientists, MAFFS, or NGO officials. They each contained a mix of senior, middle, and frontline staff, to enable each group to contribute their perspectives to the discussion. This was done to enhance better group discussion, sharing and documenting of group ideas, as well as facilitating intra-group triangulation of information. Large sheets of paper were given to each group. PowerPoint was used to display instructions for the activities in which the groups were requested to take part. The groups then documented and presented their ideas about each activity in the various workshop sessions. For the KIIs similar questions were asked of selected respondents in a bid to triangulate the data emerging from the workshops. Findings from the study showed that the key innovations on rice that have been promoted by research and extension actors are: Improved Rice Varieties, comprising mainly NERICA and Rok series; System of Rice Intensification; Technical Package on Rice; Agricultural Business Centres; Plant Health Clinics; and Purdue Improved Crop Storage (PICS) Bags.

The following are key abbreviations and their meanings used in the tables of this chapter.

Box 5.1: Key Acronyms used in Tables of Chapter 5

KII – Key Informant Interview;	**ExtM** – Extension Personnel from MAFFS;
KOD – Koinadugu District;	**TOD** – Tonkolili District;
POD – Port Loko District	**KAD** – Kambia District;
WS – Workshop;	**ExtN** – Extension Personnel from NGO;
RK – Rokupr;	**FT** – Freetown.
Res – Research personnel from SLARI;	

5.1.2 Improved Rice Varieties (IRVs)

Improved rice varieties (IRVs) are among the key innovations found to have been developed and/or promoted by research and extension actors. They see the promotion of IRVs as a strategy to increase smallholder farmers' yields and productivity. IRVs are believed to possess desirable qualities with benefits that outweigh those of local varieties. Key among the IRVs that have been developed/promoted are the New Rice for Africa (NERICA) and the ROK Series. NERICA, according to respondents, is one of the major rice varieties developed and promoted in the last ten years by research and extension actors in both the public and private sectors. They include varieties for both lowland and upland cultivation. NERICAs 3, 4, 6, 15, 16, 18, are the upland varieties, while NERICAs L19 and L20 are mainly for lowland cultivation. RARC was found to be the key developer of IRVs, including the *ROK* series, with their formal multiplication and dissemination aided by the Seed Multiplication Project, MAFFS, and some NGOs.

Box 5.1: Observation

A key observation was that some of the varieties mentioned by respondents particularly during the workshops have not been necessarily developed or promoted within the last ten years, the target timeframe of the study. A review of relevant documents from the MAFFS shows that some of the varieties have been promoted before the last ten years. ROK series 3- 16 and 21-32 were released by RARC in 1974 and 1988 respectively (MAFFS, 2015); but some of these were mentioned irrespective of the fact that they have been released long ago. However, information from the KIIs (KII-RK-Res) confirms that respondents have mentioned some of them on the premise that they are still in use by farmers and that some extension organisations are still promoting them including the MAFFS. The following are the timelines for the release of various IRVs by RARC as stated in the National Seed Catalogue published by MAFFS (2015).

Denomination	***Developing Institute& Maintainer***	***Year of Release***	***Year of Registration with SLeSCA***
Rok 3, 5, 10, 14 and 16	*RARC*	*1974*	*2016*
Rok 21, 22, 23, 24, 25, 28, 29, 30, 31, 32	*RARC*	*1988*	*2016*
Rok 34, Nerica 3, 4, 6, 15,18	*RARC*	*2014*	*2016*
Rok 35, 36, 37, Nerica L19, L20	*RARC*	*2015*	*2016*

The nomenclature "ROK", according to one respondent, is a short form of ROKUPR – to indicate that the varieties are developed by RARC. The ROK series is a range of different varieties with modified traits for cultivation in the different agro-ecologies, including upland and the various lowland ecologies – Boli, Inland Valley Swamps, Mangrove, and Riverine Grassland. Details of the different varieties that have been developed and promoted for the different ecologies, and as mentioned by respondents, are presented in appendix 1.1. However, in recent years, it appears that NERICAs have been the most widely promoted varieties. In fact, the NERICAs were identified as being promoted among farmers by MAFFS and some NGOs in the last planting season during the Ebola recovery programme. This was based on the assumption that NERICAs have the potential to increase farmers' yields and, subsequently, improve farmers' well-being. It can also be seen from appendix 1.1 that research scientists from SLARI developed and promoted all the rice varieties tabulated during the workshops. This is possibly due to the fact that their primary mandate is the development/adaptation/promotion of improved varieties of cereals – rice being key among them. However, respondents have not been able to remember all the IRVs developed and disseminated by research and extension actors. For instance, varieties like Rok 11, 17, 21, 22, 25, 28, 29, 30, 31, 32, and CP4 were not mentioned by any respondents, even though these have been officially developed and released in Sierra Leone (MAFFS, 2015). It is possible that these have not been as widely disseminated or used by farmers compared to other varieties.

5.1.3 Perceived Benefits of Improved Rice Varieties

Research and extension actors are motivated by a number of benefits that smallholder rice farmers could derive from cultivating IRVs. Consistent with assertions in the literature about the advantages of IRVs, such as NERICA and others, research and extension actors believe they are one of the key solutions to farmers low productivity problems. It was evident that the majority of respondents believed that traditional rice varieties grown by farmers are generally low-yielding and lack other desirable characteristics of their improved counterparts. This has been the key motivation for the promotion of IRVs which, according to these actors, have the ability to bring about a turn-around in farmers yield/productivity per unit area. Appendix 1.2 presents details of the perceived benefits of IRVs to farmers, as indicated by respondents. Increasing the yield of smallholder farmers emerged as one of the outstanding motivations of research and extension actors for their promotion of IRVs among farmers. This is consistent with the literature (e.g., Bruce et al., 2014) which claims that farmers' use of IRVs can significantly increase their yields. Other reasons, which can be considered a result of the aforementioned benefit and which was mentioned by most respondents, include improving the livelihood, food security, and income of smallholder rice farmers. It is possibly due to research and extension actors' beliefs that an increase in yield/productivity of smallholders will lead to these farmers realising higher incomes, which will then impact positively on their level of household food security and their general wellbeing. Several studies, such as that by Dontsop-Nguezet et al., (2011), have found that IRVs can positively impact farmers' incomes.

Other benefits mentioned by respondents include enhancing farmers' abilities to adapt to climate change, and the reduction of post-harvest losses. These benefits are based on some of the perceived drought resistance, short duration, and low shattering qualities of some of these IRVs, including NERICAs. An important point, mentioned only by the director of a local NGO in Port Loko District, is the fact that they provide improved rice seeds to farmers to help them restock seeds lost during the Ebola epidemic. This is seemingly a reason for the massive dissemination of NERICAs by MAFFS, though unfortunately no other respondent mentioned this either during the interviews or workshops.

5.1.4 The System of Rice Intensification (SRI)

The SRI is one of the prominent rice innovations that has been promoted since the early 2000s to date (KII-RK-Res; WS-FT-ExtN). It is a rice cultivation and management system that was first introduced to a group of farmers in Sierra Leone by World Vision in 2001 (Yamah, 2002; KII-FT-ExtN; WS-RK-Res; WS-RK-ExtM). It was concurrently piloted by SLARI at RARC in the same year, and has recently been promoted among smallholder farmers, in various parts of the country, by other NGOs (including Catholic Relief Services and Concern Worldwide), and MAFFS. The West Africa Agricultural Productivity Programme (WAAP) has also recently (2014 to present) promoted SRI as one of its strategies to increase smallholder farmers' lowland productivity (WAAP, 2014).

The SRI is a lowland rice cultivation method, mostly suitable for Inland Valley Swamp cultivation, with features considered by research and extension actors to be distinct from the conventional methods of rice cultivation in Sierra Leone. Key techniques in the SRI identified by respondents (as shown in appendix 1.3) include: line sowing; the planting of one seedling per hill; transplanting seedlings between eight and 14 days old; developing swamps for water control; using organic manure; planting seedlings in a square pattern of 25x25cm; and using organic manure. Other techniques, though not widely mentioned by respondents, include the use of mechanical weeders and the commencement of pre-planting operations, such as brushing, digging, and clearing of plots before the nursery stage. Commencing pre-planting operations before the nursery stage aims to discourage its long duration and enhances farmers' ability to transplant seedlings after one to two weeks in the nursery area.

These techniques make SRI a rice cultivation innovation that is completely different from the traditional methods to which smallholder farmers are accustomed, and even the conventional methods that have been promoted by research and extension actors before the advent of SRI. In an interview with the District Extension Officer of MAFFS in Koinadugu District, he said:

"…We are currently promoting SRI with 16 Farmer Based Organisations[8] (FBOs) here in Koinadugu. The project is funded by the World Bank and we implemented it this past planting season. Like I said, SRI is different from other methods…emm…with SRI, we train farmers to transplant their seedlings when they are 14 days old or younger, plant one seedling per stand after levelling and developing of the swamp properly. We also train farmers to plant in rows and preparation and use of organic manure because it is one of the requirements of SRI. And I think it is good for the farmers because most of them cannot afford chemical fertilisers…" (Interviewed, 10th March 2016; 18:10).

As opposed to the traditional method of planting more than three seedlings per hill, random transplanting in waterlogged plots, late transplanting of seedlings (usually 30 days old, or more), and hand picking of weeds, SRI is promoted as an innovative method that can help farmers overcome their current constraints (KII-FT-ExtN; KII-TOD-ExtM). SRI has been tested in other parts of the world as well as in Sierra Leone, and the literature suggests that it has been successful in increasing farmers' yields when compared to traditional methods (Yamah, 2002). SRI is perceived to offer many advantages to farmers, which could benefit them immensely if used in their production system. However, it appears that not all the actors who promote SRI are applying/using all its techniques. Most respondents mentioned only a few key techniques and omitted others, such as the use of mechanical weeders and preparation of land before planting. This is possibly due to the fact that mechanical weeders have not been widely used in the promotion of SRI as they are expensive and not easily accessible to farmers. These weeders, according to one of the key informants, are fabricated locally in Lunsar, a town in Port Loko District, and cost at least $US30 in local currency.

5.1.5: The Perceived Benefits of SRI to Smallholder Farmers

Research and extension actors are motivated to promote SRI among smallholder rice farmers for several reasons, although some are the same as those given for other rice innovations, such as to increase rice yields and, subsequently, the incomes of farmers (see appendix 1.4). However, a key benefit of SRI, as highlighted by respondents, is the use of fewer inputs for maximum output. This belief is based on the principles of, among others: planting one seedling

[8] A Farmer Based Organisation is a collectivity of 25-30 farmers, mostly living in the same community, and who function together as a group in agricultural innovation programmes, including establishment and management of demonstrations, group farming, and marketing.

per hill with a reasonable spacing of 25x25cm between seedlings; using locally available organic manure, as opposed to chemical fertilisers which are expensive and mostly scarce; and intermittently irrigating plots, as opposed to continuous flooding. The Agriculture Programme Manager of Concern Worldwide, Tonkolili District in a KII said:

"…*SRI techniques are beneficial to farmers and those that have been participating have seen the benefits. When we established the first demo plots in our target communities, participating farmers initially thought we are wasting our time cultivating one very young seedling per hill. But with time they noticed the seedlings doing well, tillering and growing well. Really, it was not easy at the start, because farmers were sceptical about the success of the method, but after the first year of demos some farmers are now using the techniques. They now use less seed compared to what they have been using before, and are now transplanting earlier than they used to. Some are lazy though, but most participating farmers have seen that SRI techniques can help them use minimum inputs. They have reduced their inputs considerably which ultimately contributes to their productivity…you see. With SRI, farmers can now save some of the rice seed they have been using for cultivation before now…the saved seed is the start of productivity…" (Interviewed, 3rd March, 2016; 10:15).*

It is also believed that adequate spacing of rice seedlings transplanted at a younger age will have a large impact on its growth and tillering ability, and therefore, on overall yield and income. Also, as one of the respondents mentioned, the use of organic manure is expected to boost farmers' savings as they no longer need to buy expensive, and sometimes scarce, chemical fertilisers. The training they receive from research and extension actors on the preparation of these manures is also expected to increase their innovative capacity in this respect. A number of studies on SRI show a positive effect of SRI techniques on yield and other variables. For instance, Islam et al., (2014) studied the productivity and socio-economic impact of SRI over the conventional method of rice cultivation in India. They found that SRI had a 209.9% average productivity of rice over conventional methods of rice cultivation; and that implementation of SRI could save seeds (97.56%) and water (78.05%), and reduce costs (70.33%) compared to the conventional method being used. Similarly, Harding et al., (2012) compared the performance of SRI over the traditional farmers' practices of rice cultivation in Sierra Leone and found the yield components associated with the number of tillers/hill, panicles/hill, spikes/panicle, yields (t/ha) of SRI plots to be 76.3%, 75.0%, 22.1%, and 52.8%, respectively, more than those found in the traditional plots. These findings seem to support research and extension actors' perceived benefits of SRI and the need for its promotion among resource-poor smallholders.

5.1.6: Technical Package on Rice (TP-R)

The Technical Package on Rice (TP-R) is a rice cultivation package that was piloted and introduced through the Japan International Cooperation Agency's Agricultural Development Project (JICA) (2006-2009), and the Sustainable Agricultural Development Project (2010-2014) in Kambia District, Northern Sierra Leone (JICA, 2012; KII-KAD-ExtM). The package was first piloted in four communities in the Kambia District through the establishment of demonstration plots where farmers who participated were taken through the techniques for a period of three years. The package was then adopted after the second phase of the project and then handed over to MAFFS as a rice cultivation package for smallholder farmers in the country, (JICA, 2014) and as JICA's activities were phased out. MAFFS is currently promoting it as one of the innovative methods of lowland rice cultivation, especially in the Inland Valley Swamps, and training has been provided to extension personnel nationwide (WS-RK-ExtM; KII-KAD-ExtM). The package is described by JICA as "low- cost" and "easy to adopt" and one that suits smallholder rice farmers' situation. As can be seen in appendix 1.5 some of the techniques of the TP-R are in some way similar to the SRI. For instance, shared techniques include: water control; reduced number of seedlings per hill; early transplantation; timely weeding; and field preparation before transplantation. Slight differences are that the TPR suggests the planting of 1-3 seedlings, and that seedlings be transplanted at 21 days old as opposed to the SRI propositions described in the preceding section. There are, however, also marked differences in that the TPR promotes the use of inorganic fertilisers and provides training on post-harvest handling techniques (KII-KOD-ExtM, KII-KAD-ExtM, WS-FT-ExtM), whereas SRI promotes the use of organic fertilisers/manure and does not go beyond production (KII-KOD-ExtM, WS-RK-Res). Training on seed treatment before the nursery stage is also one of the techniques promoted by the TPR (JICA, 2014).

5.1.7 Perceived Benefits of the TP-R to Smallholder Farmers

In appendix 1.6, the perceived benefits of the TPR, as identified by research and extension actors, are shown. As with most rice innovations identified in this study, the perceived benefits of the TPR included its potential to increase yield, use fewer inputs, and improve the incomes and livelihood of farmers in the TPR, however, additional specific benefits mentioned included the possibility of farmers performing double cropping each year, and discouraging upland rice cultivation (KII-KAD-ExtM, WS-RK-ExtM). The former is based on the assumption that farmers use short duration varieties whose growth cycle is completed within 3 months (90 days), coupled with the fact that water is controlled within the plots; while the latter benefit is possibly based on the assumption that increasing IVS yield will prevent rice farmers from engaging in upland rice cultivation, seen as a primary cause of deforestation. Since the TPR was introduced by an NGO who subsequently trained officials from MAFFS, it is seen as beneficial to MAFFS staff as it helps them increase their understanding, skills, and knowledge of agricultural innovations, and thereby increases their effectiveness. In an interview with the District Agriculture Officer of MAFFS in Kambia District, he said:

"…the TPR is a good package for farmers. It helps them reduce their inputs. For example, if a farmer used to cultivate, say one acre of swamp with one bushel of rice seed, now with the TPR technique that farmer only uses less than half of that amount. So, it is very beneficial to them. And now farmers are using the techniques in their farms and they are realising the benefits. You know…if farmers continue to use these techniques it will help also the environment. We want them to get maximum yield in the IVS and discourage them from upland rice farming because it is not as productive as the lowland and also causes deforestation…" (Interviewed February 11, 2016: 12:15)

It appears that the TPR is a slight modification of the SRI and that there is currently little, or no, literature on its successes or shortcomings in Sierra Leone, or elsewhere. TPR and the other key innovations on rice are examined from farmers' perspectives in Chapter 8.

5.1.8 Agricultural Business Centres/Rice Processing Facilities

Rice processing facilities are key innovations that provide services to smallholder farmers in the storing, processing, and marketing of their rice produce. Before the nationwide construction of the Agriculture Business Centres (ABCs), the agricultural processing facilities were either privately owned or constructed by NGOs for selected communities (KII-FT-ExtM). According to respondents, NGOs, such as Actionaid, Concern World Wide, CRS, and World Vision, have been providing post-harvest facilities, such as grain stores, dry floors, and rice mills, to smallholder farmers across the country. Some private traders have also been providing milling facilities in some communities. However, these facilities were deemed to be grossly inadequate as the majority of smallholder farmers remained constrained in their access to these facilities (KII-FT-ExtN). Beginning in 2010, the GoSL, with support from the Global Agriculture and Food Security Facility (GAFSP), constructed 193 ABCs nationwide (IFAD, 2011). According to respondents, these were constructed to help address the many constraints farmers face in the storing, processing, and marketing of rice and other agricultural produce. A standard ABC constitutes a dry floor, thresher, generator, store, rice mill, and parboiling facilities. A well-functioning one also serves as a market centre where farmers can sell their produce and buy inputs in addition to processing their paddy, either for household consumption or for sale. The ABCs are meant to be governed by the farmers themselves. Each ABC comprises at least four to five FBOs (each FBO consisting of 25-30 farmers), from which the Executive Committee which oversees the running of the ABC is elected (WS-RK-ExtM; KII-POD-ExtM). Each Committee comprises at least a Chairperson, Financial Secretary, and a Treasurer. The ABCs are designed to be collectively run by farmers as private businesses, and the farmers themselves double as the target beneficiaries of their services. In order to ensure sustainability, services from the ABCs are provided at a minimum cost to members of the constituting FBOs, and this is normally different for non-members (KII-TOD-ExtM, KII-KOD-ExtM). The standard number of ABCs per Chiefdom is one, with a few Chiefdoms having two. This distribution makes it difficult for most farmers to access the services of the ABCs as some communities are situated many miles away from them (KII-FT-ExtN). The next section discusses the motivation of extension actors for the establishment and support of the functioning of the ABCs nationwide.

5.1.8: Perceived Benefits of the Agriculture Business Centres Identified by Research and Extension Actors

The ABCs were perceived to be a sustainable solution to farmers' post-harvest constraints particularly the storage, processing, and marketing of their rice produce. For instance, most of the respondents mentioned that ABCs help add value to rice produce, overcome rice processing and storage constraints of smallholder farmers, and subsequently increase the incomes of those farmers (see appendix 1.7) Others indicated that ABCs will ameliorate the drudgery associated with manual pounding of rice by women and children, as well as serving as input and output markets for smallholder farmers. These are huge post-harvest benefits that could have immeasurable impact on farmers' agricultural enterprises, their income, and their overall well-being, if they function as prescribed. During an interview with the District Extension Officer in Koinadugu, he said:

"…ABCs are of great relief to farmers who had depended on pounding of rice with their bare hands. This has been a huge burden on women. Now, even the rice they eat in the household

is taken to the ABC for milling. Some sell their rice produce there after milling and some go there to buy. There are a lot more services the ABCs provide…" (Interviewed March 10, 2016; 18:10).

Based on the foregoing, it can be seen that research and extension actors strongly believe that ABCs are of immense value to smallholder farmers as they provide a wide range of post-harvest services. However, to fully achieve their aims requires access to their services by all farmers, everywhere and at all times. The extent to which this has occurred at community level remains unclear, and therefore the functional utility of the ABCs from the farmers' perspectives are explored later in the thesis.

5.1.9: The Plant Health Clinics and Perceived Benefits Identified by Respondents

The Plant Health Clinics are one of the innovations initiated and promoted by extension actors at MAFFS. This was a pilot project that started in 2008 and was funded by DFID to provide farmers with access to reliable advice on plant health problems countrywide. This initiative was adopted based on the successful Global Plant Clinic Model developed by CABI in the UK (KII-FT-ExtM). It involves the training of plant doctors who advise farmers on plant health problems through public consultations in village meetings or at markets. During the consultations, farmers are advised to bring samples of their diseased crops to the plant doctors for examination so they can obtain information on a safe, affordable, and locally available solution, where applicable. The clinics are held every two weeks and 'plant doctors' from MAFFS provide farmers in the target community the opportunity to bring their pest/disease-affected crop plants for diagnosis and recommendations for solutions. The doctors, in turn, record all cases reported at district level and communicate these to the Head of Plant Clinics, based in Freetown (WS-FT-ExtM).

The provision of these services could be beneficial in a number of ways. As mentioned by respondents (see appendix 1.8), the successful implementation of Plant Clinics can help prevent and manage insect pests and diseases, as well as providing timely and effective plant health services to farmers. The literature identifies many benefits of successful plant health clinics. Schnetzer (2016) indicates that they can significantly alter the distribution, incidence, and intensity of plant pests and diseases and can serve as an effective Climate Smart Agriculture (CSA) approach. This is because plant clinics can contribute to improving productivity, incomes, and food security. They enhance the government's capacity to monitor plant health, and to quickly detect and respond to emerging problems. The application and promotion of integrated pest management practices by plant clinics also enables individual farmers to reduce dependence on external inputs and price volatility (Shnetzer, 2016).

5.1.10 Purdue Improved Crop Storage (PICS) Bags and Their Perceived Benefits

The PICS bags were introduced in Sierra Leone by Catholic Relief Services, an American based INGO that has been operating in Sierra Leone for more than five decades. The PICS bags were introduced as a strategic measure in response to food and seed security concerns at the peak of the Ebola Virus crisis (CRS, 2015). CRS, in partnership with Purdue University, who developed the PICS bag technology, Cordaid Netherlands, who are co-donors of the project, and other local partners, implemented the one year long project in four districts, i Kambia, Kenema, Koinadugu, and Kailahun (KII-KOD-ExtN). The project targeted a total of 5000 farmers to receive up to 10,000 bags in the four districts, with each farmer receiving at least two bags, one 25kg and one 50kg. Although the bags were used by farmers to store seeds/grains of other crops, more than half of the participating farmers (up to 60%) used the bags to store rice seed/grain (CRS, 2015). The bags were initially ordered from Mali by CRS and were distributed to farmers free of cost since the project was mainly aimed at helping farmers recover from the agriculture-related losses associated with the outbreak of the Ebola Virus. CRS's final project report states that actions have been taken to identify a local manufacturer of the bags – a group called MILLA, based in Freetown, and that the relevant linkages have been established between this group and other actors, including NGOs and ABCs; this was confirmed by the Agriculture Programme Manager of CRS during a KII in Koinadugu District.

The PICS bag is a triple-layered sack that provides maximum protection to seeds/grains stored therein. The bags are seen to offer a number of advantages to smallholder farmers who, in most cases, store their seeds in their homes and lack sophisticated storage mechanisms for their produce, thereby exposing them to pests and diseases. With the PICS bags, farmers are able to securely store their seeds or grains (KII-KOD-ExtN). This, in turn, benefits them in several ways, including: increased shelf-life of the seeds; improved seed quality; reduced incidence of pest infestation; and contribution to an overall decrease in post-harvest losses for smallholder farmers (see appendix 1.9).

However, although claims of such benefits are yet to be proven in the Sierra Leone context, studies in other parts of Africa, where the PICS bags have been introduced recently, seem positive. For instance, a study by Hohenberger (2016) on the profile of PICS bags in Zambia reports that grains stored with PICS bags are of better quality than those stored using other methods, and that PICS bags saved the grain from spoiling and being wasted as they kept the grain clean. Some women in the study indicated that the nutritional value of the grains kept in the PICS bags improved because there were no weevils or chemicals. Further, Hohenberger (2016) indicated that the use of PICS bags reduces aflatoxin, and this provides nutritional and health benefits. The bags also save farmers' time and labour when compared to other methods of storing grain/seed. A study by Jones et al., (2011) in Tanzania similarly show that PICS bags were more profitable to farmers in terms of post-harvest losses when compared to alternative storage technologies.

However, although the PICS bags could be seen as a major innovation on rice for smallholder farmers in Sierra Leone, it is not considered to be a key innovation promoted by research and extension actors in this study. This is because it has so far only been promoted by one agency and in only four districts for a period of one year as a pilot project.

5.2 Actors involved in the Promotion of Key Rice Innovations and their Roles in Sierra Leone (Research Question 2)

5.2.1 Introduction

From a research and extension actors' perspective, this section presents findings about the actors involved in the key innovations on rice that have been promoted in the country in the past ten years by them, and the roles they each play in the innovation process. The aim is to help understand the innovation processes and the innovation system on rice from a research and extension actors' perspective. This, and subsequent sections, focuses on four key rice innovations: IRVs; SRI; TP-R; and, ABCs. These are considered the key innovations promoted by various actors in different parts of the country in the past few years. Other innovations, such as the Plant Health Clinics and PICs Bags, are relatively new and are still in the pilot stages. The PICs bags, for example, have only been piloted by CRS in selected communities in four districts. The innovation has not been promoted by any other organisation and has not continued since the end of the pilot phase. The Plant Health Clinics were piloted nationwide but are not currently fully operational due to lack of funds from MAFFS to train plant doctors and facilitate the participation of smallholder farmers.

As in the previous section, data were collected through workshops, KIIs, document review, and observations targeting research scientists from SLARI/RARC, extension personnel from MAFFS, and those extension personnel of NGOs implementing programmes on agriculture. Findings show that different actors participate in different innovation programmes, with a few actors having a stake in all the key innovations identified. MAFFS, NGOs (local and international), SLARI, and farmers are the key actors who play a key role in all innovation programmes mentioned. The roles of these actors range from the provision of funding, research services, sharing of information and ideas, monitoring, supervision and participation in field trials/demos, to technical backstopping, among others. Further details on each of the innovations are presented next.

5.2.2 Actors and their Roles in the Development/Promotion of Improved Rice Seed Varieties

The actors, and the roles they play, in an agricultural innovation programme largely determine the effectiveness, utility, sustainability, and profitability of the innovation, as well as the effectiveness of the learning, interacting, and sharing that occurs during the innovation process. Seeds are considered the primary factor to determine yields for smallholder farmers. Low quality seeds are considered to be low yielding and cannot contribute much to increasing farmers' productivity and incomes from their agricultural enterprises (KII-POD-ExtM). Research and extension programmes have, therefore, paid attention to developing, adapting, and providing improved rice varieties to smallholder farmers as an innovative strategy to increase their productivity, and subsequently their incomes (KII-FT-ExtM, KII-TOD-ExtM). A number of actors were identified in the seed system in Sierra Leone (see Table 5.2.1). Key among them include the public sector, particularly MAFFS and SLARI, and then NGOs and farmers. SLARI, particularly their subsidiary RARC, is a key actor responsible for the development/adaptation of IRVs which are then released to farmers and other actors, including MAFFS, Seed Multiplication Project (SMP) and NGOs, for dissemination (WS-RK-Res, WS-FT-Res, KII-FT-ExtM). SLARI serves as the main source of "certified" seeds as they currently work in tandem with the Sierra Leone Seed Certification Agency (SLeSCA) whose primary mandate is to certify new rice seed varieties before they are promoted among farmers. According to respondents, SLARI has been the primary developer of all ROK varieties of various series, as mentioned earlier, for different rice ecologies, and have adapted the NERICA varieties originally developed by the Africa Rice Centre, consistent with the agro-ecologies of the country. MAFFS has been a primary conduit for improved rice seed dissemination and information sharing with farmers. MAFFS has a permanent presence in all districts of the country through their line ministries and, as an official of MAFFS highlighted in a KII, feel that they bear the greatest responsibility for achieving increased levels of rice production nationwide so as to improve the food security of poor farmers. For instance, MAFFS has been engaged in the dissemination of NERICAs nationwide from 2002 to date, according to them this is the real solution to farmers' low yields. The same is attributed to all predecessors of NERICA varieties, such as the ROK series. They also play a role in coordinating the activities of all NGOs working in the agriculture sector, including the formulation and enforcement of agricultural policies (WS-FT-ExtM). NGOs also play a key role in improved rice seed dissemination to farmers. Some NGOs are local, they only operate in Sierra Leone and often only in a specific part of the country, while some are international and their headquarters are based overseas, so they operate beyond Sierra Leone. Though their interventions are normally short-lived, NGOs are seen as key and effective actors in the promotion of improved rice varieties. They purchase improved rice seed varieties from SLARI, or partner with MAFFS in some cases (KII-POD-ExtN), for onward dissemination to, and engagement of, smallholder farmers. In some cases, NGOs also purchase rice seed from farmers themselves for onward distribution to other farmers (KII-TOD-ExtN; KII-KAD-ExtN). However, there has been an increasing trend in last five to 10 years, for NGOs to focus on developing the capacity of smallholder farmers, hence, most of them only introduce IRVs to farmers and leave the rest to the farmers themselves, this includes finding sources of the seed should they be interested, according to one respondent. Some NGOs, e.g., BRAC International, have a seed testing and multiplication centre from where they multiply improved seed varieties for sale to farmers (KII-POD-ExtN).

Another set of actors, identified by almost all respondents, are the farmers. The farmers are normally the ultimate target of ISVs from MAFFS and NGOs. They participate in trials/demonstrations introduced to their communities by external actors, such as NGOs, SLARI, or MAFFS, and are considered as the end-users of all seed rice innovations. In cases where new rice seed varieties are trialled with farmers' participation, they (the farmers) give feedback about a new rice variety in terms of its desirable and undesirable characteristics, and which variety, among a range of choices, they prefer. This method was employed by SLARI through the Participatory Varietal Selection approach (WS-RK-Res).

Farmers serve as the custodian of all seed varieties disseminated in their communities and, in most cases, even sell seed varieties not only to traders, but also to other actors, such as MAFFS, NGOs, and even other farmers. Farmers have been playing a key role in the adoption and distribution of ISVs, not in only their communities or family networks, but also to other farmers outside their communities.

below lists the main actors involved in the improved seed system in Sierra Leone and their roles, as identified by research and extension actors (respondents). Other actors, such as private traders, buy and sell seeds to farmers and other actors, though "this is normally at exorbitant prices and with questionable quality of some of their seeds", reported one of the group presenters at the workshop in Freetown. Seeds from private traders are not normally trusted by farmers and farmers tend to revert to them mostly as a last resort, particularly the local varieties. The Seed Multiplication Project (SMP) is an actor identified as providing certified and good quality seeds to farmers and other actors, such as NGOs. The SMP is based in Mambolo Chiefdom, Kambia District, where they primarily multiply and disseminate improved seed varieties to farmers and NGOs, but at a cost (WS-RK-Res, KII-FT-ExtN). They have a close working relationship with MAFFS and SLARI, and also depend on the latter for IRVs. The WFP country programme was also identified as an actor, however it only buys grains and provides packaging facilities to farmers. IRRI/Africa Rice collaborate with SLARI in the development/adaptation/release of new rice varieties and provide technical assistance, including the training of scientists from SLARI. These actors are key in the seed system in Sierra Leone and have been playing a part in the development, promotion, and use of IRVs among farmers in the country. The following sub-section further discusses the interactions among these actors and the type of learning which occurs between and among them, as perceived by research and extension actors.

Table 5.1: Actors and their roles in the development/promotion of Improved Rice Varieties

Source	Actor	Role
WS-FT-Res, WS-RK-Res, WS-FT-ExtM, KII-POD-ExtN, KII-FT-Res	SLARI/RARC	• Develop technologies on cereal crops • Research services • Source of certified rice seed
WS-RK-Res, WS-FT-Res, KII-KAD-Res, KII-FT-Res	Africa Rice/IRRI/AGRA/IITA	• Capacity building • Funding • Collaboration in project implementation with MAFFS and SLARI • Provide consultancy services • Training
WS-RK-Res, WS-FT-Res, WS-FT-ExtM, KII-FT-ExtM	SLeSCA	• Facilitate technology release • Seed certification
WS-FT-ExtM, KII-TOD-ExtN, KII-KOD-ExtM, KII-FT-ExtN, KII-FT-ExtN KII-POD-ExtM, KII-TOD-ExtM, KII-KOD-ExtN,KII-FT-ExtN KII-FT-ExtM,KII-KAD-Res WS-RK-Res, WS-FT-Res	MAFFS	• Extension services – demonstration and multiplication of seed • Sharing ideas, monitoring and supervision • Facilitates the registration of farmer groups • Supporting farmers with seeds • Provide seed support to NGOs at district level • Capacity building of staff and farmers
KII-TOD-ExtN, KII-KAD-ExtM, KII-KOD-ExtM, KII-POD-ExtM, KII-TOD-ExtM, KII-POD-ExtN, WS-RK-Res, WS-FT-Res, KII-FT-ExtN, KII-KAD-Res	INGOs eg ActionAid, Child Fund, BRAC, COOPI, JICA etc LNGOs e.g. CIFD-SL, FIOH, GbonFA, ABC-Dev etc	• Funding of local NGOs • Collaboration with MAFFS and other NGOs in seed distribution • Sharing ideas with farmers on marketing • Sometimes fund MAFFS activities • Facilitate the dissemination of technologies • Enhance access to quality seeds of released varieties • Training of farmers and input supply
WS-RK-Res, WS-FT-Res, KII-TOD-ExtM, KII-KOD-ExtN, KII-FT-ExtN	Processors eg. Finic, private rice mills, ABCs etc	• Value addition eg milling, packaging etc • Feedback on milling quality of released varieties
WS-RK-Res, WS-FT-Res, KII-KAD-ExtM	Marketers/Agro-dealers/Traders	• Rice purchase, processing and sale • Marketing information regarding varietal demand • Fabrication and sale of agricultural tools • Sale of agro-inputs eg fertilizers, seeds etc • Provision of loans
WS-FT-ExtM, KII-TOD-ExtN, WS-RK-Res, KII-KOD-ExtM, KII-KAD-ExtM, KII-POD-ExtM, KII-TOD-ExtM, KII-POD-ExtN; KII-FT-Res, KII-KAD-Res	Farmers	• Testing innovations and use of technology • Participate in programme activities • Source of seeds for NGOs and colleague farmers • Provide information on grain cooking, eating and keeping qualities etc • Supporting and managing of Agricultural Business Centres
KII-TOD-ExtN, KII-KOD-ExtN	District Council	• Release of devolved funds to MAFFS line ministries at District level • Monitoring activities of MAFFS and NGOs
WS-RK-Res	SMP	• Provision of improved rice seeds to farmers, NGOs etc • Multiplication of improved rice varieties
WS-FT-ExtN	WFP	• WFP buy milled rice from farmers • Provides packaging facilities to farmers
KII-KOD-ExtM, KII-FT-ExtM	WAAP	• Funding of Ebola recovery programme • Funding of agricultural research and extension programmes
KII-POD-ExtN, KII-KOD-ExtN, KII-FT-ExtN	Community Leaders/Authorities (Paramount chief, section chiefs, youth leader, headman, Master farmers, Mammy queen)	• Monitoring project implementation • Assist in seed loan recovery • Approval/disapproval of intended activities by NGOs • Assist in mobilizing farmers

Source: Field Research, 2016.

5.2.3: Actors and their Roles in the System of Rice Intensification (SRI)

The key actors identified in the SRI are not completely different from those involved in the IRVs innovations, as can be seen in

Table 5.2 below. Government institutions (MAFFS and SLARI) and NGOs were found to be the key actors, apart from community level actors (farmers and community leaders), who are the target beneficiaries of the innovation. NGOs, such as the Catholic Relief Services, Concern Worldwide, and World Vision, were identified by respondents as key NGOs promoting SRI as an innovative system of rice cultivation among smallholder farmers. Their roles, according to respondents, include: the mobilisation of farmers at community level; provision of training to farmer groups on the key techniques of SRI through a variety of extension approaches, such as Farmer Field Schools; and, in some cases, provision of other inputs, such as rice seeds and tools. Some International NGOs, such as JICA, were identified as providing funding to MAFFS and local NGOs for scaling out SRI activities. For instance, Concern Worldwide has funded MADAM - a local NGO in Koinadugu to scale up SRI to smallholder farmers in the district. It was noted that certain NGOs are more prominent in certain districts of the country than in others. For example, the Agriculture Programme Manager of Catholic Relief Services said in an interview:

"*CRS work has been focused on three districts, that is, Kailahun, Kenema, and Koinadugu Districts for the past few years. We have only added other districts, such as Kambia and Port Loko etc., during the Ebola outbreak. For SRI, we have only been working with farmers in the Koinadugu District*".

Similar statements were made during the workshops by presenters from NGOs, and during some of the KII interviews with NGO personnel. This suggests that the services of a particular NGO may be concentrated only in a part of the country.

SLARI's role is linked more towards the conduct of research into the efficacy of the SRI compared to conventional methods of rice cultivation but has not been very active in reaching out to farmers with SRI techniques, according to respondents. This is possibly due to the fact that SLARI is more focussed on research activities to either develop innovations or to provide evidence on the advantages and disadvantages of agricultural innovations, but is not normally funded for scaling out innovations to smallholder farmers (WS-RK-Res). MAFFS is normally the major governmental institution responsible for scaling up and scaling out innovations from SLARI or other sources. Indeed, MAFFS recently (from 2012) joined NGOs in the promotion of SRI techniques to smallholder farmers through funding from the West Africa Agricultural Productivity Programme (WAAP). Its roles are not different from those of NGOs, except that it also responsible for certifying farmer groups at community level, thereby enhancing their eligibility to benefit from a range of actors in the agriculture sector (KII-KOD-ExtM). Cornell University was mentioned by the Director of ENGIM, an Italian based NGO, during the workshop in Freetown and also during an interview in his office in Port Loko District. He indicated that he has been collaborating with Cornell, who provide him with technical support in his work on SRI, and that they have been sharing experiences for more than a decade now (KII-POD-ExtN).

Farmers, being the ultimate target of the innovation, were mentioned by most respondents and in both workshops as key actors in the SRI. In addition to the farmers' roles of trying the innovation at farm level and providing feedback to research and extension agents, as perceived by respondents, farmers also act as a source of seeds of varieties suited to SRI for use by other farmers. Furthermore, a few of the farmers, e.g., the community leaders, also participate to: monitor project implementation; assist in the mobilisation of colleague farmers at community level; and act as the primary point of entry as they approve, or disapprove, of the operations of external actors, particularly NGOs, in their communities. The District Councils were also identified as performing similar functions, particularly the monitoring of activities of research and extension actors in their districts.

Other actors, such as WFP, ABCs, and SMP, were also mentioned by respondents as actors in SRI in that they provide services such as Inland Valley Swamp rehabilitation (specific to WFP), and the sale of seed and other inputs to farmers and other actors, including NGOs.

Table 5.2: Actors and their roles in the System of Rice Intensification (SRI)

Source	Actor	Role
WS-FT-ExtM, WS-RK-Res, WS-RK-ExtM	SLARI/RARC	• Determination of seedling age, spacing, density of released varieties • Develop technologies on cereal crops • Research services • Source of certified rice seed
WS-RK-ExtM, KII-FT-ExtM	SLeSCA	• Seed certification
WS-RK-Res	SMP	• Dissemination of rice technologies • Capacity building
WS-FT-ExtM, WS-RK-ExtM, KII-KOD-ExtM, KII-POD-ExtM, KII-TOD-ExtM, KII-KOD-ExtN, KII-KAD-Res	MAFFS	• Extension services – demonstration and multiplication of seed • Training, monitoring and supervision of farmers • Facilitates the registration of farmer groups • Supporting farmers with seeds • Provide seed support to NGOs at district level • Capacity building of NGOs and farmers
WS-FT-ExtM, WS-RK-Res, KII-KAD-Res, KII-TOD-ExtM, KII-KAD-ExtM, KII-FT-ExtN, KII-FT-Res	NGOs (Local and International)	• Facilitate the dissemination of SRI technologies • Documenting the advantages and disadvantages of SRI • Enhance access to quality seeds of released varieties • Provision of other agricultural inputs such as tools • Mobilization of farmers and other stakeholders • Providing training on marketing to farmers • Funding for scaling up of SRI activities eg JICA
WS-FT-ExtM, WS-FT-ExtN, WS-RK-Res, WS-RK-ExtM, KII-KOD-ExtM, KII-POD-ExtM, KII-TOD-ExtM, KII-FT-ExtN KII-KOD-ExtN, KII-KAD-Res	Farmers	• Feedback on the advantages and disadvantages of SRI • Participation in field trials • Use of SRI technology • Participate in programme activities • Source of seeds for NGOs and colleague farmers
WS-RK-ExtM, KII-KOD-ExtN,	District Council	• Monitoring of activities of MAFFS and NGOs
KII-KAD-ExtM	ABCs	• Sale of farm inputs such as seeds, fertilizers etc
WS-FT-ExtN	WFP	• WFP buy milled rice from farmers; and do IVS rehabilitation
KII-POD-ExtN, KII-KOD-ExtN	Community Leaders/Authorities (Paramount chief, section chiefs, youth leader, headman, Master farmers, Mammy queen)	• Monitoring project implementation • Assist in seed loan recovery • Approval/disapproval of intended activities by NGOs • Assist in mobilizing farmers
KII-POD-ExtN; WS-FT-ExtN	Cornell University	• Technical backstopping on SRI principles

5.2.4 Actors and their Roles in the Technical Package on Rice (TP-R)

The initial stages of the TP-R in Sierra Leone comprised five key actors, according to the District Agriculture Officer of MAFFS in Kambia District. These included: JICA, the key player and initiator of the innovation; MAFFS; SLARI/RARC; farmers; and the District Council. These were identified as key actors in the piloting and scaling up phases of the TP-R in Kambia District. JICA was represented by expatriate staff from Japan and staff recruited locally. MAFFS was represented by staff of the MAFFS district office in Kambia, while SLARI was represented by staff of RARC. Community Leaders are farmers with leadership roles in their respective communities who also play a key role at the initial stages of the innovation. In the second phase of the project the variety of actors was increased to include Community Facilitators. These are farmers trained by JICA staff as a capacity development measure to enable them to share their experiences and skills on the TP-R innovation with other farmers within their communities, and beyond. Private traders and SLeSCA were only mentioned by a few respondents on two occasions, once during the workshop in Freetown (SLeSCA) and then during an interview with one of the NGOs in Kambia District. This is because the innovation did not involve the establishment of linkages between farmers and traders for input access, and also because SLeSCA was non-existent in the initial stages of the project. SLeSCA was established only in 2015, and did not play any role in the innovation at the time.

With respect to actors' roles, JICA played a leading role, not only funding the piloting and scaling up of the innovation, but also collaborating with other actors, including MAFFS, Kambia District Council, farmers, and NGOs such as BRAC and WFP, among others. They provided training to smallholder farmers, MAFFS, and staff from other NGOs on the TP-R (KII-KAD-ExtN, KII-KAD-ExtM). JICA also funded MAFFS for scaling up the TP-R in other districts in the country, such as Koinadugu (KII-KOD-ExtM), in addition to funding the implementation of the two phases of the project. The training provided by the JICA to MAFFS staff was to enhance their understanding of the contents of the TP-R innovation to enable them (MAFFS staff) to work with smallholder farmers countrywide. Therefore, MAFFS role in the TP-R went beyond providing approval to JICA's operation in the target district, but also extended to scaling up the innovation in the country among smallholder farmers.

SLARI/RARC was reported to have collaborated extensively with JICA, according to respondents, in conducting research activities, such as soil tests taken to inform JICA about the nutrient deficiencies of soils in the IVS selected for demonstration of the innovation with farmers. This enabled JICA to make decisions on the nutrient requirements of each demonstration plot, and to act accordingly. Documenting the presence of JICA, approval and monitoring of their activities were among the key roles of the Kambia District Council and Community Leaders. The only differences between these two, according to observations, are that the latter operate at community level and their cooperation largely affects the success of any external innovations in their communities, while the former represents the government at district level, so gaining their approval is very important, particularly for NGOs to enhance visibility of their interventions.

Further, Community Facilitators, as the name implies, are farmers selected by JICA from among farmer groups in the target communities of the innovation and who are provided with additional training. This, according to JICA, was an exit strategy in that the mantle of sharing of experiences, knowledge, and skills contained in the TP-R innovation with farmers with emerging interests was taken up by the Community Facilitators. They were trained to provide services to colleague farmers on the TPR at a cost – a kind of demand-driven extension services approach. Smallholder farmers' roles were key in the TP-R in that they participated in the establishment of demonstration plots, including the physical development of the swamps, they tried the innovation on their farms, and they also provided inputs, such as rice seed, to colleague farmers as and when necessary (see

for details). The role of private traders was mentioned by one respondent who indicated that they provide marketing services to smallholder farmers, such as the purchase of rice grains and the sale of inputs, (e.g., seeds and fertiliser). However, they were not mentioned by most respondents, possibly due to the fact that the innovation was more production focussed, hence, farmers were not linked with market facilities.

Table 5.3:Actors and their roles in the Technical Package on Rice (TP-R)

Source	Actor	Role
WS-FT-ExtM WS-RK-ExtM, KII-KAD-Res	SLARI/RARC	• Research services to NGOs and farmers • Development and release of new rice varieties • Collaborated closely with JICA during project implementation
WS-FT-ExtM	SLeSCA	• Seed certification
WS-FT-ExtM, WS-RK-ExtM; KII-POD-ExtM; KII-FT-ExtM	MAFFS	• Extension services • Collaboration with JICA during project implementation • Dissemination of technology
WS-FT-ExtM KII-KAD-ExtM, KII-POD-ExtM, KII-RK-Res	NGOs (Local and International)	• Facilitate the dissemination of TP-R techniques • Enhance access to quality seeds of improved rice varieties by farmers • Development of IVS • Documenting feedback on TP-R
WS-FT-ExtM, WS-RK-ExtM, KII-KOD-ExtM, KII-POD-ExtM; KII-FT-ExtM	Farmers	• Feedback to Extension staff on TP-R • Participate in TP-R programme activities – demonstrations and use of innovation • Source of seeds for NGOs and colleague farmers
WS-RK-ExtM	District Council	• Monitoring of activities of MAFFS and NGOs • Endorsement of NGOs activities
WS-RK-ExtM, KII-KOD-ExtM, KII-KAD-ExtM, KII-KAD-ExtN	JICA	• Providing funding to the MAFFS • Innovators of technology and provision of funds/input • Dissemination of technology to smallholder farmers • Training of Extension personnel
KII-POD-ExtN, KII-KOD-ExtN, KII-KAD-ExtN	Community Leaders/Authorities (Paramount chief, section chiefs, youth leader, headman)	• Monitoring project implementation • Assist in seed loan recovery • Approval/disapproval of intended activities by NGOs • Assist in mobilizing farmers for project activities
KII-KAD-ExtN, KII-KAD-ExtM WS-RK-ExtN	Community Facilitators	• Farmers selected from community and trained by JICA Field Staff on TPR techniques • Training colleague farmers at community level • Point persons at community level between NGOs and farmers • Leaders of farmer groups
KII-KAD-ExtN	Private Traders/Agro-dealers	• Sale of Agricultural inputs to smallholder farmers • Purchase of agricultural inputs to farmers

Source: Field Research, 2016

5.2.5 Actors and their Roles in the Agriculture Business Centres

Details of the actors and their roles in the ABCs innovations are presented in **Error! Reference source not found.**. Findings from the study showed that the main actors regarding ABCs were: MAFFS; smallholder farmers; and international donors, particularly World Bank, ADB, and FAO. Other actors identified by respondents include the World Food Programme (WFP), NGOs, private traders, and community leaders.

MAFFS are the primary initiators of the innovation whose key roles, according to respondents, include the solicitation of funds for the initiation of the nationwide project, leading to the implementation and monitoring of project activities, including the purchase and installation of processing equipment and other items, and collaborating with other actors for the establishment and operationalisation of ABCs nationwide. MAFFS primarily coordinated the innovation processes of the ABCs, including the identification of the locations and participating FBOs per district, provision of relevant materials (e.g., zinc, nails, and cement), supervising the construction process of each ABC, and the final supply of equipment to the ABCs. Farmers, including community leaders, as in most agricultural innovations, are the target beneficiaries of the ABCs. Their roles, as identified by research and extension actors, include the supply of labour and locally available materials, such as sand and boards, for the construction of the ABCs. They are also responsible for identifying the committee, through a democratic process, from among those who oversee the day-to-day running of the ABCs. Farmers also provide the land for the construction of the ABC in the target community. Another important role for farmers, mentioned by the majority of the respondents in the interviews and in the workshops, is to ensure the functioning of the ABCs through the supply of paddy for processing and by buying of inputs from the ABCs. In an interview, the District Crop Officer, in Kambia District said:

"*The ABCs were established to ease farmers' constraints to accessing markets. That is why they are built in their communities, and that was why we requested them to provide all the local items for its construction. They are managing them. We only provide them with training on how to run the ABCs for success and sustainability. But the better part of it is their responsibility, such as taking their harvested paddy to the ABCs and buying from there (KII-KAD-ExtM)*". (Interviewed, February 11, 2016).

This suggests that the functioning of ABCs is largely a function of farmers' willingness to demand services provided by the ABCs and of exhibiting a sense of ownership of them. Other actors, such as the WFP, were also identified as key actors in selected ABCs in that they purchase rice grains from the ABCs for their school feeding programme, they also provide packaging materials, such as jute bags, weighing scales, and destoners, to enhance farmers' abilities to meet their buying requirements. Private traders were also mentioned by one respondent and by the MAFFS representatives during the workshop in Freetown, for their role in the sale of machinery and building materials to MAFFS for supply to the ABCs. A Chinese company, located in Freetown, was identified as the main supplier of all machinery installed in the ABCs. Other itinerant traders were also mentioned as playing a role in buying clean rice from the ABCs. A few NGOs and UN agencies, such as COOPI, GTZ, and IFAD, among others, have been providing training services to selected ABC committee members to develop their capacities to manage their ABCs. This may mean that there are capacity deficiencies among management committees of the ABCs that have not been adequately handled by MAFFS. Some NGOs, such as CRS, were identified as having worked with two of the ABCs in Koinadugu District in order to link them with farmer groups, and thus enhance the farmers' access to the ABCs' market services (KII-KOD-ExtN).

Table 5.4: Actors and their roles in the Agricultural Business Centers (ABC)

Source	**Actor**	**Role**
WS-RK-ExtM, KII-KOD-ExtM, KII-POD-ExtM, KII-TOD-ExtM, KII-KOD-ExtN, WS-FT-ExtM, KII-FT-ExtM, KII-FT-ExtN	MAFFS	• Mentoring and supervision of ABC members • Provided start-up kits eg seeds, fertilizers, pesticides and machinery • Soliciting funding • Proposal writing for project initiation • Equipment and technical support to ABCs • Recognition and approval of NGO activities
KII-KOD-ExtM KII-TOD-ExtM KII-KOD-ExtN, KII-FT-ExtM, KII-FT-ExtN	NGOs	• Provide technical training to Committee members • Buying seeds from ABCs • Linking farmers to ABCs
WS-RK-ExtM,KII-KOD-ExtM,KII-POD-ExtM, KII-TOD-ExtM,KII-KOD-ExtN, WS-FT-ExtM, KII-FT-ExtM	Farmers (FBOs)	• Ownership and provision of local materials and labour • Buying and selling of agricultural inputs and outputs in the ABCs • Managing the day-to-day affairs of the ABC
KII-KOD-ExtM, KII-TOD-ExtN, KII-FT-ExtN.	Community Leaders/Authorities (Paramount chief, section chiefs, youth leader, Councillors, headman etc)	• Mobilization of FBO members etc, • Allocation of land • Site identification • Recognition and approval of interventions from NGOs in their communities
KII-KOD-ExtM,KII-KAD-ExtM, KII-KOD-ExtN	WFP	• WFP buys milled rice from FBO members in ABCs • Funding IVS rehabilitation
WS-RK-ExtM, KII-KOD-ExtN, KII-KAD-ExtM, KII-FT-ExtM, KII-FT-ExtN	International Donors (World Bank, ADB, FAO, etc)	• Provision of funds
KII-KOD-ExtM, WS-FT-ExtM	Private traders eg	• Sale of processing equipment to MAFFS • Buying of rice grains from ABCs

Source: Field Research, 2016

5.3 Patterns of Interactions/Linkages which exist among Actors of key Rice Innovations

5.3.1 Introduction

The focus of this section of the research is to: present and interpret findings elicited about the linkages which exist among actors of the key rice innovations promoted by research and extension personnel in the past ten years; analyse the strength of those linkages; and highlight the purposes for these linkages among actors on innovations, including IRV, SRI, TP-R, and ABCs. Understanding the linkages and their strengths, as well as the purposes of those linkages, among actors of the various rice innovations will contribute to the overall understanding of the innovation processes and system with respect to the various innovations promoted by research and extension actors.

As in the previous section, data were generated through workshops, KIIs, document review, and observations, which targeted research scientists from SLARI/RARC, and extension personnel from MAFFS and those NGOs implementing programmes on agriculture. Findings show that differences in the interactions/linkages among and between actors in the innovation process of each innovation exist, and that some actors interact more often than others. This translated into weak linkages between certain actors, while medium and strong linkages exist among others. In almost all the innovations promoted, MAFS, NGOs, and farmers (and their collectives) emerged as the key actors; they interact more strongly among themselves than they each do with other actors identified in each of the key innovations studied.

5.3.2 Linkages/Interactions, Strength and Purpose of Linkages among Actors of Improved Rice Varieties

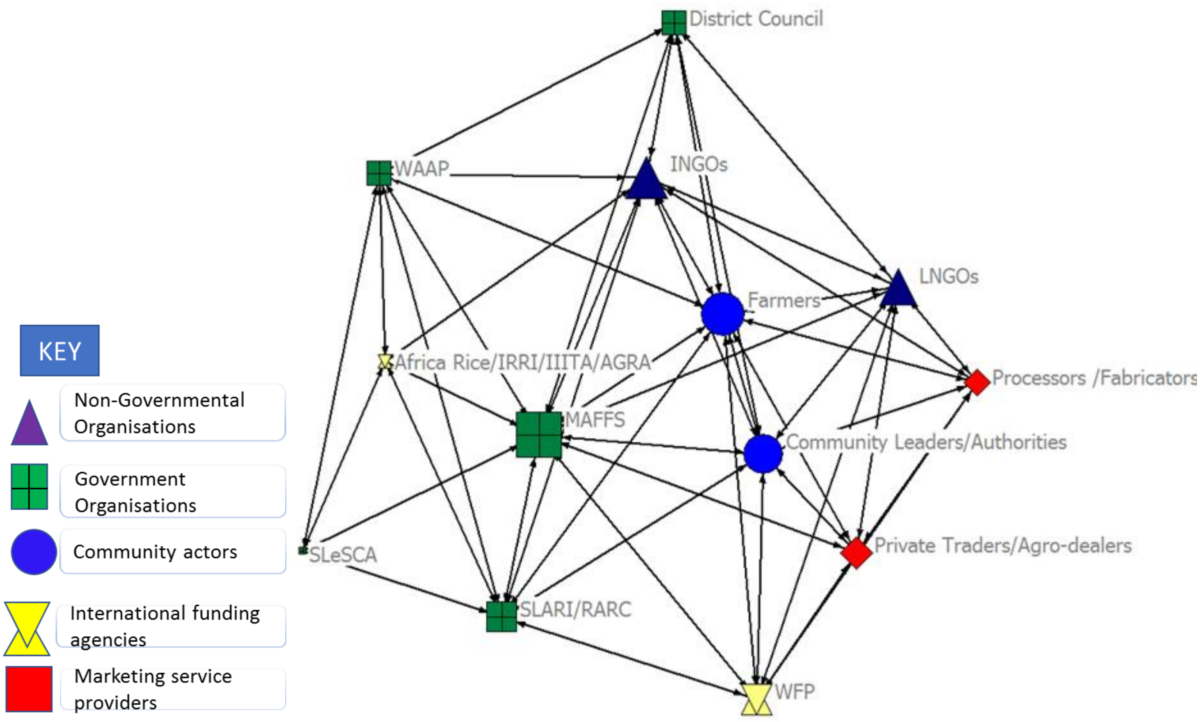
This section presents findings on the linkages/interactions which exist among actors involved in the development/promotion of IRV as an innovation, identified by research and extension actors, the target respondents. The section also includes findings on the strength of the linkages/interactions among these actors as perceived by research and extension actors nationwide.

5.3.2.1 Linkages/Interactions among Actors of IRVs

The linkages existing between and among actors involved in the development and promotion of IRVs as an innovation are shown in the sociogram (Figure 5.1) below. The figure demonstrates the existence of some form of interaction/linkages among the various actors, with each actor having interacted with more than one actor in the innovation system. However, a few actors, including MAFFS and farmers, have interacted with more actors in the innovation process than have others. They seem to constitute the centre of interaction in the system. MAFFS was identified to have interacted with 11 out of 12 other key actors mentioned (i.e., not processors), while farmers have interacted with 10 out of the other 12 actors mentioned (i.e., not with SLeSCA or Africa Rice/IRRI). Unsurprisingly, MAFFS is considered the major government institution responsible for the development of the agriculture sector and coordination of the activities of various actors, including agricultural policy formulation and enforcement, as well as the engagement of various stakeholders for the advancement of the government's objective of achieving food self-sufficiency for the country. Other actors may, therefore, feel obliged to interact with MAFFS as doing so may not only add credence to their activities, but also increase their governmental visibility. Further, institutions like SLARI and SMP are funded by MAFFS and are obliged to report their activities to them. The ministry also participates in the multiplication and dissemination of new rice varieties developed by these institutions to enhance farmers' access to IRVs.

Naturally, it is farmers who are the target for all agricultural innovations promoted by research and extension actors. Hence, they were identified as interacting with the majority of actors who promote agricultural innovations in their communities, in this case IRVs, as well as other service providers, such as processors and private traders, for processing and accessing markets. Their perceived lack of linkages with SLeSCA and Africa Rice/IRRI could be due to the fact these institutions deal more with high level agencies, such as SLARI, NGOs, and MAFFS, and so they do not implement programmes which directly involve smallholder farmers. Extension actors, such as NGOs, were identified by respondents to be interacting with a number of other actors, and International NGOs do so with more actors than do local NGOs. For instance, LNGOs were not identified as being linked to SLARI, SLeSCA, and WAAP; while, INGOs linked with both SLARI and WAAP. This suggests that INGOs tend to network more with research institutions than do their local counterparts.

Figure 5.1: Patterns of linkages/interactions among actors of Improved Rice Varieties (IRVs) (Node size: eigenvector centrality)



On the other hand, actors such as SLeSCA, Africa Rice/IRRI, district councils, processors, and private traders, were reported to have fewer linkages with other actors, and this can be seen in the sociogram in Figure 5.1. This may be due to differing interests and the perceived lack of purpose to link with actors other than those with whom they share similar interests. This also suggests that research and extension actors do not normally engage some of these actors (e.g., private traders or councils) in their engagement with farmers at community level, thereby, depicting a lack of value chain perspective in the promotion of IRVs.

The sociogram in Figure 5.1 shows the linkages among the various actors in the IRVs, as perceived by respondents. However, linkages between and/or among actors in an innovation process may not be sufficient to enhance the effectiveness of that process. It is, therefore, important to examine the strength and purpose of the linkages for a better understanding of the effectiveness of the innovation process. The following sub-sections, therefore present and interpret findings on the strength and purposes of the various linkages among actors involved in the promotion of IRVs in the country.

5.3.2.2 Strength of Linkages among Actors of IRVs

The actor linkage matrix (see **Error! Reference source not found.**) shows the linkages between actors involved in the development and promotion of IRVs and their strengths. It can be seen that although there is some form of linkage between the majority of actors identified by research and extension actors, the strengths of those linkages vary. Governmental institutions, including SLARI/RARC, SLeSCA, MAFFS, and the Government pioneered programme WAAP, were identified to have strong linkages between each other. This is mainly due to the fact that their individual activities are geared towards supporting each other's ability to achieve their objectives. For instance, SLARI constitutes rice breeders who adapt/develop new varieties of rice, SLeSCA certifies and supports the release of these varieties, while MAFFS ensures access to these varieties by smallholder farmers, through dissemination, in order to improve their productivity. Also, MAFFS is the leading institution which serves as the primary financier of these subsidiaries. It is, therefore, imperative for a strong linkage to exist between these institutions as they depend on each other to function and to achieve their goals.

However, though district councils are governmental institutions, they were identified as having a strong linkage only with MAFFS, and a weak one with SLeSCA and SLARI. This is possibly due to the fact that district councils function at local level and are more interested in activities which directly affect farmers at community level. This makes the councils more likely to have a strong relationship with MAFFS as they have a presence through their sub-offices in every district in the country, as opposed to SLeSCA and SLARI whose presence is limited to Freetown (SLeSCA) and a few other locations around the country (SLARI/RARC). Also, SLARI and or SLeSCA do not seem to need the council, in any way, to carry out their functions, and vice-versa. It was discovered that the government's decentralisation policy demands that funds for all government line ministries are devolved to the district councils. Hence, MAFFS offices at district level obtain their quarterly funds for implementation of their programmes from their district councils, and are also monitored and accountable to the councils; this increases the strength of their linkages/interactions.

Consistently, district councils were identified to have strong linkages with farmers, community leaders, and local and international NGOs. This demonstrates the importance of the district councils in the innovation process as most other actors are in touch with them for a number of reasons. Findings from the interviews and workshops revealed that the district councils host a monthly NGO meeting which brings together all NGOs in the agriculture sector, at district level, to report and share information with each other. This is a possible reason for a strong linkage between the NGOs and the council. Similarly, farmers depend on the council for endorsement of their farmer groups, and their participation at council activities which deal with rice innovations through meetings/workshops. The council was also reported to work closely with farmers to monitor activities of the research and extension actors who implement rice innovations in their communities.

It was identified that farmers have a strong linkage with the key government institutions, with the exception of SLeSCA, where there was weak linkage because they do not interact directly with farmers for seed certification. NGOs (local and international) similarly have strong linkages with farmers in the promotion of IRVs. This is possibly due to the fact that these actors work directly with farmers and may, therefore, be sharing information and technologies which benefit them both in the innovation system. On the other hand, a weak linkage was identified to exist between farmers, processors, and markets. While they may be interacting, they do not do so as frequently as necessary, and there may be no formal arrangement which protects the interests and benefits of either party. For example, the lack of a formal tie mediated by a third party, such as an NGO or MAFFS, may result in farmers getting lower prices for their goods, processors demanding more than necessary for their services, or the processors and traders being unavailable when farmers need them.

Further, MAFFS was identified to have a strong to medium linkage with most of the other actors, except for the processors with whom this link was identified as weak. This further supports the finding that MAFFS is considered the lead actor in the agriculture and seed sector, but has done little to link processors with farmers, and this could be an important consideration for the promotion of the effectiveness of the innovation system

Table 5.5:Actor Linkage Matrix of Actors in Improved Rice Varieties

ACTORS	SLARI/RARC	MAFFS	SLeSCA	WFP	Marketers/Agro-dealers/Traders eg SMP, SLPMC etc	INGOs (Concern, CRS, CARE, World Vision, BRAC)	Africa rice/IRRI/IITA/AGRA	LNGOs (ENGIM, CTF, ABC-DEV, DENDEMBEN, GbonFA, Caritas, CIFD-SL)	WAAP	Farmers	Processors eg. Finic, Private Rice mills, ABCs etc	Community Leaders/Authorities	District Council
SLARI /RARC		*S*	*S*	*W*	*W*	*M*	*S*	*W*	*S*	*S*	*W*	*S*	*W*
MAFFS	*S*		*S*	*S*	*M*	*M*	*M*	*S*	*S*	*M*	*W*	*S*	*S*
SLeSCA	*S*	*S*		*W*	*W*	*W*	*M*	*W*	*S*	*W*	*W*	*W*	*W*
WFP	*W*	*S*	*W*		*S*	*W*	*W*	*S*	*W*	*S*	*S*	*M*	*W*
Marketers/Agro-dealers/Traders eg SMP, SLPMC etc	*W*	*M*	*W*	*S*		*M*	*W*	*M*	*W*	*W*	*S*	*S*	*W*
INGOs (Concern, CRS, CARE, World Vision, BRAC)	*M*	*M*	*W*	*W*	*M*		*M*	*W*	*M*	*S*	*M*	*S*	*S*
Africa Rice/IRRI/IITA	*S*	*M*	*M*	*W*	*W*	*M*		*W*	*S*	*W*	*W*	*W*	*W*
LNGOs (ENGIM, CTF, ABC-DEV, DENDEMBEN, GbonFA, Caritas, CIFD-SL)	*W*	*S*	*W*	*S*	*M*	*W*	*W*		*W*	*S*	*M*	*S*	*S*
WAAP	*S*	*S*	*S*	*W*	*W*	*M*	*S*	*W*		*S*	*W*	*W*	*M*
Farmers	*S*	*M*	*W*	*S*	*W*	*S*	*W*	*S*	*S*		*S*	*S*	*M*
Processors eg. Finic, private rice mills, ABCs etc	*W*	*W*	*W*	*S*	*S*	*M*	*W*	*M*	*W*	*S*		*M*	*W*
Community Leaders/Authorities	*S*	*S*	*W*	*M*	*S*	*S*	*W*	*S*	*W*	*S*	*W*		*S*
District Council	*W*	*S*	*W*	*W*	*W*	*S*	*W*	*S*	*M*	*M*	*M*	*M*	

Key: W= Weak Linkage; M= Medium Linkage; S=Strong Linkage

5.3.2.3 Purpose of Linkages/Interactions among Actors of IRVs

Linkages between actors must have a purpose for them to contribute to the innovation process (World Bank, 2007). Other researchers, such as Bhattacharjee & Saravanan (2014), refer to these purposes as actions taken by actors between each other in order to enhance the innovation process. It is, therefore, important to understand not only the strength of the linkages between two actors in an innovation process, but also to understand the activities they carry out together, and/or the services they provide each other, which characterise the linkages. In this study, research and extension actors were, therefore, requested to identify the purposes of the linkages existing between the actors they identified in the development/promotion of IRVs. Details of the purposes identified are presented in Table 5.6 below.

The purpose of linkages between most of the actors in the IRVs appears to be similar. SLARI was identified to have links with the other actors mainly for purposes which include: research and the release of new rice varieties; convening and attending meetings, workshops and trainings; facilitating uptake of new rice varieties; providing technical advice; and, collaborating in project implementation with actors such as MAFFS, SLeSCA, SMP, Agro-dealers, INGOs, and farmers. This is possibly due to the fact that SLARI's core mandate is the development and dissemination of agricultural innovations, including seeds, among actors in the agriculture sector. Achievement of this mandate requires them to link with other actors for the purposes identified. However, SLARI is perceived to have no direct linkages with actors such as WFP, district councils, and processors, and therefore, has no clear purpose of linkage with any of these actors.

Similarly, MAFFS was identified to have linked with other actors for the purposes of: funding; facilitating access to, and disseminating, new rice varieties; collaborating in project activities; attending and convening meetings, workshops, and trainings; engaging in policy formulation; monitoring and coordinating activities with actors such as SLARI, SLeSCA, Africa Rice, agro-dealers, NGOs, farmers, WFP, district councils. These activities and services have been key in MAFFS efforts to achieve food self-sufficiency with support from other actors in the sector. For instance, it was noted that MAFFS collaborated with local NGOs, such as CIFD in Port Loko District, GbonFA in Tonkolili District, and ABC Development in Kambia District, to ensure that NERICA rice varieties were distributed to deserving communities immediately after the Ebola virus outbreak. Consistently, NGOs were identified to link with other actors for purposes which include: facilitating marketing services, i.e., buying rice seed from farmers and agro-dealers, SMP, and MAFFS, and other inputs, such as fertilisers and tools, from traders; implementing; collaborating; advising; and coordinating. Some NGOs were also identified to be linked with other actors for funding purposes – including the receipt and provision of funds to other actors.

Table 5.6: Purpose of Linkages/Interactions for Improved Rice Varieties

ACTORS		SLARI/ RARC	MAFFS	SLeSCA	WFP	Agro-dealers/Traders eg SMP, SLPMC etc	INGOs	Africa Rice /IRRI/IITA/AGRA	LNGOs	WAAP	Farmers	Processors eg. Finic, private rice mills, ABCs etc	Community Leaders/ Authorities	Distri Counc
SLARI /RARC			Funding; Convening and participation in meetings, Multiplication and dissemination of IRVs	Facilitating the certification of IRVs; Participation in policy formulation	Not clear	Facilitating access to seeds, Multiplication of new rice varieties, participating in mentoring sessions	Seed multiplication/dissemination, and purchase; Convening and attending meetings, workshops etc	Convening mentoring sessions; Funding research activities; Facilitating access to breeding lines	Purchase of inputs eg improve rice varieties	Funding, convening meetings/workshops	Participation in testing, use and dissemination of new varieties, Purchase of inputs, Providing information on seeds	Not clear	Facilitating approval of entry; Mobilization of farmers, Dissemination of IRVs	Not cl
MAFFS		Mentoring on seed management, Engagement in policy formulation		Facilitating access to certified seed; Engagement in policy formulation	Collaboration in IVS development	Facilitating access of new seed varieties; Dissemination, Value addition; Information sharing	Technical collaboration; Funding; Advocacy on behalf of farmers	Coaching and mentoring; Funding; Technical assistance	Collaboration in project implementation; Participation and convening meetings; Reporting; Information sharing	Funding; Receiving technical assistance	Participation in coaching sessions; Awareness raising; Information exchange; Facilitating NGOs access to seeds at community level	Participate in coaching and mentoring activities on IRVs	Endorsement; Mobilization of farmers and awareness raising	Funds disburs Monit activiti inform exchar Conve partici meetin
SLeSCA		Engagement in policy formulation; Training of staff	Funding; Training; Engagement in policy formulation		Not clear	Facilitating access to new seed varieties; Policy engagement	Consultancy for seed certification issues; Attending workshops/ meetings	Facilitate access to new breeding lines, Mentoring staff	Attending meetings/workshops	Providing funding and logistics for SLeSCA, Facilitate mentoring	Not clear	Not clear	Not clear	Not cl
WFP		Not clear	Monitoring of activities	Not clear		Facilitate availability of rice seed/grain	Collaboration in IVS development	Not clear	Source of seeds/grains; collaboration in project implementation	Not clear	Source of seed/grain; participation in meetings/workshops	Facilitate value addition to rice paddy	Mobilization of farmers	Not cl
Agro-dealers/Tr		Sale of improved varieties	Purchase of rice seeds; engagement	Facilitate access to rice seeds	Purchase of seed/grain		Facilitating purchases of rice seed, tools	Not clear	Purchase of rice seeds, fertilizer etc;	Not clear	Facilitating the sale and purchase of rice	Processing of rice paddy	Focal point/persons;	Not cl

aders eg SMP, SLPMC etc			in policy issues				and other inputs.				seeds and other inputs;			
INGOs		Provision of technical advice through consultancies; attendance in meetings; Supply of certified seeds	Facilitating approval of operations; Monitoring; Advising on policy issues Coordination of activities, Advocacy on behalf of farmers	Facilitation of access to IRVs.	Collaboration in rice seed purchase; Funding	Sale of rice seed		Provide consultancy services	Convening and attending meetings; Experience sharing; Receiving funding	Experience/ information sharing	Facilitating the sale of rice seed; participation in coaching sessions; workshops etc	Participation in project activities	Approval of activities; Mobilization of community members; Attending meeting	Endors operati Monit interve
Africa Rice/IRRI /IITA/AGRA		Adaptation and multiplication and dissemination of new rice varieties; Research activities; Participation in trainings/workshops	Participation in trainings/meetings/works	Facilitate the release of breeding lines; Attending mentoring meetings/Workshops	Not clear	Not clear	Collaboration in project implementation; Attending meetings		Not clear	Not clear	Participate in trainings/meetings/project implementation	Not clear	Not clear	Not cl
LNGOs		Not clear	Collaboration in seed distribution; Training of staff; Technical advice	Facilitation of access to IRVs.	Collaboration in project implementation; Funding of activities; Training of staff	Sale of rice seed	Funding; Training of staff; Supervision/monitoring; Meetings	Not clear		Not clear	Participating in meetings/workshops, Facilitate program access to rice seed for LNGOs, participate in coaching sessions	Not clear	Approval of operations; participation in project activities – meetings, trainings etc	Monit activit partici meetin
WAAP		Collaboration in program implementation and reporting	Attending meetings/workshops	Certification of seeds; Attending meetings/trainings	Not clear	Not clear	Participation in trainings/meetings	Not clear	Not clear		Participation in project activities/implementation	Not clear	Not clear	Not cl
Farmers		Coaching on cultivation of IRVs, Information exchange,	Facilitate access to IRVs, Coaching, facilitating	Not clear	Purchase of rice seed/grain;	Purchase and sale of rice seed and other inputs;	Coaching; Facilitating access to IRVs; Information sharing on	Not clear	Coaching; Facilitating access to IRVs; Information exchange on	Facilitating access to IRVs;		Facilitating value addition to rice paddy	Mobilization; Awareness raising; Meetings	Regist farmer Inform sharin

		Raising awareness, Mobilization for IRVs trials and dissemination	information exchange, Convening meetings/workshops			Price determination	innovations; Convening meetings; Infrastructural development		innovations; Workshops; Meetings; Infrastructural development					
Processors/Fabricators eg. Finic, private rice mills, ABCs etc		Not clear	Repairs of machinery	Not clear	Facilitating purchase of rice; provision of packaging materials	Facilitating purchase of rice seed/grain	Facilitating sales of tools for cultivation	Not clear	Fabrication of tools	Not clear	Facilitating purchase of tools and rice seed/grains		Regulation/monitoring of activities/operations; Mediation	Not cl
Community Leaders/Authorities		Coaching; Awareness raising	Coaching; information exchange, Awareness raising	Not clear	Provision of coaching sessions; Facilitating purchase of rice seed	Facilitating purchase of rice paddy; sale of rice seed and other inputs; Facilitating access to loans	Convening meetings; Raising awareness of operations	Not clear	Awareness raising of activities	Not clear	Program implementation; Meetings on innovations	Mediation		Not cl
District Council		Not clear	Awareness raising, Convening meetings/workshops, Reporting	Not clear	Not clear	Not clear	Registration of farmer groups; Raising awareness of operations	Not clear	Registration of farmer groups; Raising awareness of operations	Not clear	Registration of groups; Raising Complaints/concerns on external innovation	Not clear	Raising issues of concern; Meetings	

Further, farmers (and their collectives) were reported to link with a variety of actors for many purposes. These included: facilitating trials, using and informally disseminating new rice seed varieties; input and output marketing; participating in training and meetings; seeking technical advice; informing; and, mobilising. These purposes seem to be very important for a successful innovation process in that farmers are normally the ultimate target for most innovations. Therefore, their ability and willingness to try and/or use them informs innovation actors before, during, and after technology development, and the mobilisation of colleague farmers at community level is very important for a successful innovation process

In general, most linkages between actors identified by respondents are mainly for purposes of funding, facilitating, collaborating, mobilising, and informing. These purposes, where effective, are crucial for a successful innovation process.

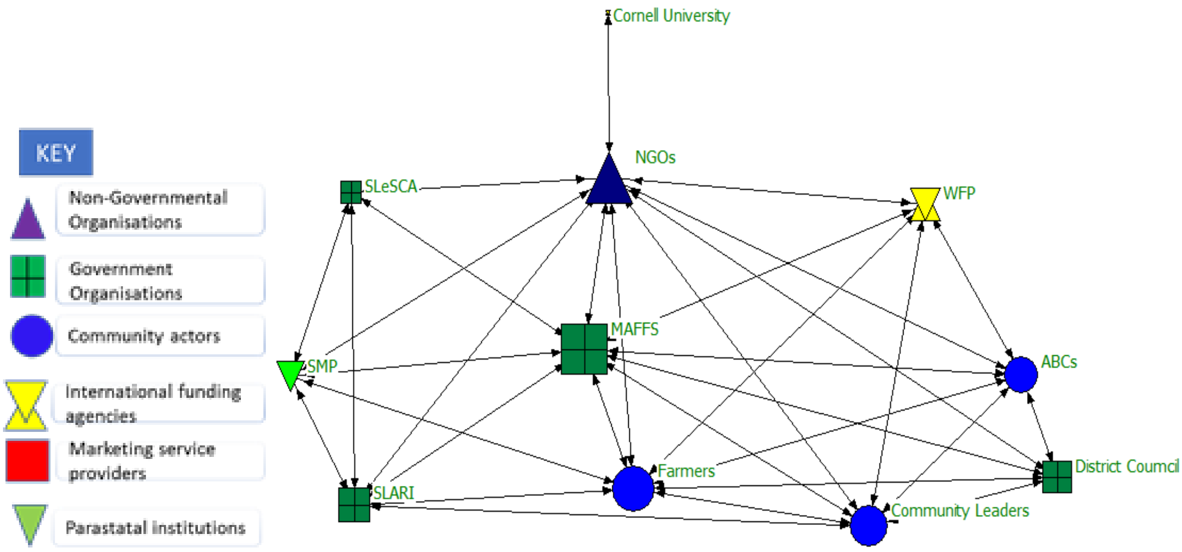
5.3.3 Linkages/Interactions, Strengths and Purposes of Linkages among Actors of the System of Rice Intensification (SRI)

This section presents findings on research and extension actors' perceptions about the linkages, strengths, and purposes of the linkages which exist among the various actors that have participated in the promotion of SRI as an innovation among the smallholder farmers.

5.3.3.1 Linkages/Interactions among actors in SRI Innovation System

The linkages existing between and among actors in the SRI innovation system are shown in the sociogram (Figure 5.2) below. It is interesting to see that NGOs have the highest number of linkages; they interacted with all other actors identified in the innovation system. This is possibly a corroboration of the fact that NGOs have been one of the key actors in the promotion of the SRI as an innovation for the sustainable and productive cultivation of rice among smallholder farmers. Key NGOs, including Catholic Relief Services, Concern Worldwide, World Vision, and ENGIM, were identified as the key INGOs promoting SRI. This suggests that in their drive to achieve their objectives these NGOs have been in touch with a variety of other actors in the public (MAFFS, SMP, SLARI, SLeSCA, councils) and private (farmers, WFP and ABCs) sectors, and with universities (Cornell). Further, farmers (including their collectives, community leaders, and ABCs) and MAFFS are also seen to have interacted with many more of the actors in the SRI innovation system than any of the other actors, with the exception of NGOs. Undoubtedly, farmers are normally the target beneficiaries of agricultural innovations, hence, they are mostly seen by external innovators as a sine-qua-non in the innovation process. Similarly, MAFFS, in addition to its role in the promotion of the innovation, also serves as the primary government institution overseeing the coordination of activities of the many actors in the sector. Therefore, other actors find it necessary to link with MAFFS for visibility of their own activities, and also for protection, when necessary. Interestingly, Cornell University can be seen to have interacted with NGOs only in the SRI innovation process. Information from a key informant who happens to be Director of ENGIM, an INGO based in Port Loko District, reveals that Cornell University has been providing mentorship on SRI activities through exchange visits. Since Cornell has only been interacting with this single NGO, it is shown to have linked only with NGOs. The subsequent sub-sections discuss further the strengths and purposes of the linkages which exist among these actors as perceived by the research and extension actors who participated in the study.

Figure 5.2: Patterns of linkages/interactions among actors in SRI Innovation System (Node size: eigenvector centrality)



Source: Field Research, 2016

5.3.3.2 Strength of Linkages among Actors in the SRI Innovation System

In Table 5.7 below, the strength of linkages among actors in the SRI innovation system, as perceived by research and extension actors, is shown. Unsurprisingly, MAFFS was identified to have very strong links with most of the actors, with the exception of Cornell University and WFP, which were each identified to have weak linkages because neither had interacted with MAFFS on SRI issues at the time of the data collection. The perceived strong linkages between MAFFS and the other actors could be due to their reliance on each other's services. For example, MAFFS depends on SLARI, SLeSCA, SMP, and NGOs for obtaining certified seeds, mentoring, and information sharing that could be important in their SRI activities. Similarly, farmers are perceived to have strong to medium linkages with the majority of the actors identified, with the exception of Cornell University and SLeSCA, with whom they are seen to have weak linkages. Farmers, being the target beneficiaries of SRI, ultimately experience some strong interactions with the majority of actors on SRI for a variety of reasons. For instance, farmers would have repeatedly interacted with MAFFS, NGOs, SLARI, and district councils, for: coaching on SRI techniques; accessing improved rice seed varieties; developing IVS; and forming Farmers' Groups at community level. They do not seem to have interacted with Cornell University or SLeSCA directly, hence the perceived weak linkages between farmers and these actors.

Further, it can be seen that a few actors were identified to have weak linkages with the majority of the actors in the SRI innovation system, they were: SLeSCA; WFP; SMP; and Cornell University. This is because these institutions often interact at the "macro" level with institutions such as MAFFS, NGOs, SLARI, and district councils for service provision and information sharing, amongst others, but do not deal with farmers or their collectives directly on SRI issues.

Table 5.7: Actor Linkage Matrix of Actors in SRI

ACTORS	MAFFS	Farmers	SLARI	District Councils	NGOs	SLeSCA	ABCs	Community Leaders	WFP	SMP	Cornell University
MAFFS		S	S	S	S	S	S	S	W		W
Farmers	S		S	S	S	W	S	S	M	M	W
SLARI	S	S		W	M	S	W	S	W	M	W
District Councils	S	S	W		S	W	M	M	W	W	W
NGOs	S	S	M	S		M	S	S	S	S	M
SLeSCA	S	W	S	W	M		W	W	W	S	W
ABCs	S	S	W	M	S	W		S	S	W	W
Community Leaders	S	S	S	M	S	W	S		M	W	W
WFP	W	M	W	W	S	W	S	M		W	W
SMP	S	M	M	W	S	S	W	W	W		W
Cornell University	W	W	W	W	M	W	W	W	W	W	

Key: W = Weak Linkage; M = Medium Linkage; S = Strong Linkage

5.3.3.3 Purpose of Linkages among Actors in SRI Innovation System

The identified purpose of linkages among actors on the SRI as perceived by research and extension actors are shown in Table 5.8. While some actors share a common purpose of linkages between each other, for instance, convening and participating in meetings and coaching sessions, there are also distinct purposes for linkages with certain actors. MAFFS was identified as linking with most other actors for funding, coordination of activities, and mobilisation. This is possibly because MAFFS is the public institution which pushes the Government's agenda in the agriculture sector, and is therefore perceived to be working with other actors, such as SLARI, NGOs, and farmers, for those named purposes. For instance, MAFFS funds SLARI's research activities, including the piloting of SRI activities in the 2000s, and has been coaching and mentoring farmers and NGOs in a bid to scale out SRI techniques in the country. Consistently, SLARI was identified to have linked with other actors for purposes which include: research activities, such as soil tests; dissemination; coaching; and to convene meetings/workshops. However, it was perceived not to have linked with other actors, such as district councils, WFP, ABC, and Cornell University, for any purposes relating to SRI activities.

Table 5.8:Purpose of Linkages among Actors in SRI Innovation System

ACTORS	MAFFS	Farmers	SLARI	District Councils	NGOs	SLeSCA	ABCs	Community Leaders	WFP	SMP	Cornell University
MAFFS		Participation in coaching sessions, workshops, and meetings	Generation and dissemination of improve seed materials; research services, information exchange	Supervision, Devolve function – disbursement of funds	Partnerships; Reporting; Funding;	Seed testing and certification for MAFFS services;	Organisation of farmer groups (FBO); Collaboration in project; Facilitating sale of seeds	Mediating, Mobilization of farmers; Raising awareness at community level; participation in coaching sessions	Funding; Collaboration in IVS development	Seed multiplication and dissemination	Not clear
Farmers	Coaching; facilitating innovation uptake		Coaching; Dissemination of improved seeds for SRI; Research activities	Advocating on farmers behalf, Registration of farmer groups	Coaching; disseminating, convening meetings, and sometimes advocating	Not clear	Facilitating input access inputs e.g. seed; convening meetings, mediating and coaching	Raising awareness on innovations; mediating, advocating, and representation	Facilitating purchases of rice seed, funding of IVS development activities	Facilitating farmers access to IRVs for SRI activities	Not clear
SLARI	Funding; Convening and participation in meetings and workshops; Dissemination of IRVs for SRI activities	Participation in innovation activities; Experimenting and advising based on demo results		Not clear	Seeking technical/research collaboration;	Seed certification for SLARI; Attending workshops and meetings	Not clear	Mediating, Mobilization of farmers; Raising awareness at community level; participation in coaching sessions	Not clear	Multiplication of improved seed varieties	Not clear
District Councils	Participating in meetings; Reporting; Receiving funds	Registering FBOs; Information sharing.	Not clear		Endorsement, Joint monitoring; Reporting	Not clear	Advocating on behalf of farmers, information exchange	Provision of information on SRI-related projects	Funding of activities	Not clear	Not clear
NGOs	Monitoring, Coordination of activities; Convening meetings, brokering	Participating in meetings and coaching sessions; facilitating demo plot establishment ; Experimentin	Research and evaluation services to NGOs, Convening mentorship activities, facilitating access to	Quality assurance and supervision of NGOs activities; Collaboration		Seed certification for NGO; Workshops	Facilitating access to inputs, participating in meetings.	Mediating, mobilization of farmers; Raising awareness at community level; participation in coaching sessions	Funding of activities	Facilitating access to IRVs, information exchange	Mentoring/providing technical backstopping on SRI techniques

		g SRI techniques	IRVs for SRI activities								
SLeSCA	Provision of funding, convening and participating in meetings and mentoring sessions	Not clear	Collaboration in seed related issues, Convening meeting/workshops	Not clear	Convening meetings, Seeking consulting services on seeds etc		Not clear	Not clear	Not clear	Receiving certified seeds	Not clear
ABCs	Monitoring of activities; Initial funding; and mentoring	Participating in meetings/trainings; facilitating input sales	Not clear	Monitoring of activities	Capacity building of members through coaching and mentoring	Not clear		Provision of services to farmers (NAFFSL)	Purchase of rice seed/grain; Training of farmers	Not clear	Not clear
Community Leaders	Consultation through meetings, surveys, Seeking advice and support; mobilization	Information exchange and advising	Coaching on SRI techn, convening meetings/workshops, facilitating access to seeds	Engagement in monitoring of SRI projects	Awareness raising; Consultations, Convening meetings, trainings/workshops	Not clear	Dissemination of information on SRI, participation in meetings.		Facilitating sales of rice seed/grain, Coaching	Not clear	Not clear
WFP	Collaboration in IVS development, advise on rice purchase, facilitating rice purchases	Facilitating access to rice seed/grain by WFP	Not clear	Not clear	Partnerships in IVS development; Information exchange	Not clear	Facilitating access to rice seed/grain; information exchange, receiving inputs.	Sale of rice seed/grain		Not clear	Not clear
SMP	Dissemination of IRVs, Convening meetings, facilitating operations	Participation in demo/coaching activities, Purchases of seeds for SRI activities	Facilitating access to foundation seed; Convening meetings/workshops	Not clear	Facilitating purchases of improved seed varieties; Convening meetings/workshops	Facilitating access to certified seeds, information exchange	Not clear	Not clear	Not clear		Not clear
Cornell University	Not clear	Not clear	Not clear	Not clear	Seeking mentorship/providing technical backstopping on SRI	Not clear	Not clear	Not clear	Not clear	Not clear	

This suggests that SLARI has not interacted with these actors in SRI activities in the way they have with others, such as farmers, community leaders, SLeSCA, SMP, and NGOs. This is possibly due to the fact that the latterly named actors seem to be indispensable to the promotion of agricultural innovations. For instance: SLARI may need the services of SLeSCA for seed certification before the seeds can be accessed by farmers; NGOs may need SLeSCA to help in the dissemination of SRI techniques and to share their experiences with those techniques; while farmers are required to mobilise, test, advise on, and use the SRI techniques.

NGOs (local and international), are also perceived to link with other actors in the innovation system for purposes of information sharing, dissemination, convening, partnering, coaching, reporting, and funding. Given that NGOs, such as World Vision and Concern Worldwide, among others, have been key pioneers of SRI in the country, they have therefore interacted with the vast majority of actors for: disseminating SRI techniques through meetings; coaching farmers and other actors, such as MAFFS staff; partnering and providing funding to other local NGOs, such as MADDAM in Koinadugu District, for intensification of the SRI as a rice cultivation innovation with immense benefits for smallholder farmers in the country.

It can be seen from the foregoing that the majority of actors were perceived by research and extension actors to be interacting with one another for the right purposes, purposes that are essential for a functioning innovation system.

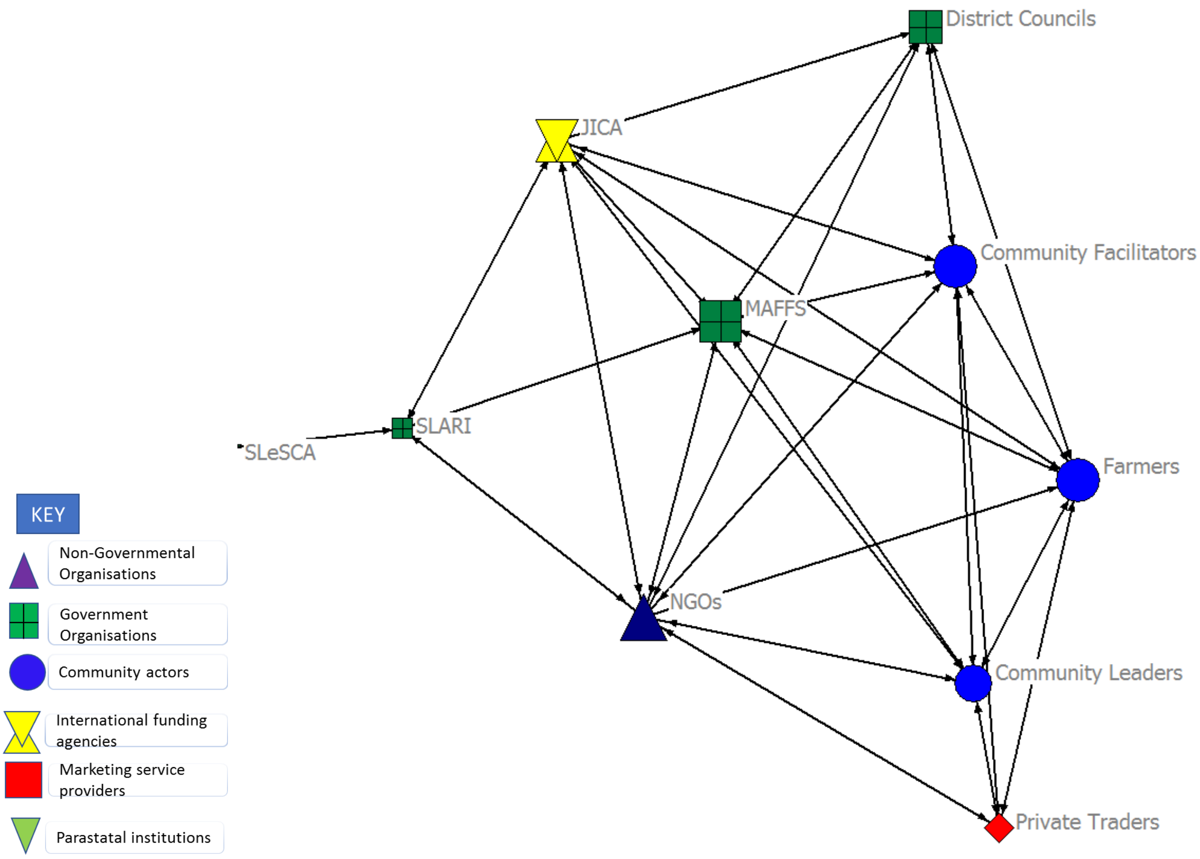
5.3.4 Linkages/Interactions, Strength and Purpose of Linkages among Actors of the Technical Package on Rice (TP-R)

This section presents findings on research and extension actors' perceptions of the key linkages which exist among actors in the TP-R innovation on rice, as well as the perceived strength of these linkages. The purposes for which the actors in the TP-R innovation system interact/link with each other are also presented and interpreted in this section.

5.3.4.1 Linkages/Interactions among actors on Technical Package on Rice Innovation

It can be seen from the sociogram (Figure 5.3) below that the majority of actors identified in the TP-R are interacting with one another, possibly to ensure the functioning of the innovation system on TP-R. Most actors identified in the sociogram are interacting with more than one actor; JICA, MAFFS, NGOs, farmers, and community facilitators are among those with the highest number of interactions/linkages with other actors. Unsurprisingly, JICA, the initiators of the innovation, have interacted with all key actors, except SLeSCA, during the development and promotion of the innovation. However, even though JICA interacted with almost all the actors identified, varying degrees of interaction were reported. For instance, it was reported that JICA interacted more frequently and intensively with MAFFS (at district level), NGOs, SLARI's subsidiary in Rokupr (RARC), and farmers (including facilitators and leaders), than with other actors. This is possibly to promote the visibility of their activities, to share their experiences, and to enhance trials, adoption, dissemination, and use of TP-R. Interestingly, the community facilitators, who were initially trained by JICA, were identified to be interacting with a lot more actors than one would expect. An official from the MAFFS in Kambia District revealed that in addition to their primary function of providing technical guidance to colleague farmers on the TP-R techniques, they now function as focal persons for other actors, such as MAFFS and NGOs working in their communities.

Figure 5.3: Linkages/Interactions among actors in TPR Innovation System (node size: **eigenvector centrality**)



Further, it is interesting to note that private actors were identified as actors in the TP-R, but mainly with farmers (and their collectives) and NGOs (other than JICA). This suggests, to some extent, that the TP-R as an innovation which lacks a marketing component that ensures smallholder farmers access to inputs and opportunities to sell their produce; neither JICA nor

MAFFS were identified to have interactions with private traders who sell inputs to farmers. It also suggests that the interactions between the farmers and traders are not coordinated by research and extension actors promoting the TP-R, rather, it is the farmers' responsibility to identify sources of access to inputs and for the sale of their outputs. An interview with JICA's focal person in Kambia District confirmed that the innovation did not focus on linking farmers to markets, but more on agronomic practices. This also explains why no interaction was identified between private traders and JICA, and MAFFS by respondents, as shown in the sociogram.

Finally, SLeSCA is seen to have interacted only with SLARI. This is possibly due to the fact that SLeSCA work very closely with SLARI and might have been involved in some way with SLARI in the innovation process, for instance in experience sharing during meetings. Unsurprisingly, SLeSCA's role may be limited to seed certification, for which they may be interacting mainly with SLARI.

5.3.4.2: Strength of Linkages among Actors in TP-R Innovation System

The strength of linkages among the actors in the TP-R innovation system seems to reflect the linkages among them. Actors who interact with many other actors in the system seem to exhibit strong to medium level linkages compared to those with fewer interactions. Smallholder farmers, JICA, MAFFS, community facilitators and leaders were perceived to have strong linkages with most of the actors with whom they interact. This suggests the existence of useful linkages which contribute to the effectiveness of the innovation system, they include mentoring, coaching, dissemination, and the use of the techniques contained in the TP-R package. On the other hand, SLeSCA and SLARI top the list for having the highest number of weak linkages with most of the actors (see Table 5.9 below). Apparently, these were identified to have linked/interacted with fewer actors in the system, a possible reason for the perceived weak linkages with the majority of the actors. This depicts the non-existence of a common point of interest between SLARI and SLeSCA with most other actors in the system.

Additionally, private traders were identified to have strong linkages only with farmers and community leaders, while the rest of the actors have either medium or weak linkages with them. This suggests, and possibly confirms, the lack of effort by research and extension actors, in their promotion of the TP-R, to establish linkages between farmers and private traders in a bid to enhance their (smallholder farmers) access to marketing facilities/services.

Table 5.9:Actor Linkage Matrix of Actors in TPR Innovation System

ACTORS	Farmers	SLARI/ RARC	SLeSCA	NGOs (Local and International)	MAFFS	Community Leaders	JICA	Private Traders/ Agro-dealers	District Council	Community Facilitators
Farmers		W	W	S	S	S	S	S	M	S
SLARI/ RARC	W		M	M	S	W	S	W	W	W
SLeSCA	W	M		W	W	W	W	W	W	W
Other NGOs (Local and International)	S	M	W		M	S	M	M	M	S
MAFFS	S	S	W	M		S	S	W	M	S
Community Leaders	S	W	W	S	S		S	S	W	S
JICA	S	S	W	M	S	S		W	W	S
Private Traders/ Agro-dealers	S	W	W	M	W	S	W		W	M
District Council	M	W	W	M	M	W	W	W		W
Community Facilitators	S	W	W	S	S	S	S	M	W	

Key: S – Strong linkage; M – Medium linkage; W – Weak linkage

5.3. 4. 3: Purpose of Linkages/Interactions among Actors in TP-R Innovation System

The purposes of linkages/interactions among actors in the TP-R were identified to further understand the linkage matrix of the actors. Logically, it seems inadequate to identify linkages and their strengths without investigating their purpose, details of which can be seen in Table 5.10 below. While there are common purposes of linkage among some actors, such as convening and participating in coaching, mentoring, and awareness raising sessions, and facilitating access to services and facilities, it is worth noting that differences also exist. For instance, advocacy was associated mainly with community leaders and district councils. This may be connected with ensuring that farmers have a say in the innovation process of the TP-R, and that research and extension actors work in the farmers' best interest as they represent the farmers at community level. Also, funding TP-R activities was most often associated with one of JICA's many reasons for interacting with MAFFS, and with MAFFS interaction with the district councils. It was reported that JICA funded MAFFS at district level to scale up TP-R activities – this was particularly reported in Koinadugu and Kambia Districts. On the other hand, as a KII respondent from MAFFS in the Koinadugu District espoused, the district councils are responsible for disbursing funds from the central government to all line ministries at district level, including MAFFS, following the government's decentralisation policy.

Further, while the purposes for the linkages of most research and extension actors (e.g., MAFFS, JICA, NGOs, SLARI) are mainly to disseminate and facilitate processes, and to mentor and coach, those of farmers (and their collectives) are mainly to receive information and inputs, participate in meetings and coaching sessions, mobilise colleagues, exchange information, consult, and sell/buy inputs/outputs. These activities are geared at contributing to the functioning of the innovation system on the TP-R by the actors.

Table 5.10: Purpose of linkages/interactions among actors on TP-R

ACTORS	Farmers	SLARI/ RARC	Community Leaders	NGOs	MAFFS	Community Facilitators	JICA	District Councils	Private Traders/ Agro-dealers
Farmers		Awareness raising, Mobilization at community level	Advocacy on behalf of farmers, and on land access and use; Awareness raising.	Facilitating access to fertilizers and IRVs, Coaching on TPR techniques, Information exchange	Coaching and mentoring on TPR techniques, Facilitating access to inputs, Registration of FBOs	Facilitating access to technical information on TPR; Coaching and mentoring farmers	Coaching sessions on TPR techniques, Facilitating access to inputs and training; Consultations; Information exchange	Facilitating registration of farmers groups	Facilitate sale/ purchase of inputs; Information sharing on price of inputs/outputs; Facilitating access to loans
SLARI/ RARC	Participation in coaching sessions, receiving advice and inputs		Mobilizing farmers at community level; Information exchange on innovations between farmers and scientists	Dissemination of IRVs, Participation in workshops; Engagement in consultancy services	Information exchange	Not clear	Collaboration in research activities eg soil tests; Information exchange	Not clear	Facilitate purchase of inputs for TPR activities;
Community Leaders	Farm land acquisition; Information on innovations/programs	Raising awareness on innovations; Mobilization of farmers		Collaboration in innovation programs; Recognition of interventions; mobilization of farmers, coaching sessions	Convening meetings, Coaching sessions/meetings; Awareness raising on TPR; Information exchange, Consultations	Meetings; Exchange of information on innovations; Seeking approval and recognition of activities	Creating awareness of activities; Seeking consent and support Convening meetings; Coaching and mentoring	Registration of farmer groups; Convening meetings on agriculture programs	Facilitate access to inputs for TPR activities; Mediation between them and farmers
NGOs	Sale of seeds to NGOs; participation in innovation programs, workshops, trainings, meetings	Provision of research services e.g. soil tests; Workshops; Sale of improved varieties	Collaboration (entry point); Workshops; Meetings; Approval of innovations		Coaching sessions for NGOs on TPR; Monitoring of activities; Information exchange	Partners in innovation; Sources of information; Participate in coaching sessions and meetings; Sharing information on TPR	Experience sharing, Mentoring of TPR techniques, Funding TPR activities	Monitoring of activities; Advocacy on behalf of farmers; Participate in needs assessment;	Facilitating access to inputs; Participation in meetings; workshops; Information exchange

MAFFS	Sale of seeds; participation in innovation programs, workshops, meetings, coachings, consultations; Feedback on innovations	Agricultur e policy formulatio n; Developm ent and release of new rice varieties; Reporting	Collaboration in project implementati on; Participation in needs assessment; Agents of information at community level	Collaboration in project implementati on; Workshops; Funding		Raising awareness, mobilizing farmers, Advocate for farmers and representation , Participation in meetings/wor kshops; Sharing information	Funding TPR activities; Joint monitoring; Coaching staff on TPR techniques	Devolved funding of activities; Monitori ng of activities	Facilitating access to inputs for TPR activities; Participatio n in workshops, meetings
Commun ity Facilitato rs	Seeking information on innovations; participation in trainings and meetings	Not clear	Exchange of information; Meetings; Mobilization of farmers	Partnerships in project implementati on; Training;	Coaching sessions; Mobilizing farmers; information exchange		Conducting coaching sessions; Information exchange; Disseminatio n of TPR techniques; Monitoring; Technical advice	Informati on exchange	Facilitating access to inputs, Information sharing on prices
JICA	Participation in TPR activities – trainings, demos, meetings; Feedback on TPR	Provision of research services eg soil tests; Sale of improved rice varieties;	Participation in project implementati on; Identification of trial sites; mobilization of farmers; Facilitating interaction with farmers	Workshops; Seeking technical information on TPR	Facilitating project start-up;; Geographic al guidance; Convening and participatio n in meetings	Participate in coaching and mentoring sessions; Advocating for farmers, Sharing of information, Disseminatio n of TPR Techniques		Endorse ment of activities; Joint monitorin g of programs ; Advocati ng for farmers	Facilitating access to inputs; Information exchange
District Councils	Registration of groups; Feedback on projects/innovatio ns; Convening meetings	Not clear	Registration of farmer groups; Convening meetings	Raising awareness of activities; Collaborative monitoring and evaluation	Funding purposes; Reporting; Planning of activities; Monitoring and evaluation	Not clear	Collaboration in project monitoring and evaluation; Seeking approval and endorsement of activities		Not clear
Private Traders/ Agro-dealers	Purchase/sale of inputs; Facilitating loan acquisition; Seeking information on prices	Facilitatin g sale of rice seed;	Facilitating sales and purchase of inputs; Facilitating loan recovery	Purchase of inputs – seeds; Convening meetings	Purchase of inputs; Convening meetings, Sharing info on prices of inputs	Facilitate sales of inputs for dealers, information exchange	Facilitate sales of inputs for dealers	Not clear	

5.3.5 Linkages, Strength and Purpose of Linkages among Actors of the Agricultural Business Centers (ABCs)

In this section the linkages, and their strengths and purposes, which exist among the various actors involved in the ABCs, as identified by respondents, are presented and interpreted.

5.3.5.1 Linkages/Interactions among Actors in ABCs

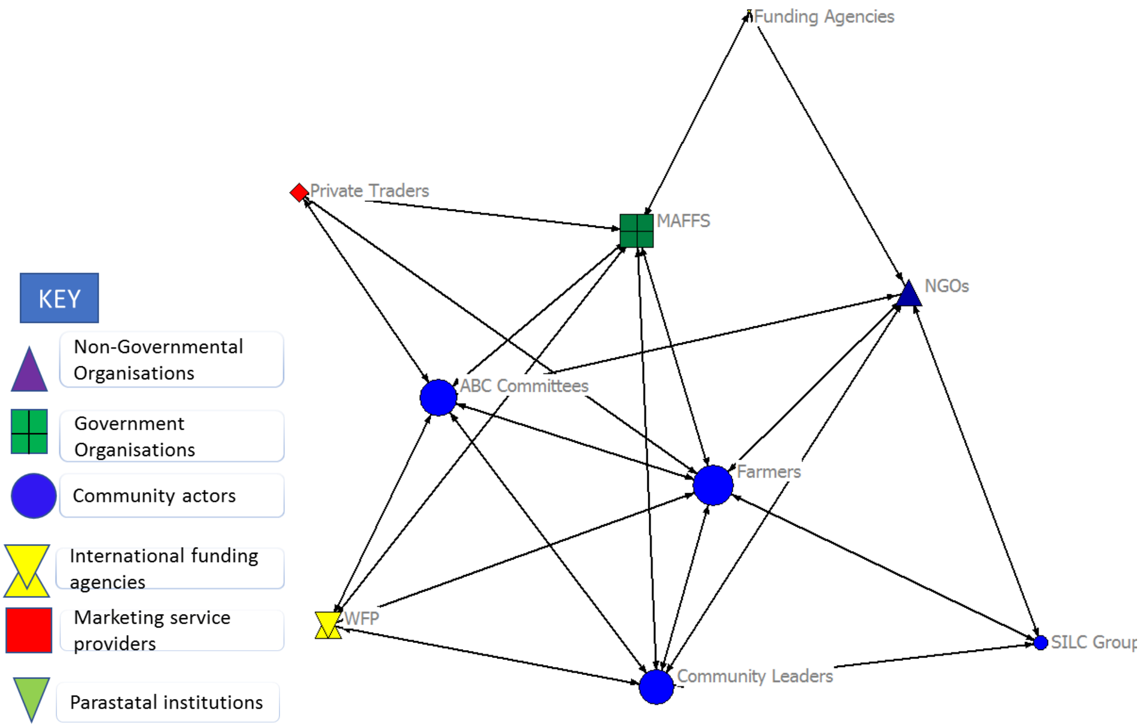
Interestingly, a total of nine (9) actors were identified to be participating in the ABCs as an innovation geared mainly towards ameliorating smallholders' production and post-harvest constraints. These actors include MAFFS, NGOs, private traders, funding agencies/donors, WFP, and farmers and their collectives (including SILC Groups and ABC Committees). The interactions depicted in the sociogram (see Figure 5.3.4) show that actors tend to interact based on their vested interests, therefore some actors interact only with a few other actors, while some interact with many. Funding agencies, for instance, can be seen to interact only with MAFFS and NGOs. This is based on the premise that the latter depends on the former for funding their interventions in the ABCs, and that funding agencies do not normally interact directly with other actors beyond the intermediary institutions involved in research and extension. On the other hand, actors such as MAFFS, NGOs, farmers and their collectives, are shown to interact with many more actors within the system than actors such as WFP and private actors do. This suggests the interdependence of the former (MAFFS, NGOs, and farmers) in agricultural innovation systems and their relevance in the innovation process. Private traders are shown to be interacting mainly with farmers, ABC committees, and MAFFS. This is possibly because private traders transact with ABCs for buying outputs, such as clean rice, and selling inputs, including fertilisers and seeds. MAFFS also interacted with private traders for the initial purchase of start-up kits for all ABCs in the country.

SILC[9] Groups are shown to be interacting with NGOs, community leaders, and farmers. The SILC groups actually constitute farmers who are organised and trained by NGOs so they can generate incomes among themselves in order to solve family and farming problems as the need

[9] SILC – is an acronym meaning Savings and Internal Lending Communities. It is a community level microfinance group established, funded and run by the members themselves. SILC groups were reported to have been promoted by NGOs among members of the ABCs as Self-Help Groups that help farmers mobilise financial resources they could use among themselves, as and when needed. The groups can provide loans among members, they encourage members to save financial resources for a given period of time and then to share the accrued amounts, with any interest, among the members. This is believed to help farmers increase their resilience to financial shocks, as well as maximising their participation in ABC activities, an official from MAFFS disclosed in a KII interview.

arises. This is possibly the reason for the perceived linkages between SILC Groups and these actors. Further, WFP, as one of the main buyers of rice from ABCs, is shown to be interacting with MAFFS and farmers. This is because MAFFS normally plays a role in the identification of the appropriate ABCs for WFP to target for rice purchases and for training about value addition, while the farmers (and their collectives) are the ultimate customers from whom WFP purchases their rice product.

Figure 5.4: Sociogram showing actors in Agricultural Business Centers Innovation System (Node size: eigenvector centrality)



5.3.5.2 Strength of Linkages among Actors in ABC Innovation System

The strength of linkages existing between the various actors participating in the ABC innovation system were identified based on research and extension actors (respondents) perceptions. It can be seen in Table 5.11 that strong linkages were identified to exist between most actors who interact with farmers, except funding agencies and private traders who are perceived to have weak and medium links, respectively. This confirms the proposition that farmers have little, if any, interaction with the funding agencies. The spontaneous and not-so-organised interactions between farmers and private traders might have led to the perceived medium (not strong) linkages between the two. On the other hand, farmers depend on most of these actors for the functioning of the ABCs, including the provision of start-up kits, organisation, and coaching. This also justifies the perceived strong linkages between farmers and most of these actors.

Further, the strength of linkages between MAFFS and most other actors within the ABC system is perceived to be strong, except for that with SILC Groups which is seen to be weak. This is possibly due to the fact that SILC groups are mainly introduced into the ABCs by NGOs, which suggests limited or no interaction between MAFFS and SILC Groups. Similarly, NGOs are perceived to have strong linkages with most other actors in the ABC innovation system, except with WFP and private traders. This cannot be unconnected to the fact that NGOs work independently of these two actors in the ABCs; there has been little, if any, interaction between them. NGOs were reported to have worked in ABCs in areas of capacity building of the farmers (FBOs), such as coaching on SILC activities, and do not seem to need the services of WFP and private traders in their execution of these activities.

Table 5.11: Linkages among actors on Agricultural Business Centers

ACTORS	**Farmers**	**ABC Committee**	**Community Leaders**	**NGOs**	**MAFFS**	**WFP**	**SILC groups**	**Funding Agencies (eg. FAO, IFAD etc)**	**Private traders**
Farmers		S	S	S	S	M	S	W	M
ABC Committee	S		M	M	S	S	W	W	S
Community Leaders	S	M		S	S	S	S	W	W
NGOs	S	M	S		S	W	S	M	W
MAFFS	S	S	S	S		M	W	s	S
WFP	M	S	S	W	M		M	W	W
SILC Groups	S	W	S	S	W	M		W	W
Funding Agencies	W	W	W	M	S	W	W		W
Private Traders	M	S	W	W	S	W	W	W	

5.3.5.3 Purpose of Linkages among Actors on Agricultural Business Centers

The purpose of linkages among actors vary across actors (see **Error! Reference source not found.**). While some actors are perceived to mainly link with others for purposes of coaching, mentoring, funding, monitoring, advising, and coordinating, e.g., MAFFS, NGOs, and funding agencies, some interact for related, but different, purposes. For instance, farmers are perceived to interact with most other actors for purposes which include: facilitating the exchange of information; accessing processing and marketing services provided by the ABCs; raising awareness; and mobilising colleague farmers at community level. Additionally, farmers were identified as participating in meetings and coaching sessions convened by other actors geared towards enhancing the smooth functioning of the system in the ABCs, as well as disseminating information among ABC stakeholders. Further, ABC committee members, who are mainly charged with the responsibility of ensuring the smooth day-to-day running of the ABCs, were identified as interacting for purposes which include mediating among members, sharing information among members on ABC operations, and facilitating the raising of funds among members, possibly by fostering the continuity of SILC activities.

Table 5.12:Purpose of Linkages among Actors on ABCs

ACTORS	Farmers	ABC Committees	Community Leaders	NGOs	MAFFS	WFP	SILC Groups	Funding Agencies (DFID, FAO, ADB, IFAD, etc)
Farmers		Convening meetings/coaching sessions; Facilitating access to post-harvest facilities; Mediation; Facilitate marketing; Agro-information services exchange	Mobilization; Passing on information/ messages; Mediation	Facilitate access to input support, Convening meetings and coaching sessions on use of machinery and governance of ABC	Coaching sessions; Formation of farmer groups; Monitoring of ABC activities	Facilitating purchases; Support with rice packaging; Information exchange	Loans; Dissemination of information about the ABC	Not clear
ABC Committee	Facilitating continuity of activities eg processing, marketing of input/outputs; Information exchange		Governance of ABCs; Convening meetings	Funding; Facilitate access to input support; Convening meetings and coaching sessions on use of machinery and governance of ABC	Funding; coaching and mentoring; Monitoring; Facilitate marketing produce from ABC members	Facilitating purchase of milled rice; Provision of packaging materials; information exchange	Not clear	Not clear

Community Leaders	Participation in meetings and awareness raising activities; Sharing information	Convening meetings; Information sharing on ABC operations		Collaboration (entry point); Raising awareness; Coaching sessions; information exchange	Coaching and mentoring opportunities; information exchange; Raising awareness	Mobilization of ABC farmers/committees	Mediation; Facilitating the settling of group dynamics	Not clear
NGOs	Participation in coaching sessions eg use of machinery in ABC, leadership etc; Facilitating sale of outputs in ABCs; Information exchange;	Promoting marketing activities of ABC; Participation in innovation programs; Providing information; Mediation	Facilitating access to farmers; Mobilization of farmers; Awareness raising; Participation in meetings, workshops and coaching sessions; Sharing of community level information		Monitoring; Funding; Collaboration in project implementation; Provision of technical advice; Coordination of activities	Partnerships in rice purchases, information exchange	Seeking technical advice and support; reporting; Participation in meetings and coaching sessions; sharing of information	Funding of programmes; Monitoring
MAFFS	Participation in meetings; Registration of Farmer Groups; Seeking technical advice	Funding opportunities; Reporting; Participation in meetings, workshops and coaching sessions; Facilitating sale of inputs/seeds; Information exchange;	Facilitating access to farmers; Mobilization of farmers; Awareness raising; Participation in meetings, workshops and coaching sessions; Sharing of community level information; Advocating for farmers	Funding; Reporting; Experience sharing		Collaboration in coaching sessions with ABC members; information exchange; Seeking approval; Reporting of activities	Facilitating sale of seeds; Information sharing; participation in meetings	Funding of programmes; Monitoring
WFP	Facilitating marketing of outputs; Attending coaching sessions on rice processing/value addition	Facilitating the purchase/sale of milled rice; Participation in coaching sessions	Coordinating marketing of milled rice; Sharing of information; Raising awareness	Not clear	Facilitating interface with ABCs		Facilitating the purchase/sale of milled rice; Participation in coaching sessions	Not clear
SILC Groups	Facilitating loans availability for members; Seeking funds/loans	Information exchange; Raising funds	Mediation among members	Coaching sessions, Funding of activities	Coaching sessions; Provision of improved seed varieties	Facilitate the buying of rice from members; Conducting coaching sessions on value addition		Not clear
Funding Agencies	Information exchange on ABC innovation	Not clear	Not clear	Seeking funding opportunities; Reporting	Seeking funding opportunities; Reporting on progress;	Not clear	Not clear	

5.4 Factors Constraining the Effectiveness of the Innovation System on Rice in Sierra Leone

5.4.1 Introduction

This section provides findings on the key factors which constrain the effectiveness of the innovation system on rice in the country from a research and extension perspective. These were studied after Schut et al., (2014) whose framework also informed the formulation of that adapted for this study. These factors, which are usually seen as structural conditions affecting the functioning of the innovation system (Schut et al., 2014; Turner et al., 2016), have been grouped into the following categories: infrastructural; institutional; collaboration and interaction; and, capabilities and resources. However, another category – natural – which does not seem to fit in any of the aforementioned categories, emerged during the study. A wide variety of constraints were identified under each category which research and extension actors perceive to be limiting their effectiveness in carrying out their functions, and hence, limiting the effectiveness of the innovation system with respect to the various rice innovations that have been promoted in the country within the time frame of the study.

As in the previous section, data were generated through workshops, KIIs, document review, observations, and questionnaires, and targeted research scientists from SLARI/RARC and extension personnel from MAFFS and NGOs implementing programmes on agriculture. The following sub-sections present and interpret findings from the study through these tools/methods.

5.4.2 Capabilities and Resources Factors

These were identified as one of the key factors limiting the effectiveness of the innovation system from a research and extension perspective (see appendix 1.10). In this study, this was sub-divided into financial and human resources to better understand the limiting influences of each.

5.4.2.1 Human Capacity/Resources:

The human resource base and capacity of innovation actors in Sierra Leone are perceived to be mired with many deficiencies and bottlenecks that are playing no small role in thwarting the effectiveness of the innovation system in the country. For an innovation system to be effective, it requires a sound human resource base with the requisite capacities to understand, decide, and take action, as the case may be, on innovation processes. However, this study finds that factors such as limited and ageing staff, particularly regarding MAFFS officials, poor training/mentoring opportunities for staff, illiteracy among the vast majority of farmers, and labour constraints at community level, are key human resource issues that are affecting not only the research and extension actors, but also the farmers. Respondents espoused during the workshops and KIIs that most staff involved in extension, particularly those from MAFFS, are normally overstretched and staff members have too many farmer groups each, thus making it a challenge to engage with them effectively. The high prevalence of ageing staff, beyond retirement age of 60, still serving in “field” positions, is a major impediment as some are too weak to frequently conduct field work and engage with farmers as required. Further, the lack of training/mentoring opportunities which enable staff to keep up-to-date with innovations and standard practices were reported to be a constraint in the majority of research and extension institutions, thereby affecting staff capacity and effectiveness. The District Agriculture Officer, Kambia District, said in a KII:

“…we are constrained by lack of extension personnel for field activities. Right now, we have only 22 farmer groups[10] in the district because we lack the staff and logistics to target all the farmers. My extension staff are overwhelmed as each has to be dealing with up to 4-5 farmers’ groups, when the ideal is 2-3 for proper engagement…”

Further, respondents identified that the farmers’ low level of literacy affects their continued dependency on external actors for hand-outs, irrespective of efforts to move away from this dependency perspective, as well as their level of participation and use of external innovations which could positively impact their levels of productivity. The lack of labour at community level was also reported, particularly because a) migration into bigger towns and cities is playing a role, and b) some agricultural innovations require additional labour and an able-bodied work force for their use.

5.4.2.2 Financial Resources

Financial resources are considered key to enhancing innovation. Research and extension actors, for instance, need financial resources to initiate innovations, coaching, mentoring, disseminating, and engaging with other actors. Financial resources were reported to affect both research and extension actors as well as farmers. Almost all research and extension respondents expressed a limitation of funding sources for the initiation and implementation of innovation programmes, as well as for their engagement with other actors. KIIs with research and

[10] Each farmer group comprises 25-30 members at community level. These, according to the DAO, are what are now called Farmer Based Organisations (FBOs).

extension actors in MAFFS and NGOs, revealed that, in cases where funding opportunities are available, the mode of use of the funds is often defined by the funding agency, and that recipients' institutions can do little to bring in components which may enhance a functioning innovation system in the long term. Therefore, engaging many more actors in an agricultural innovation programme is often constrained by the limited resources at the actors' disposal. Respondents reported that there are a small number of donor agencies funding agricultural programmes in Sierra Leone. Most of the key donors, such as World Bank, IDB, ADB, and FAO, hardly fund NGOs, if at all, as their funds are normally provided for MAFFS and this makes it difficult for other players to access funds. On the other hand, MAFFS officials disclosed a major limitation of the decentralisation policy, which includes the devolvement of funds to the district councils, through which line Ministries in the districts can access funds for programme implementation. This was reported to constrain innovation programmes from MAFFS as councils hugely delay the disbursement of these funds to MAFFS. In an interview with the District Agriculture Officer, Koinadugu District, she said:

> "*The council is slow in the disbursement of funds. For instance, up till now the first quarter funds are not disbursed yet and the last month in the quarter is almost ending… you see. This is the one of the biggest problems we have been facing since funding to ministries was devolved to council…" (Interviewed March 10, 2017)*

Local NGO personnel interviewed across the study districts expressed a similar constraint of late disbursement of funds by their donors, who are mostly INGOs, thus limiting programme implementation.

Based on their experience and interaction with farmers, research and extension actors reported factors they perceived to be limiting farmers' innovations and participation in external innovation programmes. These included lack of farmer-friendly loans[11]/credit facilities and, where they do exist, high interest rates. Also, farmers perceived high cost of inputs (e.g., improved seeds and fertilisers), and services (e.g., transportation and milling), and this was seen by research and extension staff to be influencing farmers' openness to, and use of, external innovations, and subsequently, the innovation system in general. Respondents espoused that most smallholder farmers in rural communities lack access to favourable credit facilities, and therefore they find it difficult to access resources and services needed to augment their

[11] Farmer-friendly loans were defined by participants as those loans whose mode of repayment recognise farmers farming calendar such that repayments are tailored to coincide with harvesting periods and not on a weekly or monthly basis, as is the case with most conventional credit institutions.

participation and engagement in innovative activities. Most formal credit facilities in the country are designed for petty traders who earn money on a daily basis and can, therefore, repay loans weekly or monthly. Smallholder farmers are, therefore, left with limited options to obtain credit, or they fall at the mercy of local money lenders, where they exist, who exploitatively provide loans at exorbitant interest rates. A KII respondent in Tonkolili District noted that the lack of favourable financial services has largely contributed to the vicious cycle of poverty among farmers as some are continuously trapped within the nets of local money lenders who perpetually exploit them.

5.4.3 Infrastructural Factors

Infrastructural constraints were among the most commonly reported among respondents. The initiation of innovations and effective dissemination and use are largely influenced by the presence or absence of required infrastructure. The following infrastructural constraints were identified by research and extension actors to be limiting their, and farmers', effectiveness in innovation processes in the country.

5.4.3.1 Communication:

Communication among research and extension actors was identified as one of the key factors to limit the effectiveness of research and extension actors' interaction among themselves, and with other actors in the innovation processes. Communication among actors is perceived to be ineffective due to the poor ICT network in the country, vis-à-vis limited and costly internet facilities, and poor and untimely communication from supervisors at national level[12]. This communication constraint was mainly reported by research and extension actors in the public sector, i.e., MAFFS and SLARI. When asked to highlight some the key constraints he perceived to affect innovation in the country, the District Agricultural Extension Officer in Koinadugu, said, among other things:

> "…*We do not have access to internet facility in the district offices...but interestingly our Directors in Freetown want us to email reports. Even this laptop computer I am using here is mine. I want to send reports or email anything to someone, I have to personally subscribe to Airtel, which is very expensive. So you tell me my brother, how you can network with other agencies or exchange information when even within your organisation it is difficult…"*

The lack of internet facilities in district offices of MAFFS and SLARI is believed to be

[12] This was reported mainly by MAFFS officials at district level

limiting the information exchange and reporting, particularly between field staff and those at national level, thus contributing to a less effective innovation system as actors either miss out on important activities or decisions that require approval, or these are delayed until such a time that they have little, or none, of the desired impact.

Box 5.3: Observation on constraints to communication

During the workshops in Rokupr and on other times I have been there, I noticed that staff of the Rokupr Agriculture Research Center (RARC) can only access internet facilities from a central location – the conference room. Not a single staff member of the research center has internet connectivity in their offices – not even the Director. Any access to internet facilities by staff outside the conference room is personally funded. Every staff member has to come down to the conference room to check emails and surf the web. An interview with the Deputy Director of the Center disclosed that the funds they receive from central government for the running of the Center is grossly inadequate, therefore, they cannot afford to provide internet facilities to staff offices, not even for senior members of staff. He commented 'This is really affecting our work as researchers who really need the internet for many purposes'.

Similarly, district level offices of the MAFFS lack access to connections. In all the four district offices I have been to, only the District Agricultural Officer (normally known as the District Directors) have an internet modem and these are considered to be very slow and expensive to run. In Koinadugu District, most senior management staff of the MAFFS can use the internet in the offices of NGOs. For example, I waited for about an hour at the District Agricultural Extension's office in Koinadugu, while he was trying to send an email at CRS – one of the INGOs operating in the district.

Additionally, the lack of software was also reported by scientists at RARC, particularly by members of the socio-economic department, as a serious constraint. The head of the division disclosed that they only have a licence for SPSS, despite the fact that they have expertise in other software, such as STATA and Eviews. Therefore, they find it challenging to analyse data, particularly those scientists who are not familiar with the use of SPSS. He reported that "this has therefore been affecting our ability to communicate or share important information emerging from findings on some studies conducted by the centre with our partners and other senior management colleagues".

5.4.3.2 Mobility:

Movement of people and goods is important for the smooth running of any social system. For innovation actors to be effective, there should be a corresponding effectiveness in their mobility. This study found that the vast majority of research and extension actors are constrained in terms of mobility. Poor road networks linking rural communities and the lack of vehicles to convey them to their areas of operations are the key constraints identified which impact the effectiveness of their interactions with other actors, such as farmers. The road conditions in most communities are reported to be so terrible that even accessing public transport to most communities is a challenge. Along with ministry officials, the vast majority of field staff, such as the block and frontline extension workers, do not have access to any official form of transport. In a KII interview with a FEW in Port Loko District, he said,

"*My work is slowed down by the lack of a means of transportation. I have to ride a bicycle to communities where I work. And this is not really easy for me. It's not easy for me to go to some communities riding a bicycle, so I normally go to those close to my duty station".*

Similarly, a FEW in Tonkolili District, fortunate to have an aged motorbike, revealed that he is responsible for its maintenance, including repairs and fuel, which makes it difficult for him to carry out his activities. He added that, given the bad road conditions, wear and tear on the motorbike is high, therefore, maintaining a motor for a low-salaried FEW is a big problem. This trend was found to be common among MAFFS and SLARI staff. Even mid-level management staff, such as agricultural officers who own motorbikes, are responsible for their maintenance, repairs, and fuel. This increases the burden on their perceived meagre salaries and their ability to deliver their services effectively.

However, the situation is completely different within NGOs. While most NGO staff, particularly those in Koinadugu District, reported on the challenges of the road network, the lack of vehicles was not largely reported. The majority indicated they have no problems with movement as they are provided with vehicles which are also maintained by their organisations. The only constraint which they perceived to affect their work in some way was noted to be the delay in repairs and provision of fuel in some cases. In fact, this was further confirmed in an interview with the Director of GbonFA, a local NGO in Tonkolili district, who disclosed that they face a huge burden of having to transport MAFFS personnel each time they need their technical services in the field, such as for advice on swamp development and for their monitoring activities.

5.4.3.3 Market facilities/services:

Markets are considered important to the enhancement of the effectiveness of agricultural innovations. Research and extension actors identified a number of market-related factors that are limiting the effectiveness of innovations in the country. Key among the factors identified included the lack of markets for improved seeds, agro-chemicals, fertilisers, farm outputs, market information for farmers, and the lack of private sector dealers of agro-inputs. Farmers, as well as research and extension actors, are constrained by the lack of market facilities and services, particularly in remote communities where the majority of farmers live. According to research and extension actors, private sector dealers of agro-inputs are few and far between, and this makes access to improved inputs very difficult and, where they exist, very costly. It also makes it difficult for farmers to sell their rice products after harvest. It was reported that most agro-input dealers are predominantly based in district headquarter towns where it is impossible for farmers at community level to access them.

5.4.3.4 Tools/Materials:

The lack of improved tools and materials was identified by research and extension actors as one of the infrastructural constraints which limits the effectiveness of the innovation system for both research and extension actors and farmers. Key among the issues are: the lack of spare parts for machinery; inadequate/lack of post-harvest facilities; farmers over dependence on manual labour; and the lack of packaging materials for value addition on rice. The lack of spare parts for machinery was closely linked with those ABCs equipped with power tillers, rice mills, and other technologies. Respondents claim that spare parts for this equipment are scarce due to the low numbers of vendors in the country, and this makes it difficult for farmers and extension actors to access them. This has been affecting innovations, such as the ABCs, as any breakdown of machinery normally results in a halt in the provision of ploughing and milling services from most ABCs. It was further disclosed, for example, that even private service providers who own rice mills face difficulties accessing spare parts in their districts. They have to go to either Freetown or Guinea in search of them, and this is a disincentive for them to provide services in the innovation system. Similarly, the lack of packaging materials, such as durable plastic bags, to boost the value addition drive of ABCs was also reported.

Further, the unavailability of machinery for production and post-harvest practices across the country is viewed by research and extension actors as an important factor which constrains farmers' use of external innovations, and also their ability to innovate. The majority of smallholder farmers still depend on the use of crude tools, such as cutlasses and hoes, and manual post-harvest practices, including rice milling and threshing. This is seen to affect their ability to use external innovations, such as the SRI and TP-R, which may require them to develop swamp areas when they lack the appropriate tools to do so, clearly this is seen to be challenging. Also, one respondent said that because farmers depend on crude tools they often find it difficult to engage in large scale agricultural production, and this increases their risk averseness to trying innovations promoted by research and extension actors.

5.4.3.5 Soil Conditions:

Research and extension actors view soil resources as one of the factors which impedes their interactions with farmers, and hence the effectiveness of the innovation system. The factors identified here included poor soil fertility, rapid depletion of soils, and the lack of developed swamps in the country. Poor soil fertility is perceived as a disincentive to farmers' engagement in agricultural innovation programmes. This is based on the premise that farmers find it difficult to realise high yields without the burden of having to buy huge amounts of chemical fertilisers to boost productivity in situations where the fertility levels of the soils are poor. This has been seen to discourage farmers from trying innovations, such as new rice varieties which cannot do well in depleted soils without the addition of fertilisers. Further, the lack of developed swamps was reported by respondents as a key impediment to their innovation activities with farmers. Two of the key innovations they have been promoting, TP-R and SRI, require developed swamps as one of the practices for success. One of the respondents reported during the presentations in the workshops in Freetown that given that this is an expensive activity, the majority of smallholder farmers cannot try these innovations beyond the demonstration stage. The lack of developed swamps is also seen to add to the financial burden on research and extension actors who promote innovations that require this activity as they have to buy the appropriate tools and labour.

5.4.4 Interaction and Collaboration Factors

Research and extension actions identified a wide variety of factors affecting actors' interactions and collaboration, and subsequently, the effectiveness of the innovation system on rice. Actors' ability and willingness to interact and collaborate is vital for the functioning and effectiveness of innovation processes, and for the system in its entirety. The key factors influencing the interaction and collaboration of actors, as identified by respondents, included: the unwillingness of farmers to work as a group; the lack of trust among actors; poor partnerships between international and local NGOs; poor coordination of the agricultural activities of the various stakeholders; poor cooperation of farmers in innovation programmes; and elite capture at community level.

It is reported that research and extension actors face a myriad of problems in getting farmers to work as group, an approach deemed appropriate for the effective learning and sharing of knowledge and experiences among themselves and research and extension actors. Getting farmers to meetings during the initial stages of an innovation programme is not normally a problem, but getting them to participate in group work (such as demo plot establishment) or in group marketing, as just two examples, is a problem (KII-KAD-ExtM; KII-KOD-ExtN). A respondent in Kambia disclosed that farmers tend to prioritise their individual activities over group activities, and that this is a major challenge in attempts to promote an innovation at community level. It is perceived to limit the farmers' ability to learn from each other and from external innovations. This was somewhat linked to farmers' lack of trust among themselves, and also in some external innovations from external actors. A field officer for MADAM, an NGO in Koinadugu, mentioned that farmers' faith in the innovation being promoted, and in the leaders of their groups, affected their willingness to participate in the group activities. He further said:

"When we were demonstrating SRI techniques, we experienced some attrition of members during the planting stage as seedlings were planted singly. Some farmers withdrew from participating saying we are wasting their time. They think it is not possible for one seedling to survive. Only a few remained till the end of the season. And this was a common problem across all our groups…"

This suggests that farmers risk averseness can limit their participation in group activities, and hence in innovation activities. Another interaction and collaboration factor which limits the effectiveness of innovations, identified mainly by extension actors, is the poor partnerships between local and international NGOs. Local NGOs are normally formed at district level, and usually by indigenes of the district who not only have first-hand knowledge of the district and normally feel better placed to promote innovations at community level, but who also perceive their partnerships with INGOs to be useful for the innovativeness and effectiveness of both. Moreover, it was discovered, in this the study, that most of these NGOs depend on either INGOs operating in the country or on MAFFS for funds to sustain their existence and their programmes. However, it was reported by most local NGO officials interviewed that most of the local NGOs face difficulties partnering with the INGOs for programme implementation due to the latter's reluctance to fund the former. In a KII with the Director of CIFD-SL, a local NGO based in Port Loko District, he said:

"*Unwillingness of INGOs to partner with local NGOs is one of our major constraints. SLANGO*[13] *stipulates that INGOs collaborate with local NGOs for project implementation, but 80% of them do not. This is the reason why some of their projects are unsustainable because once the project ends, there is nobody on the ground to monitor and ensure continuity. Most of them prefer direct implementation…*"

This was confirmed across all districts by local NGO personnel interviewed. For example, the Director of ABC Development, a local NGO in Kambia District, mentioned that they currently, i.e., at the time of the interview in 20X, have only one small project funded by ActionAid, and that is not enough to meet their running costs as an organisation.

Further, the poor coordination of agricultural activities among research and extension actors is one of the constraints which limits the effectiveness of the innovation system on rice. Participants in both workshops disclosed that the activities of stakeholders, particularly those of NGOs, are poorly coordinated, such that there has been duplication of efforts in most communities. Most communities were reported to host much more engagement with NGOs (local and international) than with others. The study finds that most NGOs have been poorly coordinated to the extent that the communities in dire need of engagement with research and extension actors are normally overlooked, while others receive help from more than one NGO carrying out almost the same interventions at the same time. Also, MAFFS, which is primarily responsible for coordinating activities of research and extension actors, reported facing difficulties in getting NGOs to attend meetings and report their activities. However, in a KII with the Programme Manager, CRS, he opined that MAFFS is not doing much to ensure the NGOs comply with their policies as the punitive measures are weak and hardly enforced. This suggests the pervasive nature of this constraint if the mode of operation within MAFFS remains the same. The study, however, notes that this coordination constraint was prominently focused among NGOs and between NGOs and MAFFS. There was no mention of NGOs' coordination with research actors, which the researcher believes to also be weak, where it exists.

Finally, elite capture was one the factors noted by one interviewee, the District Agriculture Extension Officer, Port Loko District. She indicated that some communities face difficulties participating in external innovation programmes due to the attitude of one or two members who always want to dictate the *modus operandi* of the group. These are normally people viewed to

[13] SLANGO means Sierra Leone Association of NGOs. It is one of the regulators of NGO activities in the country. It is, therefore, a requirement that all NGOs register with them and report their activities to them on a monthly basis.

be better off in the community, who may be a bit more enlightened than the rest, and who others in the community cannot challenge on any issue. The resultant effect is the attrition of group members who are not in favour of these elites' views or decisions, she noted. This is one way by which interactions at community level are constrained, and thereby limit the effectiveness of innovations, particularly those promoted by research and extension actors. This also constrains farmers' abilities to share experiences and skills within their communities.

5.4.5 Institutional Factors

The key institutional factors to impact the effectiveness of the innovation system are diverse, though the majority are hinged on policy issues, particularly from the public sector who are perceived to be the key regulators of the agriculture sector. The study found the following as key factors identified by respondents during the workshops and across the four target districts: ineffective/lack of policies on decentralisation, land tenure, salaries, honorarium, and pricing of agricultural produce; divergent organisational interests/objectives, poor monitoring and evaluation structures; and bureaucracy.

Institutional policies, or the lack of them, were identified by respondents as one the factors limiting the effectiveness of the innovation system as it affects the activities of research and extension actors as well as farmers. The decentralisation policy of the government dictates that funds are devolved to local councils at district level, but this policy was viewed as ineffective by respondents from MAFFS across the study area as the councils have not been able to maintain the timely disbursement of funds for innovation activities in the districts. Policies on salaries and honoraria for MAFFS officials were reported to be a demotivating factor for research and extension actors' effectiveness and their engagement with other actors. For example, the majority of respondents indicated that the salary structure in their institutions, particularly MAFFS and SLARI, is very low, and sometimes salaries are paid late. This demotivates them and weakens their effectiveness in the execution of their activities. This, according to respondents, is also responsible for the high turnover of staff in MAFFS as they leave for employment with other agencies or sectors. On the other hand, honoraria for public officials, including MAFFS and SLARI staff in the agriculture sector, were also perceived by NGO actors as being too high and making it difficult for NGOs to engage with the public sector staff whose expertise they normally need in their innovation processes.

Other policy issues identified by respondents across the study districts are the land tenure system and the pricing of agricultural produce. The policies on the land tenure system in rural areas were reported to contribute to 'watering down' the innovative efforts of potential farmers. The study found that lands in rural communities are mostly communally or familially owned , meaning there are restrictions on who works on the land, what they do with it, and for how long. In most cases, people who have the capital and willingness to take innovation risks do not have access to land and are often restricted by those who have. This is viewed by respondents as a deterrent to innovation processes at community level. Also, the lack of pricing policies for agricultural produce is viewed to directly affect smallholder farmers' incomes and their ability to engage in extensive agricultural innovation processes. The study found no policies or initiatives which seek to address these problems faced by farmers. Thus, as an NGO official in Tonkolili District noted, smallholder farmers are left at the mercy of the traders to determine prices, and so the farmers do not realise much from their farming activities.

Further, differences in organisational objectives and interests were identified as key policy factors limiting the engagement of actors with one another. This was more prominent among NGOs, particularly between international and local NGOs. Local NGOs find it difficult to collaborate or partner with their international counterparts due to differing objectives/interests. This is so if, for example, one actor's interests lie in livestock development, while the other's interest is in rice production. In this situation, it is difficult for those actors to partner or fund the activities of the other. Also, if one actor's operations, or mandate, is on a particular district or region, collaborating with others in another district or region is not feasible. A local NGO official from CAWEC, based in Kambia District, when presenting to a workshop on behalf of his group, cited an example of how they approached an INGO, Welt Hunger Hilfe, whose priorities lie mainly on cash crops, for funding. The country representative of the latter was quite forthright when he rightly pointed out that they are not doing anything on rice and that their operations are focused on the south and east, not the north of Sierra Leone. This was just one of the many similar problems faced by a variety of actors across the country.

Another institutional factor limiting the effectiveness of innovation processes, as identified by respondents, is the lack of monitoring and evaluation structures. This was mainly reported by MAFFS officials. For example, in an interview with the District Agricultural Extension Officer in Tonkolili, he said:

"I think the M&E needs to be intensified by MAFFS. As it is now, our supervisors at national level hardly even to come to the field to see what's going on, and if they do, it is normally limited to the district office, not field level. So, if only one is not honest with what they do, you can write reports on activities that are not happening…"

This suggests that the Monitoring & Evaluation structures, particularly at MAFFS, need to be revisited and made robust to ensure that innovation processes at field level are conducted in a favourable and useful manner to all stakeholders, including the ultimate beneficiaries, the smallholder farmers. However, this constraint was more specific with MAFFS personnel. NGO officials interviewed indicated the strong existence of M&E structures in their agencies. This may be due to NGOs being accountable to their donors in order to enhance their funding opportunities.

Additionally, bureaucracy emerged strongly as one of the policy factors to limit the effectiveness of innovation processes in the country. Respondents across the study area disclosed that bureaucracy in organisations limits interaction between actors and decision making processes, e.g., interaction between government and non-government actors, and internal decision making processes within organisations. MAFFS, for instance, was cited as a very clear example where extension actors in the field faced difficulties making decisions without the approval of their superiors, including the directors of the respective units, the Chief Agriculture Officer, and the Minister, as the case may be. Trying to get approval, or disapproval, for their decisions takes a very long time and contributes to slowing innovation processes at field level. At inter-agency level, bureaucracy within organisations was reported to have slowed collaboration and partnership between organisations. For instance, an NGO official mentioned that it is extremely difficult to meet with public officials in MAFFS and SLARI, or to get information from them. It may be necessary to visit several times simply to book an appointment for a meeting with, for example, the Chief Agricultural Officer, and can be even worse for a meeting with the Minister. The same is also reported in some NGOs, particularly between INGOs and their local counterparts; meeting senior management personnel in the majority of INGOs is extremely difficult, as it does require appointments beforehand, but at times being turned down on the day of the appointment. All of these support the proposition that bureaucracy affects interactions among actors in the country, and subsequently the effectiveness of innovation processes.

Other issues related to policies, and raised by some respondents as they perceived them to impede the effectiveness of innovation processes, included the lack of policies on climate information for research and extension actors and farmers, e.g., there are no early warning systems in the country, and the non-adherence to a farming calendar by research and extension actors.

5.4.6 Natural Factors

The study found a number of factors that the researcher has classified as natural factors which constrain the innovation processes. These are considered as such because they seem to be beyond human regulation and control. The key factors in this area are climate related and were identified in the workshops, and in some of the KIIs, to include heavy rainfall and disasters, inconsistency of rainfall, and increases in temperatures. Heavy and/or inconsistent rainfall at the start and end of the rains, for instance, were reported to affect the farmers' calendars and the normal initiation of innovation activities on rice by actors at community level. This also contributed to farmers' low participation in innovation programmes on rice, such as trying new rice varieties or trying new methods of farming, because they do not want to deal with "double" risks – that of climate and the innovation itself. Respondents disclosed that heavy rainfall interrupts trials and any subsequent use/adoption of rice technologies by the farmers. In an interview with the field officer from Concern Worldwide in Tonkolili, he said:

"…*demonstrating SRI techniques does not need high rainfall because incidences of high rainfall after transplanting seedlings will cause the loss of the seedlings. This may discourage participating farmers and contribute to farmers discrediting the innovation. But this is normally hard for us to prevent, we usually try to make farmers understand that*…"

These climatic factors are, therefore, considered by research and extension actors as key constraints; they interrupt the start, and impact the results, of their innovation activities on rice, and thereby their potential benefits or usefulness to farmers are blurred. The likely overall effect is farmers' non-use, or lack of appreciation, of innovations that would otherwise benefit them immensely. It is on this basis that the researcher believes it prudent to include natural causes as one of the factors which constrain innovation processes in Sierra Leone, and maybe even beyond.

5.5 Summary of Findings

This chapter addresses the first objective of the study, which is to describe the innovation system on rice in Sierra Leone by exploring perspectives of research and extension professionals. It specifically seeks to identify and analyse: the key rice innovations promoted by research and extension actors in the past ten years (2005-15) and their perceived benefits to smallholder farmers; the key actors involved in the promotion/development of these innovations and their roles; the key linkages which exist among these actors; and the factors which constrain the effectiveness of the innovation system on rice in the country.

Consistent with the above, the key rice innovations identified as being promoted by research and extension actors within the target period include: IRVs, mainly of NERICA and Rok series; SRI; TP-R; ABCs; PHCs; and, PICS Bags. However, this study focussed on the first four innovations due to reasons highlighted earlier. The subsequent findings are, therefore, focused on these four innovations. The key benefits that motivated the promotion of these innovations to farmers include: increasing farmers' yield/productivity and incomes; improving farmers' livelihoods, food security, and access to seeds; reducing post-harvest losses; improving farmers access to markets; enhancing adaptation to climate change; reducing drudgery associated with crude tools; and enhancing value addition on rice production and marketing.

With respect to the key actors involved in the development and promotion of the key rice innovations, and their roles, the study found that irrespective of the many actors mentioned, only a few emerged as having a major stake in the promotion of these innovations. These include: MAFFS; NGOs, both local and international; SLARI; and the farmers. The roles of these actors range from: providing funds for innovation programmes and research services; sharing information and ideas; monitoring, supervising, and participating in field trials/demos; and, technical backstopping, among others. Further details on each of the innovations are presented below.

Findings showed that differences exist in the interactions/linkages among and between actors in the innovation process of each innovation – some actors interact more often than others. This translated into weak linkages between certain actors, while medium and strong linkages exist among others. In almost all the innovations promoted, MAFFS, NGOs, and farmers (and their collectives) emerged as the key actors as they interact more strongly among themselves than they each interact with the other actors identified in each of the key innovations studied.

Finally, the effectiveness of the innovation system on rice was found to be constrained by several factors, characterised as:

a) capabilities and resources (human and financial) factors, such as: illiteracy of smallholder farmers; poor training/mentoring of staff; lack of credit facilities; limited and aging staff; lack of funding opportunities; high cost of technologies; late disbursement of funds by district councils and donors, etc;

b) infrastructural factors, such as: poor communication facilities; lack of access to markets; poor mobile facilities for staff, particularly at MAFFS and SLARI; lack of appropriate tools, etc;

c) interactions and collaboration factors, such as: lack of trust among members; unwillingness of farmers to work as a group; poor or non-existent partnerships; poor coordination of activities among actors, etc;

d) institutional factors, such as: poor decentralisation policy; high level of bureaucracy in public institutions; poor land tenure system; poor salary/remuneration policies; poor M&E structures, particularly at MAFFS; lack of, or poor, pricing policies for agricultural commodities, etc;

e) natural factors, such as: changes in climate/weather conditions which result in increases in temperatures, heavy rainfalls, floods, fires, and inconsistencies to the start and end of the rainy season, etc.

It is evident from these findings that the innovation system on rice in Sierra Leone is still not as effective as it should be. The findings have largely shown that research and extension professionals have been developing and promoting a variety of innovations aimed at increasing smallholder productivity and socio-economic well-being. However, the innovation system remains weak, thwarted by a myriad of constraints, including: the dominance of a few actors and the exclusion of others, particularly those outside the research and extension circles; poor institutional policies and modes of operation; over-reliance on external donors for funding of agricultural innovation programmes; and, ineffective collaboration/interactions among innovation system actors in all the innovations studied.

Interestingly, in all the innovations studied, none adopted a value chain approach, as is suggested by the AIS literature, with the aim to increase smallholder farmers' access to holistic services, from production through to marketing. While three of the innovations focussed mainly on production (SRI, TPR, and IRVs), one focussed on processing and marketing (ABCs), and no clear links seemed to exist between the former and the latter innovations. Please refer to Chapter 9 for a detailed discussion on the relationship between these findings and those in the extant literature.

CHAPTER 6 : BELIEFS, ATTITUDES, AND BEHAVIOURS OF RESEARCH AND EXTENSION PROFESSIONALS INFLUENCING THE USE OF AN AIS APPROACH IN SIERRA LEONE

6.1 Introduction

This chapter presents results from the application of the theory of planned behaviour (TPB), developed by Ajzen (1985), which examines the beliefs and attitudes of research and extension professionals influencing their intention to adopt an AIS approach in research and extension programmes in Sierra Leone. This study was motivated by the body of literature on AIS, coupled with the researcher's experience, which suggest that, although the AIS approach is perceived as the current approach for the design and implementation of sustainable and effective research and extension programmes, there seems to be an adherence to the preceding linear, top-down approaches in the developing world, to which Sierra Leone is not an exception.

In Sierra Leone, policy documents of the leading and regulatory national institutions on agricultural research and extension (MAFFS and SLARI) theoretically support the adoption of an AIS approach in agricultural innovation processes (MAFFS, 2012; SLARI, 2011). However, the current, though limited, body of literature, alongside the researcher's personal experience, suggests the contrary. For example, a study by Research Into Use (RIU) (2012) found a weak adoption of an AIS approach in innovation processes by research and extension actors, evidenced by the existence of weak linkages among a variety of the actors studied. A number of factors are believed to be responsible for this. It is on this basis that this study examines research and extension actors' attitudes, beliefs, and behaviours which influence the adoption of an AIS approach, and it uses TPB to do so.

As highlighted in Chapter 4, TPB provides a framework for understanding the rationale behind an individual's engagement, or not, in the performance of a given behaviour. It suggests that behaviour is influenced by behavioural intention, which is, in turn, influenced by three main factors, including the individual's attitudes towards the behaviour, the subjective norms, and the perceived behavioural control. Findings based on the TPB variables form the basis for addressing the second objective of the study via the following research question: "What are the behaviour patterns, beliefs, and attitudes of research and extension actors that influence the adoption of an AIS approach in rice innovation processes in Sierra Leone?"

Data for this study were generated by conducting a sequential mixed-method research approach in which qualitative data collection, through FGDs, preceded quantitative data collection through structured questionnaires. The qualitative data collection involved a total of 12 FGDs conducted among research scientists from SLARI, extension professionals from MAFFS, and NGOs implementing programmes of rice-related innovations in the country. The quantitative survey was initially targeted at a total of 140 respondents – 40 research scientists from SLARI and 100 extension professionals (50 each from MAFFS and NGOs). However, only 122 questionnaires were returned by the target respondents (87% response rate) – 35 from research scientists (87.5%), 42 from NGO extension professionals (84% response rate), and 45 from MAFFS extension professionals (90% response rate). Therefore, findings in this chapter are based on data generated from 122 research and extension actors across the country, comprised of senior, middle, and frontline professionals in three different domains – MAFFS, NGOs, and SLARI.

This chapter specifically presents findings on the socio-economic characteristics of research and extension actors, the constraints they face, their views on their own and on farmers' roles in innovation processes, their perception and knowledge of the AIS approach, and finally, the TPB variables. Findings on these variables all contribute to addressing the research question that this chapter sets to address as summarised in the last section of this Chapter.

6.2 The Socio-economic Characteristics of Research and Extension Professionals

The key socio-economic characteristics examined by the study are presented in appendix 1.11. The majority of the variables were measured as dichotomous variables, the exceptions to this were measured as ordinal variables, i.e., age; level of education; experience in research and extension services; and length of service in their current organisation. However, respondents experience in research and extension and their length of service in their current organisations were measured as continuous variables and then recorded into ordinal variables to get an idea of the total percentages falling within a given range of years.

The majority of respondents (86.1%) were male, only a few (13.9%) were female. This suggests very low employment of female staff in the agriculture sector compared to their male counterparts. This disparity may stem from the traditional belief among the vast majority of Sierra Leoneans that the study of agriculture is mainly for men, therefore very few females tend to pursue agriculture as a course of study at higher education institutions. Although the overall number of female respondents was small, MAFFS seems to be recruiting more female staff than NGOs or SLARI. This is possibly due to the high standards set in the recruitment criteria in the latter institutions. For example, SLARI are widely known for recruiting graduates with at least a division two degree, thus barring weaker graduates from applying. NGOs are similarly known for competitive recruitment processes, making it a bit difficult for some female applicants to outperform their male counterparts in recruitment processes, hence, a possible reason for the low number of female staff compared to males.

The majority of respondents fall within the age bracket of 31-40 years or above. While a higher number of respondents (37.7%) are between 31-40 years, a striking number (25.4%) are 50 years or older. The latter are mainly found in NGOs and SLARI. This is possibly due to the fact that most staff within NGOs are recruited on the basis of their experience and with little consideration given to their age. The more experienced you are, the more likely you are to be recruited into an NGO. Similarly, SLARI is also known for retaining highly skilled staff who are considered to be "specialists" in certain areas. MAFFS, on the other hand, has undergone a recent (2016) policy of retirement and redundancy of staff 60 years old and over, and recruitment of younger professionals. This largely explains the low number of aged respondents from MAFFS compared to SLARI and NGOs.

Further, more respondents hold at least a Bachelor's degree (48.1%) or higher. However, more respondents within SLARI (42.9%) hold a Master's degree compared to those from MAFFS (11.1%) and NGOs (19.0%). This is possibly due to the fact that SLARI requires staff to undertake postgraduate degrees in the first two years of employment before they can be confirmed as research scientists (SLARI, 2011), which is not the case in MAFFS or NGOs. However, only a few respondents (2.5%) hold a PhD, 1.6% of these are from SLARI, 0.8% from MAFFS, and none from NGOs. This suggests that PhD professionals are generally few in research and extension institutions in the country, NGOs employing the fewest. Further, the majority of respondents (61.5%) depend on their job for their only source of income, while only 38.5% indicated they have additional sources of income. Most respondents from NGOs (59.5%) had other sources of income, followed by MAFFS (31.1%), and then SLARI (22.9%). It is believed that this has either a positive or negative impact on the performance of staff, depending on the situation. For instance, having another source of income may serve as security in the event of job loss, e.g., NGO professionals, who are normally hired on a contractual basis, may not have their contract renewed. On the other hand, it may lead to a divergent focus and in cases where the second source of income seems more profitable, research and extension responsibilities may be compromised.

Respondents’ participation in inter-agency meetings was also measured as this could serve as a platform for sharing ideas and experiences on agricultural innovation processes and similar topics among research and extension actors. The majority of respondents (76.2%) indicated they had participated in inter-agency meetings in the past 12 months. Interestingly, all respondents from NGOs (100%) indicated they had done so. On the contrary, the majority of respondents within SLARI (51.4%) indicated they had not attended such meetings, and neither had 80.0% of respondents within MAFFS. The high attendance of NGOs is possibly due to their drive for collaboration, and sometimes as a result of reporting their activities to other agencies, such as MAFFS and SLANGO. The high non-participation of respondents from SLARI suggests weak interaction of SLARI with other actors within the agriculture sector. Similarly, more respondents within NGOs (73.8%) indicated they are members of professional networks, compared to only 22.2% from MAFFS and 22.9% from SLARI. Surprisingly, more than half of all respondents (59.8%) do not belong to any professional networks. This suggests that most respondents may find it difficult to keep up-to-date with current practices and principles in their respective fields due to their limited networking with colleagues of similar backgrounds in other agencies.

The majority of respondents (82.0%) indicated they attended training sessions related to their jobs in the last 12 months. More respondents within NGOs (95.2%) indicated they have done so compared to those within SLARI (60.0%) and MAFFS (86.7%). This suggests that there is a high-level drive to upgrade staff skills and knowledge in their various roles, particularly in NGOs and MAFFS. With regards to experience in research and extension, the majority of respondents (63.9%) had experience ranging from one to 10 years, while 20.5% had experience ranging from 11-20 years. Only a few (6.6% and 9.0%) had experience ranging from 21-30 years and 31-40 years, respectively. The mean number of years of experience was 11.07. This largely suggests that respondents have had a fair amount of experience in research and extension activities, enough to coordinate successful innovation programmes in their respective organisations. Similarly, the majority of respondents (77.9%) had only served in their respective organisations for one to 10 years, and the remainder between 11-20 years, or longer. The mean years of service was 8.64. Unsurprisingly, none of the respondents from NGOs indicated they had served in their organisations for more than 10 years. This is possibly due to the contractual nature of jobs in NGOs, with contracts usually lasting between three and five years, and only extended upon availability of funding for the project and the necessity for the position.

Research and extension professionals' backgrounds in agriculture were measured based on the belief that this may influence the way they perceive farmers' problems, and possibly the way they engage with them. The vast majority of respondents (92.6%) indicated they have a background in farming, i.e., they have participated in farming themselves, either as a child or an adult. This might have even served as one of the motivating factors for them to pursue agriculture as a course of study. Surprisingly, all respondents from NGOs (100%) indicated they had a farming background compared to their MAFFS (82.2%) and SLARI (97.1%) counterparts. Further, research and extension professionals' ability to speak the *lingua franca* of their areas of operation is considered important as this may impact on their interaction and engagement with community stakeholders, and the effectiveness of the communication process. In this regard, more than half of respondents (75.4%) could speak the local language in their areas of operation, with the majority of respondents within NGOs (90.5%) able to do so, compared to 68.9% from MAFFS and 65.7% from SLARI. This largely suggests that NGOs may be better at engaging community stakeholders with little distortion to communication since the majority of them can speak directly with programme participants without the aid of an interpreter.

6.3: Constraints Faced by Research and Extension Professionals in the Execution of their Duties.

The effectiveness of any worker is, to a large extent, a function of a number of factors; two of the most important of these are the working environment and conditions of service. This study elicited the key constraints faced by research and extension actors in carrying out their day-to-day duties in their respective organisations. This was based on the belief that highly-constrained staff are likely to be ineffective in the dispensation of their duties and, in this case, this may translate into poor services to smallholder farmers who are mostly the target beneficiaries of external innovations from research and extension professionals. The researcher acknowledges that this is not directly related to the TPB, however, understanding the constraints faced by research and extension professionals in their work is useful for understanding the functioning of the innovation system.

The results displayed in appendix 1.12 suggest that the majority of respondents interviewed faced more than one constraint. The vast majority of respondents (81.1%) indicated they had faced a number of constraints in carrying out their duties. The topmost of these, mentioned by more than half of respondents (55.7%), was lack of, or limited, access to logistics, which included: vehicles to facilitate movement; internet connectivity; computers; software for data analysis; and electricity. The second topmost constraint, mentioned by 27.9% of respondents, was the poor monthly remuneration received for their services. This was followed by constraints such as: limited budgets/financial resources for innovation processes (mentioned by 24.6%); the bad road conditions/network in their areas of operation (24.6%); and the lack of training opportunities (16.4%). Other constraints, and the percentage of respondents who mentioned them were: poor research-extension linkages (4.9%); limited, aging, and unqualified staff (9.0%); language barriers (4.1%); and, the cultural practices of smallholder farmers (4.9%). Interestingly, there were differences among the three different institutions studied. The majority of the topmost constraints, i.e., those seen above, were faced more often by professionals in MAFFS than by those in the NGOs and SLARI (see Table 6.2 below). The only exception to this was the lack of/limited financial resources for innovation processes, this was mentioned more often by researchers from SLARI than by their counterparts in MAFFS and NGOs. In general, it can be seen that the top constraints mentioned were mostly faced by respondents from public institutions, i.e., MAFFS and SLARI, compared to those from NGOs. This cannot be unconnected with the high dependence of the former two on the government's consolidated funds, which are generally perceived to be hugely inadequate to meet the needs of the many professionals in these two institutions. Therefore, MAFFS and SLARI depend greatly on donor funds for implementation of their programmes; these funds are not readily available, and when they are available their use is limited by many imposed conditions that hardly help to eliminate the endemic constraints faced by these institutions. Overall, these were some of the reasons identified as largely responsible for the perceived ineffectiveness of public institutions, such as MAFFS, in their service to smallholder farmers.

6.4 Research and Extension Professionals Perception and Knowledge of an AIS Approach

In order to understand research and extension professional perceptions and knowledge of an AIS approach as a new perspective to the provision and support of research and extension programmes, three questions were asked. They were:

A) Please rate your level of understanding of an AIS as a current perspective in the provision of agricultural research and extension services.

B) How important do you think the use of an AIS approach is in agricultural research and extension programmes?

C) Please rate your level of experience in the use of an AIS approach in agricultural research and extension programmes.

Responses were recorded using a five-point bipolar Likert scale, ranging from -2 to +2, to indicate a negative or positive association to a particular question.

The results are displayed in the Figures below. More than half of the respondents (68.0%) think it is extremely important to use an AIS approach in research and extension, while 27.9% think it is important (see **Error! Reference source not found.**). It can be seen from Figure 6.2 that differences exist among the three different organisations under study. The figure shows that all NGO extension professionals think it is important (21.4%) or extremely important (78.6%) to use an AIS approach in research and extension.

Figure 6.1: Respondents' perceptions on the importance of using an AIS approach

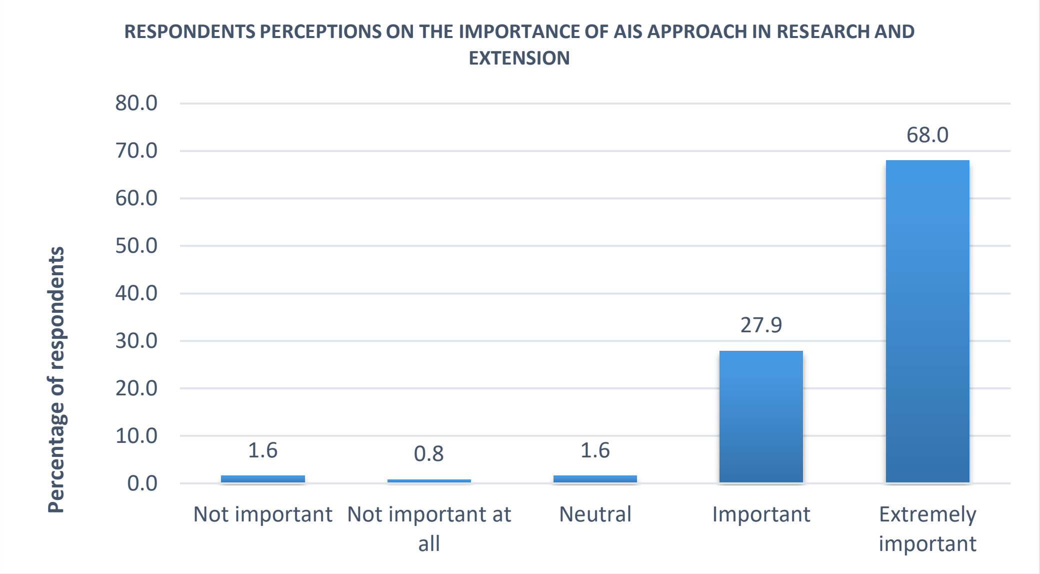
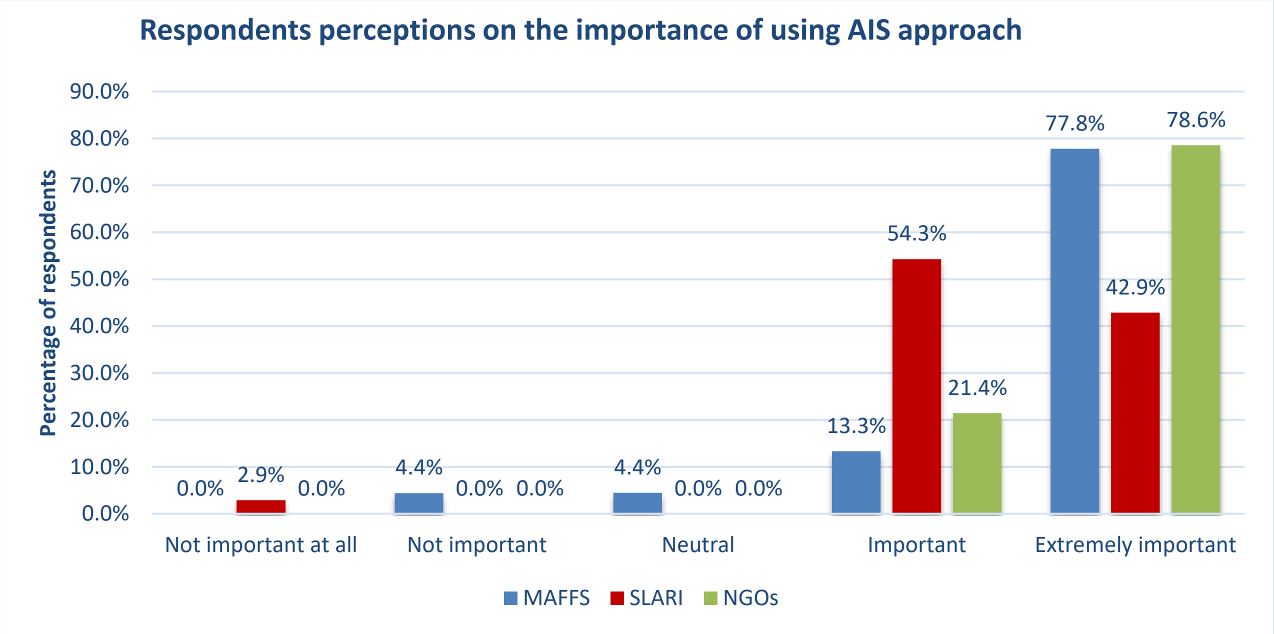


Figure 6.2: Comparison of respondents' perceptions on the importance of using an AIS approach by organisation



A similar trend is observed with MAFFS and SLARI professionals, though a few respondents from MAFFS indicated this to be not important (4.4%) or neutral (4.4%). However, professionals from MAFFS and NGOs represent the greatest number of those who believe that it is extremely important. With respect to respondents' understanding of the use of an AIS approach (see Figure 6.3), more than half indicated they have a high (50.8%) or very high (32.8%) understanding . However, 9.8% think they have a very low understanding in this area. Consistently, more than half of the respondents (see Figure 6.2b) think they have high (46.7%)

or very high (27.0%) experience with the use of an AIS approach. Only a small number indicated to have extremely low (8.2%) or low (0.8%) experience in the area.

Further, it can be seen in Figure 6.4 that more extension professionals from NGO indicated they have a cumulatively high (52.4%) or very high (38.1%) understanding of the use of an AIS approach than their MAFFS (33.3%, 40.0%) and SLARI (71.4%, 17.1%) counterparts, who have almost the same number of professionals with a high or very high understanding of the use of an AIS approach.

Figure 6.3:Respondents' perceptions on their understanding of using an AIS approach

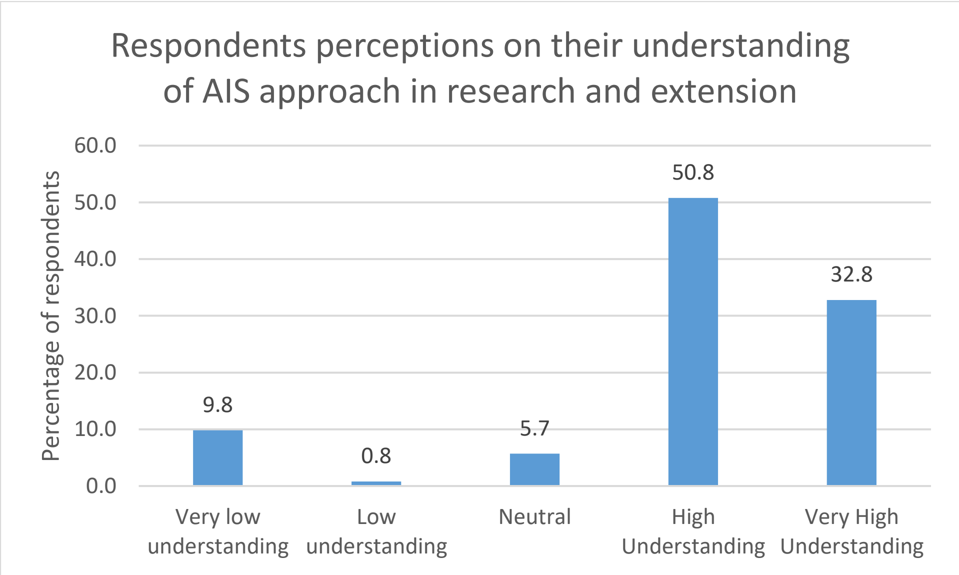
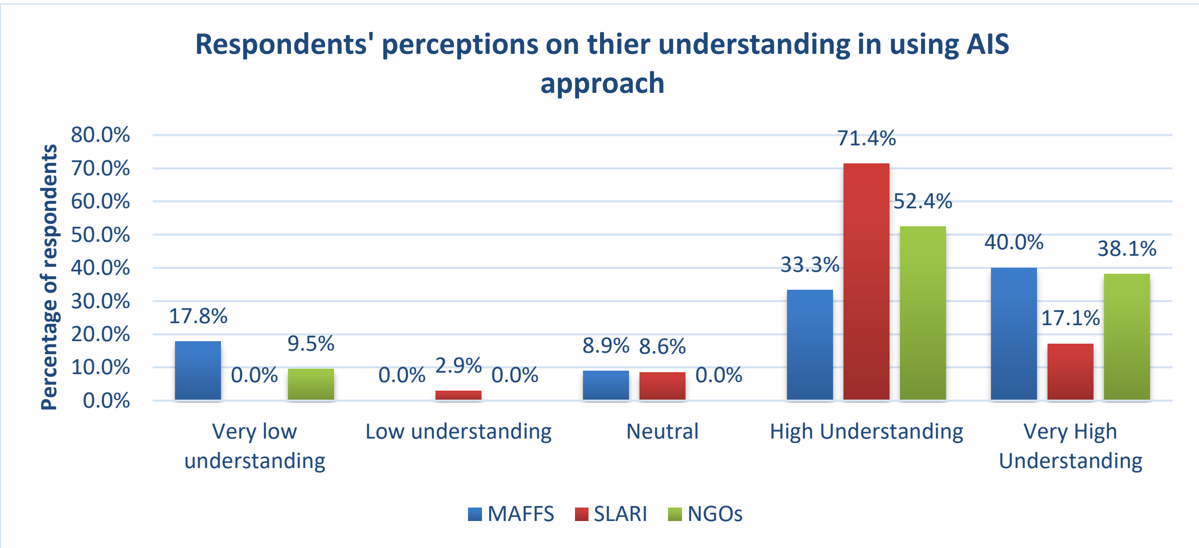


Figure 6.4:Comparison of level of understanding in using AIS approach among respondents by organisation



With respect to research and extension professionals' level of experience, more than half (see Figure 6.5) rate themselves as having high (46.7%) or very high (27.0%) experience in the use of an AIS approach in research and extension. While up to a total of 73% indicated they have a high level of experience, the remainder of the respondents were either neutral or think their experience is low.

Figure 6.5:Respondents' perceptions on their level of experience of using an AIS approach

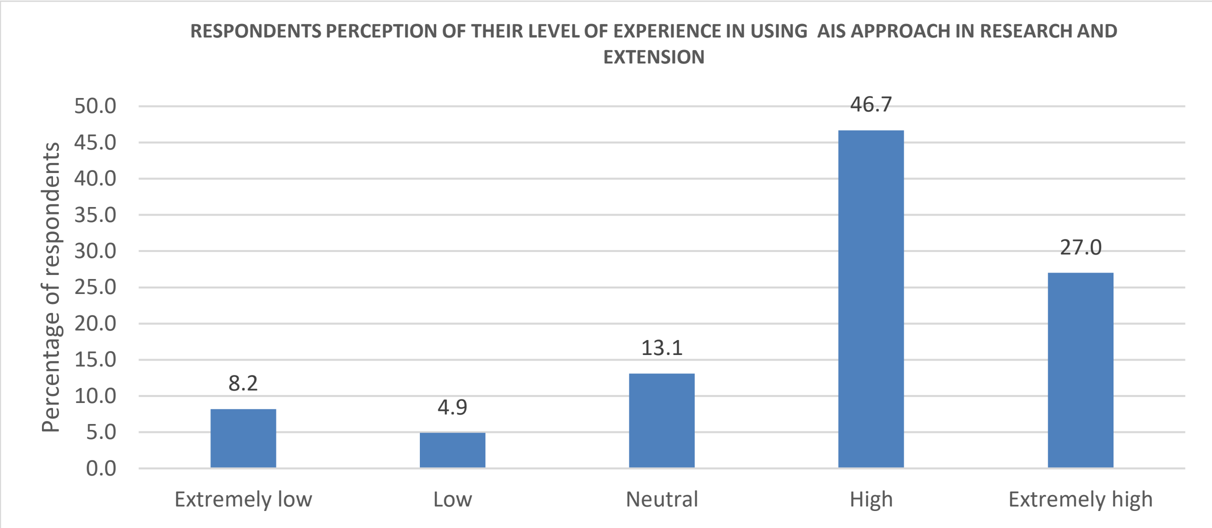
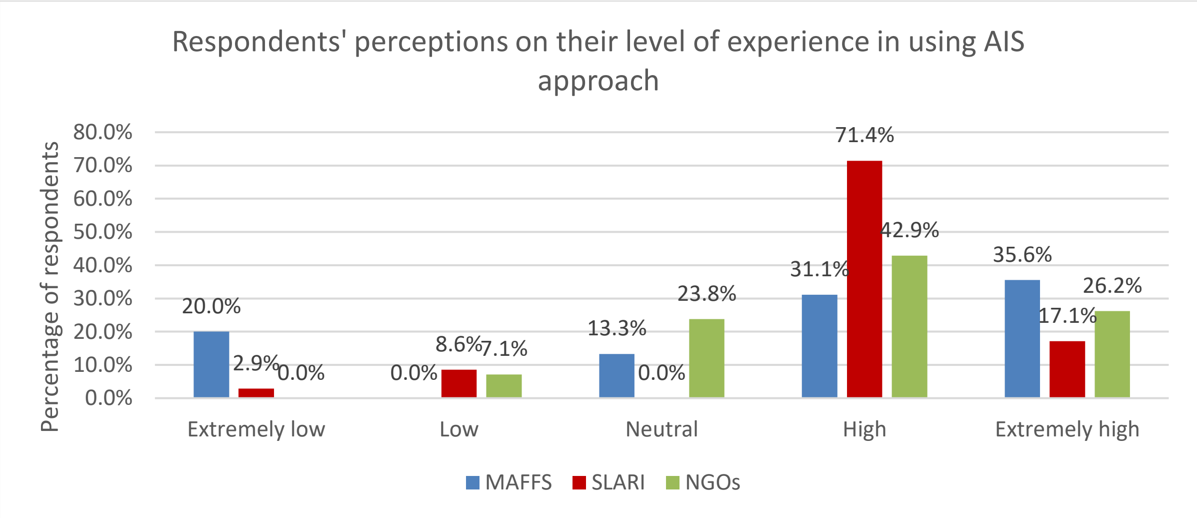


Figure 6.6 shows SLARI with the highest number of respondents to have indicated a high (71.4%) or very high (17.1%) experience of the use of an AIS approach in research and extension, compared to their counterparts in MAFFS (31.1% high; 35.6% very high) and SLARI (42.9% high, 26.2% very high). It can also be seen from the figure that MAFFS and NGOs recorded the highest number of respondents who rated themselves as having low experience, or who were neutral on their use of an AIS approach in research and extension.

Figure 6.6: Comparison by organisation of the level of experience in using AIS Approach by organisation



These results suggest that the majority of research and extension professionals interviewed have some understanding and experience using an AIS approach, and that they think its use is important in their innovation processes. This suggests there has either been some form of adoption of an AIS approach in their programmes, or that respondents have gone through some form of training that has increased their understanding and knowledge of the importance of an AIS approach. Although only half of the respondents indicated they have undergone training on an AIS approach provided by their employers, or other sources within their respective organisations, findings from the KIIs show that institutions such as SLARI and MAFFS have implemented specific projects with an AIS focus. This could be a contributing factor for respondents' perceived knowledge and experience in the use of an AIS approach. These perceptions and beliefs are explored further in subsequent sections of this chapter.

6.5: Research and Extension Professionals views on their and Smallholder Farmers roles in Agricultural Innovation Processes.

In this section, findings on respondents' beliefs about both their own (see appendix 1.13) and the smallholder farmers' roles in agricultural innovation processes for those farmers are presented (see appendix 1.14). In the first part, a number of questions which reflected both top-down thinking and innovation system thinking were asked in order to further understand respondents understanding and beliefs about the key elements which constitute an AIS approach, based on the degree to which they agreed or disagreed with each statement. Interestingly, respondents tended to agree or agree strongly with all the statements – both those concerned with top-down thinking as well as those concerned with the participatory innovation system thinking. As can be seen in appendix 1.13 more than half of the respondents agreed or agreed strongly with statements which identified more with top-down thinking in research and extension services provision. These statements included: helping farmers to adopt new technologies; constantly providing farmers with new technologies and ideas; and, providing free inputs/technologies. Although a relatively small number (17.2%) disagreed or disagreed strongly to the latter.

Similarly, more than half of respondents agreed or agreed strongly to those statements that supported an AIS approach. This largely suggests that, although research and extension professionals may be aware of the essence of adopting an AIS approach in the provision of research and extension services, they still seem to hold strong beliefs in some elements of top-down approaches. For example, 78.7% of respondents agreed strongly that the role of research and extension is to help farmers adopt new technologies, which suggests a traditional top-down view of their professional role in interacting with farmers. This is consistent with Rolling (2009) who found that research and extension professionals still adhere to top-down approaches, despite the advancement of innovation system thinking.

Disaggregating the results by organisation revealed a similar trend, as can be seen in appendix 1.14. While the majority of respondents from all three organisations agreed or agreed strongly to almost all statements, a striking difference can be seen between respondents from SLARI and their MAFFS and NGO counterparts to the statement that research and extension professionals should provide free inputs to smallholder farmers. While the majority of respondents from MAFFS and NGO agreed or agreed strongly to this, more respondents from SLARI were either neutral or disagreed with this statement. This perhaps suggests that researchers are more aware of some of the principles of an AIS approach and the likely (negative) impact of handouts to smallholder farmers as a strategy to improve their innovative capacity. On the other hand, it could be that NGO and MAFFS staff still align their thinking with the recovery phase of the war during which time smallholder farmers were provided with hand-outs by most extension agencies in the country.

In the second part, appendix 1.15 presents findings on research and extension professionals' beliefs about the role of farmers in agricultural innovation programmes/processes. As in the preceding part, questions in this part were also framed to reflect both linear top-down thinking and a participatory AIS approach thinking. These questions were framed based on Klerkx et al., (2012) categorisation of the elements of top-down and AIS approaches. Their beliefs aligned with the linear top-down approaches in agricultural innovation processes, such as perceiving smallholder farmers as: adopters or rejecters of new technologies; only a source of information for research and extension professionals; experimenters; perpetual dependants on research and extension for solutions to their problems. Meanwhile the remainder of the beliefs seen in Table 6.5 align with an AIS approach.

The results here also largely suggest that respondents still hold a firm belief in linear top-down approaches; the majority of them agreed or agreed strongly to the key top-down approach elements/statements mentioned earlier. However, although the majority of them also agreed or agreed strongly to pro-AIS approach elements/statements, a striking high number (43.4%) disagreed that farmers are innovators who can come up with solutions to their problems, contrary to Klerkx et al., (2012). This suggests, to some extent, that respondents lack a holistic understanding of the tenets of an AIS approach, or do not currently align their interventions with participatory AIS approaches which enhance the innovative capacity of smallholder farmers.

Results by organisation, seen in appendix 1.16 show that there were no marked differences between respondents from the three organisations studied. However, one notable difference was the fact that respondents from NGOs disagreed with, or were neutral on, the statement that farmers must always depend on research and extension actors for sustainable solutions to their problems. While this denotes a demonstration of a clear understanding of some of the principles of an AIS approach, this group constitutes the largest proportion of respondents (compared to SLARI and MAFFS) who disagreed with, or were neutral on, the statement that farmers are innovators who exert demand for research and extension services. This largely indicates that research and extension actors were aware of some of the principles of an AIS approach in research and extension, however, more needs to be done to augment their understanding in this direction. They lack an understanding of some of the key tenets that constitute an effective AIS approach as they still align themselves with top-down principles and perceptions.

6.6: AIS Behaviours and their Exhibition by Research and Extension Professionals in the last 12 Months

The behaviours displayed in appendix 1.17 were elicited during the first phase of the study through FGDs with research and extension professionals in the target organisations. In this phase of the study, respondents were asked to indicate which behaviours they believe reflected an AIS approach in research and extension programmes. It can be seen from Table 6.7 that more than half of the respondents agreed or agreed strongly that all the behaviours elicited during the FGDs reflected an AIS approach. Although no behaviour scored a 100% agreement from all respondents, the results shown below are adequate to propose that these are behaviours that research and extension professionals in the study area believe reflect an AIS approach.

Further, respondents were asked to state whether or not they had exhibited these behaviours in the last 12 months. This aimed to help understand the extent to which research and extension professionals currently align their activities to what they believe is an AIS approach. The results show that the majority of respondents agreed they have exhibited most of the behaviours in the last 12 months. However, two of the behaviours, “formulation of policies favourable for collaboration and partnerships” and “decentralising management of innovation processes”, were indicated not to have been exhibited by 51.6% and 52.5% of respondents, respectively. It is possible that these respondents lacked the opportunity to take such decisions as they could be senior management decisions, and many of them were not in such a position. Other behaviours, such as “promoting network-based knowledge dissemination among actors” and “having confidence of innovation stakeholders in the innovation process”, were also not believed to have been exhibited by up to 40.2% and 36.9% of respondents, respectively. This is possibly due to financial and time constraints which may limit knowledge sharing among innovation stakeholders. Also, the lack of established modes of interaction or engagement with other stakeholders could be a possible reason for the lack of confidence in other stakeholders. These findings seem to suggest that although most of the respondents may not exhibit all or most of these behaviours holistically, they are currently exhibiting some of them, and this suggests an alignment of their activities with their perceptions of an AIS approach. The next section of this chapter, therefore, employs a social-psychological model, i.e.,TPB, to understand and predict the likely tendency of respondents to use an AIS approach in their activities, which in turn should ascertain the extent to which these behaviours are likely to be exhibited by respondents in the next year. Importantly, the model will also help understand the factors which influence respondents' ability and willingness to use an AIS approach in their activities in the next year.

6.7 Theory of Planned Behaviour (TPB)

The various components of the TPB framework used in the structured questionnaire have already been discussed in detail in Chapter 4. In summary, respondents were asked questions relating to the three TPB components that influence their intention to use an AIS approach in research and extension, including their formation of attitudes towards the use of an AIS approach, the subjective norms (salient referents) that influence their decision to use an AIS approach together with their motivation to comply with those referents, and the perceived behavioural control which includes factors that enhance or discourage the use of an AIS approach in research and extension programmes by respondents. The following are results of the initial elicitation process described in Chapter 4, which led to the identification of beliefs in the three components measured. For attitudes, subjective norms, and perceived behavioural control, a total of 13 outcome beliefs, seven salient referents and six control beliefs are presented in boxes 6.1, 6.2, and 6.3 respectively.

Box 6.1: Outcome beliefs used for the calculated attitudes relating to the use of AIS approach.

1. Can increase productivity and profitability of innovations for farmers
2. Can increase the attainment of food security among smallholder farmers
3. It enhances the effectiveness and sustainability of innovations on rice
4. It fosters capacity development of stakeholders including farmers
5. Can improve smallholder farmers' access to input and output markets.
6. It enhances experience sharing and best practices among different actors
7. Helps reduce burden on any one actor.
8. Increases agricultural innovation actors (including farmers) ability to innovate
9. Makes coordination of activities of the various stakeholders difficult
10. It is difficult to use due to the diversity of interests of various actors.
11. It is time consuming
12. It is expensive
13. It is difficult to use outside the organisation's policies

Box 6.2: Control beliefs used for the calculated perceived behavioural control relating to the use of AIS approach.

1. Have the knowledge and skills on AIS approach
2. Have adequate financial resources (eg from donors) to use an AIS approach
3. Institutional policies of my organization discourage me from the use of an AIS approach
4. The cooperation and behaviour of other actors will discourage me from adopting an AIS approach
5. Cultural norms of smallholder farmers will discourage me from using an AIS approach
6. The lack of incentives from my organisation will discourage me from adopting an AIS approach in research and extension.

Box 6.3: Salient referents used for the calculated subjective norm relating to the use of AIS approach.

1. Employer
2. Supervisor
3. Professional colleagues

4. Donors 5. Farmers 6. Community leaders 7. Family members

6.7.1 Research and Extension Professionals' stated Intention to use an AIS Approach

The behaviour examined in this chapter is "the use of an AIS approach in research and extension". As indicated in Chapter 4, this behaviour incorporated a number of behaviours, identified during the elicitation stage of the study, which are typical of a functioning AIS and largely consistent with AIS literature. Respondents' intentions to use an AIS approach in innovation processes was measured using three items. These included asking respondents if they i) intended ii) wanted, or iii) expected to use an AIS approach in research and extension programmes over the next year. Their responses were scored on a Likert-type scale ranging from one to five to show the extent to which they agreed or disagreed with these statements. These were then recoded in SPSS using a five-point bipolar scale ranging from -2 to +2. Details of the methodology can be found in Chapter 4.

Reliability analysis of the scale used for the three items was calculated using Cronbach's Alpha Reliability Coefficient. This gave a reliability coefficient of 0.921, which depicts that the scale used is highly reliable. As presented in Table 6.1 below, further analysis shows that the majority of the respondents (63.1%) had positive intentions to use an AIS approach in innovation processes, 29.5% agreed and 33.6% agreed strongly with this. Meanwhile, up to 28.7% of respondents were undecided, and only a few (8.2%) indicated negative intentions to use an AIS approach. The mean intention to use an AIS approach for all respondents was 0.83 (from a possible range of -2 to +2), with MAFFS staff having the highest mean score (1.18), followed by NGOs (0.76), and then SLARI (0.46). These results suggest generally positive intentions to use an AIS approach by research and extension professionals in innovation processes, though it does not seem high enough for professionals from SLARI and NGOs compared to those from MAFFS. That MAFFS staff have the highest intention to use an AIS approach cannot be unconnected with the fact that they see themselves as pace-setters and, therefore, feel more obliged to be the first to adopt new guidelines or paradigms in agricultural innovation processes, and then to be followed by other actors in the sector.

Table 6.1:Respondents' intention to adopt an AIS approach

Intention to adopt an AIS approach			**Mean Intention by Organisation**		
	Frequency	%	Organisation	Mean Intention	Std Deviation
Strongly disagree	7	5.7	MAFFS	1.18	0.984
Disagree	3	2.5	SLARI	0.46	0.950
Undecided	35	28.7	NGO	0.76	1.246
Agree	36	29.5			
Strongly agree	41	33.6			
Total	**122**	**100.0**	**Total**	**0.83**	**1.104**

Source: Field Survey, 2016/17

Further analysis, disaggregated by respondents' mean intentions based on their socio-economic characteristics and the correlation that exists between selected characteristics and their intentions to use AIS approaches (see Table 6.2). Correlations were computed only for ordinal variables as nominal variables such as sex, membership in professional organisations etc are not suitable[14].

The results show that female professionals had a stronger mean intention to use an AIS approach (1.41) than their male counterparts (0.73). This suggests that women professionals are more likely to try new ideas than their male counterparts, consistent with Morris et al., (2005) who found gender differences exist in the use a new technology and that females' intentions to adopt were significantly higher than that of their male counterparts. Further, women tend toward a stronger preference for collaborative styles of working, which is a focus of the AIS approach.

The mean of the stated intentions for younger professionals between 18-30 years (1.44) and 31-40 years (1.04) is stronger than that of their older counterparts, 41-50 years (0.74) and over 50 years (0.23) old. These results also show that the intentions of respondents decreased with age, which suggests that younger people are more likely to adapt to new ways of working. This group are less likely to have settled for traditional approaches compared to older professionals who might have become mired in their traditional approaches and find it difficult to change. This is in line with Morris et al., (2005). However, a negative and significant ($r=-0.358$; $p<0.001$) association exists between the age of respondents and their intention to use an AIS approach. Also, respondents from MAFFS displayed the strongest mean intention (1.18),

[14] See https://statistics.laerd.com/statistical-guides/spearmans-rank-order-correlation-statistical-guide.php

followed by NGOs (0.76) and SLARI (0.46). The possible reason for this disparity has been explained above. It can be seen from the results that frontline staff from the target organisations had the strongest mean intention to use an AIS approach (1.02) compared to their middle (0.97) and senior level (0.36) counterparts. This is possibly due to the fact that the frontline staff are closer to the smallholder farmers at community level than their counterparts, and so they may be more aware of the constraints they face and the likely usefulness of adopting an AIS approach to ameliorate these constraints. On the other hand, it is also possible that senior and middle level professionals are sceptical given the limitations associated with the use of an AIS approach, including the time required, coordination, and resource constraints. However, a negative and significant association (r= -0.150; p<0.05) exists between the respondents' managerial hierarchy and their intention.

The mean stated intention for the use of an AIS approach decreased with respondents' number of years' experience in research and extension. Respondents with the least number of

Table 6.2:Correlation between respondents' socio-economic characteristics and their mean intention to use an AIS approach in research and extension

Socio-economic characteristics	**Categories**	**Frequency (n=122)**	**Mean stated Intention**	**Correlation with Intention (P-value in parenthesis)**
Sex	Male	105	0.73	-
	Female	17	1.41	
Age of respondents	18-30yrs	18	1.44	-0.358**(0.000)
	31-40yrs	46	1.04	
	41-50yrs	27	0.74	
	Above 50yrs	31	0.23	
Organisation	MAFFS	45	1.18	0.156*(0.044)
	NGO	42	0.76	
	SLARI	35	0.46	
Managerial hierarchy of respondent	Frontline	57	1.02	-0.150*(0.049)
	Middle	32	0.97	
	Senior	33	0.36	
Years of experience in research and extension	1-5yrs	78	1.04	-0.279**(0.002)
	6-10yrs	25	0.88	
	11-15yrs	8	0.50	
	16-20yrs	11	-0.55	
Years in current organisation	1-5yrs	95	0.92	-0.188*(0.038)
	6-10yrs	9	1.00	
	11-15yrs	7	0.43	
	16-20yrs	11	0.18	
	Yes	93	0.98	-

Participation in inter-agency meeting	No	27	0.33	
	Not available	2	0.50	
Membership in professional networks	Yes	49	0.88	-
	No	73	0.79	
Have a farming background	Yes	113	0.80	-
	No	9	1.22	
Level of education of respondent	College Certificate	17	0.71	-0.080 (0.3890)
	College Diploma	23	0.87	
	Bachelor's Degree	51	1.08	
	Master’s degree	28	0.50	
	PhD	3	0.00	

*Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

years of experience (1-5 years) had the strongest mean intention (1.04), followed by those with 6-10 years of experience (0.88), 11-15 years of experience (0.50, and then even a negative mean intention for those with 16-20 years of experience (-0.55).

This could be partially explained by the fact that highly experienced professionals feel more comfortable with the traditional top-down approaches they have become used to and may be uncomfortable about moving beyond the comfort zone this has created for them. Meanwhile, less experienced colleagues may be much more open to new techniques and approaches as they may not consider themselves highly experienced in the traditional approaches. However, a negative and significant association ($r=-0.279$; $p<0.01$) exists between the respondents’ years of experience and their intention to use an AIS approach. A similar trend is also observed between the mean intention and the number of years respondents have spent in their organisations. This may be due to inertia emerging among research and extension professionals as a result of their length of service, which may have made them more cynical about embracing new ideas or ways of operating. Also, the challenges associated with AIS requirements, such as inter-institutional collaboration, may be perceived as not to be in the direct interests of their institutions, such collaboration may derail their ability to meet their performance indicators or to attract funding.

Furthermore, the mean intention of respondents who had participated in inter-agency meetings is stronger (0.98) than those who had not (0.33). A similar trend is observed for respondents’ membership of professional networks. Members have a stronger mean intention (0.88) than non-members (0.79). The higher mean intentions of those who attended inter-agency meetings and those members of professional networks could mean that they learned about the AIS approach and are, therefore, more informed about its relevance in enhancing the effectiveness of innovation processes, particularly with smallholder farmers. Also, it is possible that professionals with the motivation to collaborate with other people and organisations are more likely to be members of professional networks and to participate in inter-agency meetings, and thus in an AIS approach.

It is also interesting to find that respondents who have a background in farming have a lower mean intention (0.80) to use an AIS approach compared to those who do not (1.22). This is possibly due to the disparity in the number of respondents in each category. The analysis shows that respondents with a farming background have a higher frequency (113) and standard deviation (1.119) compared to the frequency (9) and standard deviation (0.833) of their counterparts. This may mean that respondents in the former category have a wider range of disparity in their responses than the latter, a possible reason that could affect their overall mean intention. Surprisingly, the data show that respondents with a Bachelor's degree have the strongest mean intention (1.08) to use an AIS approach compared to respondents with any other qualification, including those with higher qualifications (Masters (0.5) or PhD (0.00). The results even show a decreasing mean intention the higher the level of qualifications held. This may be partly explained by the fact that Bachelor's graduates are more open to new ideas as most may not have been glued to traditional top-down approaches in the research and extension programmes. However, a negative and not significant association exists between respondents' levels of education and their mean intention to use AIS in research and extension.

6.7.2 Respondents' Attitude towards the use of an AIS Approach in Research and Extension

The underlying attitudes towards respondents' use of an AIS approach in innovation processes in the next 12 months were elicited by employing both direct and indirect methods. The direct method (also known as stated attitudes) used to evaluate respondents' intentions to use an AIS approach included four items, namely, i) how pleasant or unpleasant, ii) how useful or worthless, iii) how good or bad, and iv) how sustainable or unstainable is the use of an AIS approach in research and extension (Ajzen, 1991; Mose, 2013). These were scored using a scale of 1-5 (from a highly negative (1) belief to a highly positive (5) belief in each statement). These were then recoded into a bipolar Likert-type scale ranging from -2 to +2. The indirect attitudes were measured (calculated attitudes) by asking the respondents to evaluate each belief statement (in Box 6.1) and its outcome. The belief statements are those salient beliefs elicited during the first phase of the data collection.

6.7.2.1 Stated Attitudes of Respondents

The instrument statements used for measuring the stated attitudes of respondents were analysed for reliability using Cronbach's alpha reliability coefficient. The alpha coefficient is 0.875, which shows that there is internal consistency of the items used and that the scale may be considered 88% reliable.

As can be seen in Table 6.3 below, the majority of respondents (93.4%) have either a positive (33.6%) or very positive (59.8%) attitude towards the use of an AIS approach. A few respondents (6.6%) indicated a neutral attitude; no respondent indicated a negative attitude. Consistently, the overall mean attitude for all respondents was 1.53 (out of a possible range of -2 to +2). Similarly, disaggregation by gender and organisation shows that all three organisations have a highly positive attitude towards the use of an AIS approach, with the mean attitudes for MAFFS, SLARI and NGOs being 1.64, 1.20, and 1.69, respectively. Respondents from NGOs seem to have a slightly more positive attitude than their counterparts, although this was nearly the same for MAFFS respondents. On a gender basis, female respondents have a higher positive mean attitude (1.71) towards the use of AIS compared to their male counterparts (1.50). A similar trend is observed among MAFFS and NGO staff, with the exception of SLARI. Finally, a positive and significant association ($r=0.424$; $p<0.001$) exists between respondents' attitudes and their intentions to use an AIS approach in innovation processes.

The generally positive attitude towards the use of an AIS approach suggests that research and extension personnel are aware of the positive effects of its adoption and the overall impact this may have on the achievement of the broad objectives of their respective organisations. This also suggests that, all other conditions being equal, there is a high tendency for these professionals to adopt the use of an AIS approach, evident in a highly positive attitude towards it.

Table 6.3: Mean stated attitude of respondents disaggregated by organisation and gender

Name/category of organisation	Sex of Respondent	Mean	Std. Deviation
MAFFS (n=45)	Male	1.57	0.558
	Female	1.90	0.316
	Total	**1.64**	**0.529**

SLARI (n=35)	Male	1.27	0.719
	Female	0.00	0.000
	Total	**1.20**	**0.759**
NGO (n=42)	Male	1.65	0.484
	Female	2.00	0.000
	Total	**1.69**	**0.468**
Total (n=122)	**Male**	**1.50**	**0.606**
	Female	**1.71**	**0.686**
	Total	**1.53**	**0.619**

Source: Field Survey, 2016/17

6.7.2.1.1 Belief Statements which underpin Respondents' Stated Attitudes for the use of an AIS approach

The four belief statements that underpinned respondents stated attitudes towards the use of an AIS approach are presented in Table 6.4 below. The mean attitude towards the use of AIS being pleasant or unpleasant (labelled as Stated Attitude 1 (SA1)) was 1.35 (out of a range of -2 to +2), with the majority of respondents indicating it to be either pleasant (33.6%) or extremely pleasant (50.8%) to use an AIS approach in innovation processes. Only 15.6% of respondents were neutral, and no respondent indicated it was unpleasant to use an AIS approach. The mean attitude of the second stated attitude (SA2), which evaluated the extent of usefulness, or not, of an AIS approach was 1.58, more than half of the respondents indicated it to be either useful (27.0%) or extremely useful (65.6%). Only 7.4% were neutral and none had thought it was worthless. Further, the third item of the stated attitude (SA3) revealed a mean of 1.43; the majority of the respondents indicated it as either good (32.0%) or extremely good (55.7%) to use an AIS approach; 12.3% of respondents were neutral and none thought it was bad or extremely bad to use an AIS approach. Finally, the mean of the fourth item (SA4) used for measuring the stated attitude was 1.30, the majority of respondents agreed that it is either a sustainable (32.0%) or extremely sustainable (49.2%) strategy to use an AIS approach in research and extension. A total of 18.9% were neutral, but no respondent thought it an unsustainable or extremely unsustainable strategy. These results are largely consistent with those seen in the preceding section and, therefore, corroborate the suggestion that research and extension actors seemed to generally have an increased awareness of the importance and possible impact of adopting an AIS approach in their innovation processes in their respective organisations.

Table 6.4: Belief statements underpinning stated attitudes for the use of AIS by respondents

How pleasant or unpleasant (SA1) (n=122) (Mean =1.35)	F	%	How useful or worthless (SA2) (n=122) (Mean =1.58)	F	%	How good or bad (SA3)? (n=122) (Mean = 1.43)	F	%	How sustainable or unstainable (SA4) (n=122) (Mean = 1.30)	F	%
Extremely unpleasant	0	0	Extremely worthless	0	0	Extremely bad	0	0	Extremely unsustainable	0	0
Unpleasant	0	0	Worthless	0	0	Bad	0	0	Sustainable	0	0
Neutral	19	15.6	Neutral	9	7.4	Neutral	15	12.3	Neutral	23	18.9
Pleasant	41	33.6	Useful	33	27.0	Good	39	32.0	Sustainable	39	32.0
Extremely pleasant	62	50.8	Extremely Useful	80	65.6	Extremely Good	68	55.7	Extremely sustainable	60	49.2

Source: Field Survey, 2016/17

Further, results on the correlation between respondents' intentions to use an AIS approach and the four belief statements constituting their stated attitudes are presented in Table 6.5. It can be seen that all four belief statements have a positive and significant association with respondents' intentions to use an AIS approach in their innovation processes. The belief statement which asked respondents to state the extent to which they perceive the use of an AIS approach as pleasant or unpleasant had the highest positivity towards respondents' intentions to use it ($r=0.530$; $p<0.01$) than the other three belief statements (SA2, SA3 and SA4), with correlation coefficients of 0.456, 0.266, 0.343 respectively, all significant at $p<0.01$. These results are consistent with findings reported in section 6.7.2.1, which similarly showed a high positive mean stated attitude of respondents to the use of an AIS approach in research and extension processes. This also implies that research and extension actors are likely to adopt an AIS approach in their activities, all other conditions being equal or met.

Table 6.5: Correlation between Research and Extension Professionals' Intentions to use AIS and their Stated Attitudes

	Intention	SA1	SA2	SA3	SA4
Intention	1.000				
SA1	0.530**	1.000			
SA2	0.456**	0.593**	1.000		
SA3	0.266**	0.704**	0.675**	1.000	
SA4	0.343**	0.515**	0.550**	0.673**	1.000

**Correlation is significant at the 0.01 level (2-tailed).

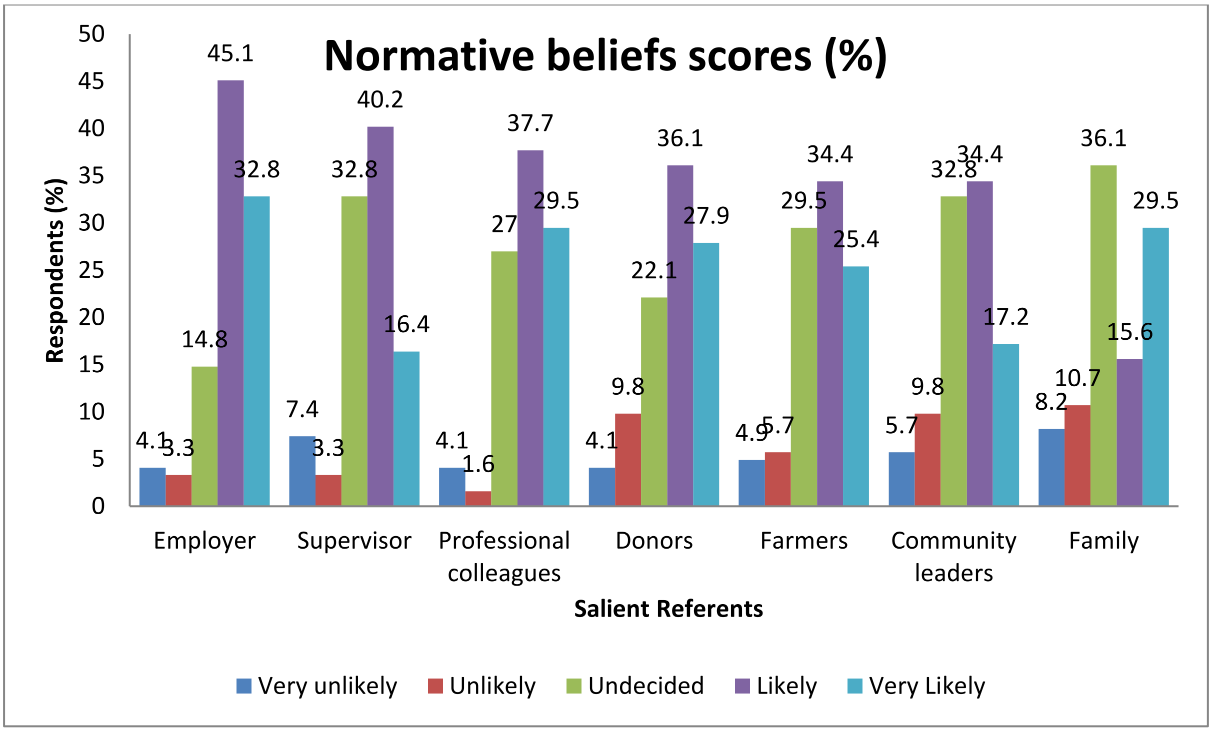
6.7.2.2 Calculated Attitudes of Respondents for the use of AIS in Research and Extension

The Calculated Attitude (CA) towards the use of an AIS approach was derived from the summation of the product of the values of the 13 outcome belief statements elicited during the FGDs, and their outcome evaluation. The individual outcome attitude score was derived from the product of the individual belief strengths of each belief statement (b_i) and their corresponding outcome evaluation measure (e_i). These gave the outcome attitude for each belief statement (b_i*e_i) whose values ranged from -4 to +4. These outcome attitudes were then summed up ($\sum b_i*e_i$) to give the calculated attitude of respondents towards the use of an AIS approach in innovation processes.

6.7.4.4 Understanding Normative Beliefs

The normative beliefs scores were obtained by asking respondents to state the likelihood of their salient referents wanting them to adopt an AIS approach in research and extension. Their responses are shown in Figure 6.7 below. Most respondents indicate that their salient referents would likely or very likely want them to use an AIS approach in research and extension. This is particularly true for salient referents who include employers, supervisors, colleagues, donors, and farmers. This implies that these referents are not only a source of social pressure, but are also important in influencing research and extension professional's use of an AIS approach in their work. Family members and community leaders were those groups with the least number of respondents to believe that these referents are likely, or very likely, to want them to use an AIS approach, but these groups also had a relatively high number of undecided respondents. The high number of undecided respondents among family members wanting them to use AIS may mean that they perceive their family members to have little or no knowledge about AIS and would therefore have little influence on respondents' decisions to use the approach in their activities. This could also be true for community leaders.

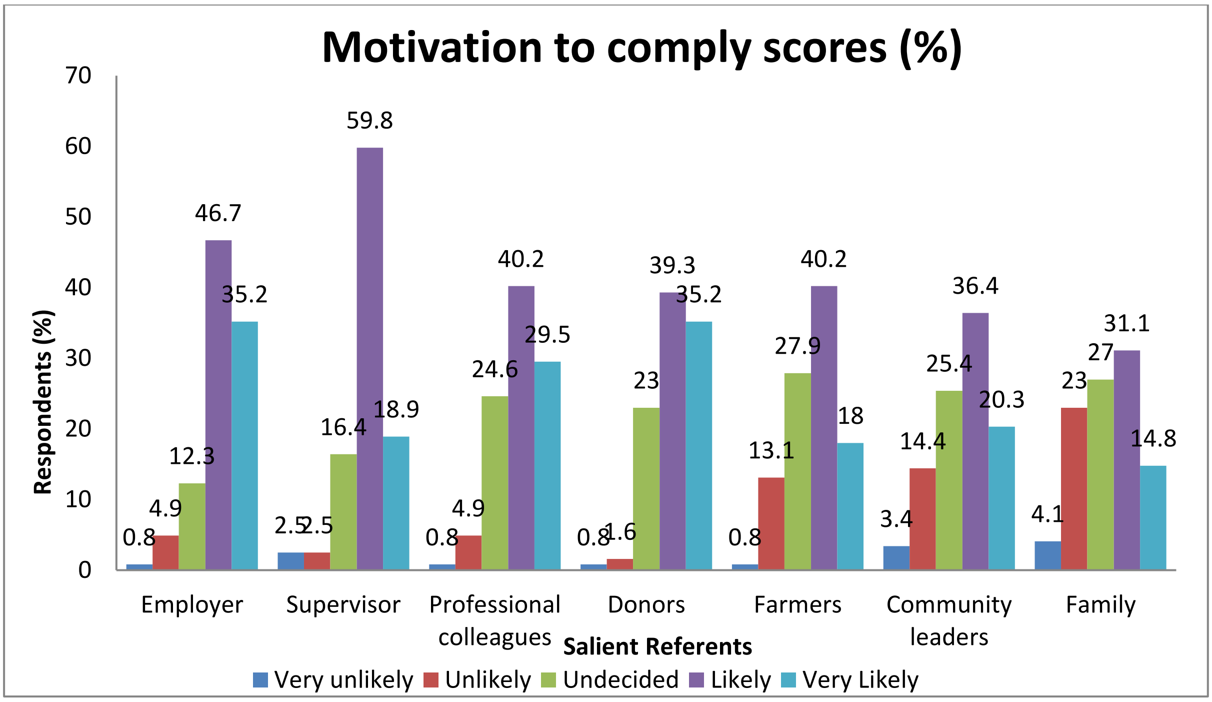
Figure 6.7: Respondents normative beliefs used in the indirect SN



In Figure 6.7, the respondents' motivation to comply with the advice of their salient referents for using an AIS approach is shown. Unsurprisingly, most respondents indicated they would likely, or very likely, comply with the advice of their employers, supervisors, colleagues, donors, and farmers, while they are least likely to comply with family members. These findings could be expected as employers and supervisors in any organisation have the greatest influence on what employees do, including the decisions and actions taken in relation to their jobs. Losing one's job is imminent in cases of failure to comply with directives and advice from supervisors and or employers. It is therefore justifiable for the respondents to comply with these two groups more than any other category of their salient referents. Donors also normally set specific conditions with which research and extension professionals may need to comply before funds are disbursed.

The low level of compliance for community level referents – community leaders and farmers – is possibly due to research and extension professionals' beliefs that these referents cannot significantly influence their activities and decisions on the use of a specific approach compared to other salient referents, such as employers, supervisors, and donors. Therefore, complying with their advice is not seen as important compared to compliance with that of the latter groups.

Figure 6.8: Respondents' motivation to comply with the salient referents



In summary, respondents attached a high level of importance to their employers, supervisors, donors, and colleagues for influencing their use of an AIS approach in their activities, and less importance to farmers, community leaders, and family. This largely suggest that adopting an AIS approach may need the support of key players within the relevant institutions to bolster its success.

6.7.4.5 The Indirect Subjective Norm and its Correlation with Respondents' Intention to use an AIS Approach

The calculated subjective norm (see Table 6.6) for all respondents was moderately positive (8.844, out of a range of -28 to +28). This shows that the salient referents can have a positive influence on respondents' intentions towards the use of an AIS approach in their activities. Consistently, it can also be seen that respondents had a higher mean motivation to comply with their employers (1.11), donors (1.07), colleagues (0.93), and supervisors (0.90) compared to that of farmers (0.61), community leaders (0.56), and family members (0.30), regarding the use of an AIS approach. This also vividly points to the essence of these salient referents in influencing respondents' use of an AIS approach in their programmes.

Overall, a positive and significant association ($r=0.453$, $p<0.01$) was found to exist between the calculated subjective norm and respondents' intention to use an AIS approach in research and extension programmes. Similarly, a positive and significant association was found between each of the outcome normative beliefs of respondents and their intention to use an AIS approach in research and extension. This suggests that the salient referents identified can greatly enhance respondents' intentions and, subsequently, their use of an AIS approach in research and extension programmes.

Table 6.6: Subjective belief, motivation to comply and Outcome normative belief and their correlation with intention to use AIS approach.

	Subjective belief strength (sb_j)	Motivation to comply (m_j)	Outcome Normative belief (sb_j *mj)	Correlation (r_s) with intention
Employer	0.99	1.11	1.615	0.493**
Supervisor	0.55	0.90	0.951	0.427**
Professional colleagues	0.87	0.93	1.320	0.369**
Donors	0.74	1.07	1.246	0.269**
Farmers	0.70	0.61	0.967	0.349**
Community leaders	0.48	0.56	1.049	0.313**
Family members	0.48	0.30	0.869	0.261**
Indirect Subjective Norm ($\sum sb_j{*}m_j$): Range -28 to +28			**8.844**	**0.453****

** Correlation is significant at the 0.01 level (2-tailed)

6.7.5 Comparison of Means of the Theory of Planned Behaviour Variables Disaggregated by Gender and Organisation

The overall means for all variables, intention, attitude, subjective norm, and perceived behavioural control are positive. Out of a possible range of -2 to +2, the mean attitude of respondents was 1.53 and was the highest among all variables measured (see Table 6.7).This was followed by the mean intention (0.83), subjective norm (0.35), and then perceived behavioural control (0.11). This indicates that respondents have strong positive attitudes towards the use of an AIS approach. The least positive mean value for the perceived behavioural control illustrates that respondents' control over engagement in the use of an AIS approach is moderately low. This means there are other factors that influence the extent to which respondents think they have control over their ability to use an AIS approach in research and extension.

Interestingly, female respondents returned a higher mean for all variables measured compared to their male counterparts. This is possibly due to the fewer number of female respondents in the sample compared to their male counterparts.

Table 6.7:Mean intention, attitude, subjective norm and PBC disaggregated by organisation and gender

Organisation	Gender	Mean Intention	Mean Attitude	Mean Subjective Norm	Mean PBC
MAFFS (n=45)	Male	1.17	1.57	0.54	0.46
	Female	1.20	1.90	0.80	0.10
	Total	**1.18**	**1.64**	**0.60**	**0.38**
SLARI (n=35)	Male	0.42	1.27	-0.24	-0.03
	Female	1.00	0.00	0.00	1.00
	Total	**0.46**	**1.20**	**-0.23**	**0.03**
NGO (n=42)	Male	0.59	1.65	0.38	-0.11
	Female	2.00	2.00	2.00	0.00
	Total	**0.76**	**1.69**	**0.57**	**-0.10**
Total (n=122)*	Male	0.73	1.50	0.24	0.10
	Female	1.41	1.71	1.06	0.18
	Total	**0.83**	**1.53**	**0.35**	**0.11**

Intention	**SN**	**PBC**	**Attitude**
Low Intention (n=45)	-0.16	-0.20	1.27
High Intention (n=77)	0.65	0.30	1.69

Source: Field Survey, 2016/17. *Out of a possible range of -2 to +2.

Further, respondents from MAFFS had the highest mean intention, subjective norm, and perceived behavioural control, while those from NGOs had the highest mean attitude. However, mean perceived behavioural control for NGOs was slightly negative. This may have influenced the lower mean scores of NGO respondents in terms of intention, irrespective of them having a positive attitude towards the use of an AIS approach.

For MAFFS, it is not so surprising that they had the highest means in most of the variables as they are perceived to be the leading actors and regulators of the agricultural sector and to be mostly well informed of current approaches emerging within the sector. They have more access to resources, at least from the Government's consolidated funds disbursed to them on an annual basis. These are all necessary reasons that could contribute to them favouring the use of an AIS approach in research and extension more than other actors, such as NGOs and SLARI.

Disaggregation of the results by respondents with low and high intention to use AIS shows that respondents with high intention had higher means across the three TPB variables. It is surprising that respondents with low intention still had a mean positive attitude (1.27), although lower than those with a high intention to use an AIS approach. This largely supports earlier findings, seen in the preceding sections, that respondents hold a very positive attitude towards the use of an AIS approach in research and extension programmes in the country.

6.7.6 Regression Results of Respondents' Intention to Adopt AIS with the basic TPB Variables

In order to investigate the relative contribution of the TPB constructs, a hierarchical linear regression was run with intention as the dependent variable, and then attitude, subjective norm, and perceived behavioural control in the first step, then with the addition of selected respondent characteristics in the second step. The results are presented in Table 6.. Respondents' perceived behavioural control had the highest influence on their intention to use an AIS approach, followed by their subjective norms. Respondents' attitude had the least influence on their intention to use an AIS approach but was still significant. The results further showed that respondents' attitude, subjective norm, and perceived behavioural control had significant and positive influence on their intention to use an AIS approach in the next 12 months. This is consistent with findings in earlier sections which showed that a positive and significant correlation exists between respondents' attitude, subjective norm, and perceived behavioural control, and their intention to use an AIS approach. Further, the addition of a selection of respondents' socio-economic characteristics (education and experience) mediated the influence of the TPB variables on intention. Only the number of years of experience of respondents as research and extension professionals had a significant but negative influence on intention. The level of education is not significantly different from 0. However, the added characteristics of respondents significantly influenced the relationship between the TPB variables and their intention to use an AIS approach. This resulted in respondents' attitude having a higher influence on their intention than their subjective norm, though the perceived behavioural control remains the highest. The subjective norm had the least influence on respondents' intention and was insignificant. This suggests that respondents' level of education and experience in research and extension have a mediation effect on the TPB variables as they relate to their intention to use an AIS approach.

Table 6.7: Results of the hierarchical regression analysis on intention to adopt AIS, with basic TPB variables only in the first step, and farmer characteristics added in the second step

Variables	Standardized Coefficients
ATT	0.237**
SN	0.240**

PBC	0.289***
ATT	0.337***
SN	0.141
PBC	0.343***
Level of education	0.086
Years of experience	-0.376***

** P<0.01

***P<0.001

6.8 Summary of Findings

This chapter presents findings that emerged from data collected with the aim of examining respondents' beliefs and attitudes towards the adoption of an AIS approach in research and extension programmes. Adoption of an AIS means exhibiting a variety of behaviours that contribute to the effective engagement of diverse actors beyond agricultural research and extension in innovation processes. A clear definition of an AIS approach was provided by the researcher to reinforce respondents existing knowledge and to ensure uniform understanding of the concept.

The key variables examined in this chapter include: socio-economic characteristics of research and extension professionals (respondents) and their influence on the beliefs and attitudes of those professionals towards the use of an AIS approach; the constraints they face in executing their duties; their knowledge of an AIS approach; beliefs about their own and farmers' roles in agricultural innovation processes; beliefs about behaviours that constitute an effective AIS approach; and finally, the TPB variables used to understand beliefs and attitudes of respondents' towards the adoption of an AIS approach.

The findings, with respect to respondents' socio-economic characteristics, are that majority of respondents are male, and mostly fall within the age bracket of 31-40 years. Bachelor's or Master's degrees were the most commonly held qualifications among respondents. More than half of respondents had: a background in farming; participated in training related to their roles in the last 12 months and in inter-agency meetings; research and extension experience; served in their current organisation for between one to ten years; the ability to speak the local language of their areas of operation. On the other hand, the majority of respondents had no other source of income in addition to their jobs and were not members of any professional networks.

The major constraints to negatively influence research and extension professionals' execution of their duties in general were: the lack of adequate logistics, including computers, vehicles, internet facilities, software for data analysis, etc; poor remuneration; inadequate financial resources' or limited budgets; poor road conditions/networks; lack of training opportunities; and limited/ageing/unqualified field staff.

Further, the majority of respondents indicated they have a fair understanding of, and experience using, an AIS approach in their activities, and they thought it was an important approach for the success of research and extension activities. However, most of them seem to hold beliefs regarding their own roles, and that of the smallholder farmers, in innovation processes that align to both the linear top-down and the AIS approaches in the delivery of research and extension programmes.

The key behaviours that were perceived to be typical of a functioning AIS approach to be exhibited by research and extension professionals include: use of innovation platforms; use of participatory research methods; strengthening of smallholder farmers' capabilities to independently solve their farming problems; promotion of learning within and between organisations for innovation; formulation of policies favourable for collaboration and partnership; decentralisation of the management of innovation processes; strengthening individual/collective capabilities to innovate; facilitation of complex and dynamic interactions for smallholder farmers' access to knowledge sources, input, and markets; promotion of network-based knowledge dissemination among various actors; and having confidence in all stakeholders in innovation processes. The majority of the respondents alluded to having exhibited these behaviours in the last 12 months before the study.

The majority of respondents showed high intention to use an AIS approach in research and extension programmes, although intentions vary with organisation. Staff from MAFFS had the highest intentions, followed by NGOs, and then SLARI. Additionally, a significant and positive association was found between respondents' attitudes, subjective norms, and perceived behavioural control, and their intention to use an AIS approach in research and extension in the next 12 months.

However, respondents perceived control over the use of an AIS approach had the highest influence on intention, followed by advice from people within their social circles (social referents), who include, employers, supervisors, colleagues, donors, farmers, community leaders, and family members, with the first four groups having the highest influence. Their attitudes had the least influence. When factors such as level of education and experience were considered, respondents' attitudes had the second highest influence on their intentions after their perceived control, which remained the highest. It seems that people within their social circles do not have any significant influence in this case.

In addition to beliefs that constitute the direct formation of the TPB constructs, the following are underlying attitudes that contribute to respondents' attitudes and PBC in relation to the use of an AIS approach. Beliefs that contribute to respondents' positive attitudes include the ability of an AIS approach for: increased productivity and profitability of innovations; food security; effectiveness and sustainability of innovations; capacity development of stakeholders; access to markets; and, for stakeholders to have the ability to innovate and to reduce burden on any one actor. On the other hand, underlying beliefs of respondents that negatively affect their attitudes include: the AIS approach being time consuming, expensive, and difficult to use due to the diverse interests of actors; difficulty in coordination of activities of actors; and difficulty of its use if not enshrined in one's organisational policies. The difficulty associated with the use of AIS amidst actors of differing interests was the most significant belief contributing to negating the attitudes of respondents.

Further, respondents' perceived knowledge and skills in the use of an AIS approach was one of the key underlying beliefs that contributed positively to their perceived behaviour control over the use of an AIS approach, while their perceived lack of adequate financial resources contributed negatively to this perception.

CHAPTER 7 BELIEFS AND ATTITUDES OF RESEARCH AND EXTENSION PROFESSIONALS INFLUENCING THE FACILITATION OF COMPLEX AND DYNAMIC INTERACTIONS AMONG DIVERSE AGRICULTURAL INNOVATION SYSTEM ACTORS

7.1 Introduction

This chapter presents results from an application of the TPB, developed by Ajzen (1985), which examines the beliefs and attitudes of research and extension professionals influencing their intention to facilitate complex and dynamic interactions among diverse AIS actors on rice in Sierra Leone. Such facilitation is considered an important behaviour that needs to be adopted by research and extension actors in order to enhance the effectiveness of the AIS. The study of this behaviour was motivated by its identification as one of the keys to the implementation of a functioning innovation system by respondents during the elicitation stage of the research, as well as the final quantitative survey. In addition to this behaviour being supported in the literature as key for a functioning innovation system, findings in Section 6.6 show that more than half of respondents agreed (35.2%) or agreed strongly (39.3%) with this. Generally, in an AIS approach, the success of innovations is largely perceived as a function of the process of networking and interactive learning among a heterogeneous set of actors, including farmers, traders, research and extension professionals, civil society organisations, processors, etc. (Leeuwis, 2004; Hall et al., 2006). A number of arguments have been put forward in the literature which favour the need for interactions in innovation processes. Hermans et al. (2015), claim that innovations or new ideas are not necessarily the work of one brilliant individual. An effective innovation system is stimulated by interactions which ensure the cooperation and active exchange of ideas through a concept called “social learning” by a collective of various actors. Interactions are the corner stone through which actors in an innovation system are able to align their personal mental models into a shared group model, learn from each other, and form new relationships that develop their capacity to take collective action (Reed et al., 2010; Wals, 2007; Beers et al., 2014; Home et al., 2013). Cantner and Graf (2008), maintained that the accumulation of knowledge and broadening of capabilities of various actors, which can potentially lead to innovation, is accelerated through knowledge and experience exchanges among the actors, and these exchanges characterise the interactions among those actors. Also, innovation processes are seen as interactive and socially embedded networking activities (ibid). Similarly, Turner et al. (2013) recommends the need for strengthening interactions among diverse actors, such as researchers and their organisations, and other actors in knowledge development. Zabala-iturriagagoitia and Jimenez-saez (2007) similarly noted that such interactions are considered crucial for the development of innovations, interactive learning, and technology transfer. This largely supports respondents' perceptions that the interactions are vital for the functioning of an AIS. However, it has been found, in some cases, that interaction does not always contribute to the creation and diffusion of knowledge and that the advantages of interaction to strengthen the innovative capabilities of actors are not always realised in innovation processes (Albuquerque et al., 2007). Therefore, to some extent, this suggests that not all interactions always lead to positive or desired results. The success of interactions in an AIS should be rigorous, consistent, flexible, and well-coordinated for the desired results to be achieved, and this is largely perceived to be influenced by a number of factors, including actors' beliefs and attitudes towards the facilitation of interactions. This study therefore focussed on understanding research and extension professionals' beliefs and attitudes towards the facilitation of complex and dynamic interactions in innovation processes. For the purpose of this study, complex and dynamic interactions are defined as those interactions involving a multiplicity of actors beyond research and extension who exchange well-coordinated ideas, experiences, knowledge, and services recurrently over a given period of time; and who modify their exchanges, as and when required, in agricultural innovation processes.

The TPB was used to examine research and extension actors' beliefs and attitudes towards the facilitation of complex and dynamic interactions among diverse actors in the innovation processes. As highlighted in Chapter 4, the TPB provides a framework for understanding the rationale for an individual's engagement in the performance of a given behaviour, or not. It suggests that behaviour is influenced by behavioural intention which is, in turn, influenced by three main factors, including the individual's attitudes towards the behaviour, the subjective norms, and the perceived behavioural control. For this study, the key behaviour under investigation is the facilitation of complex and dynamic interactions among diverse actors. The TPB variables (intention, attitudes, perceived behavioural control, and subjective norm) were used to help understand and predict middle and frontline extension professionals' intention to engage in the facilitation of complex and dynamic interactions, and by extension, their beliefs and attitudes towards this.

Data for this study were generated by conducting a sequential mix-method research approach in which qualitative data collection, involving Focus Group Discussions (FGDs), preceded quantitative data collection, involving structured questionnaires. The qualitative data collection involved a total of 12 FGDs conducted among research scientists from SLARI and extension professionals from MAFFS, and NGOs implementing rice-related innovations in the country. The study targeted middle and frontline research and extension professionals from these institutions. Initially targeted at a total of 100 respondents, 30 research scientists from SLARI and 70 extension professionals (35 each from MAFFS and NGOs), only 89 questionnaires were returned by the target respondents (89% response rate), 25 from research scientists (83%), 32 from NGO extension professionals (91% response rate), and 32 from MAFFS extension professionals (91% response rate). Therefore, findings in this chapter are based on data generated from 89 research and extension actors across the country, comprising of middle and frontline professionals in three different domains –MAFFS, NGOs, and SLARI.

This chapter specifically presents findings on the socio-economic characteristics of research and extension actors, the constraints they face, their views on their own and farmers' roles in innovation processes, their perception and knowledge of the AIS approach, and finally, the TPB variables, as follows.

7.2 Theory of Planned Behaviour

The various components of the TPB framework used in the structured questionnaire have already been discussed in detail in Chapter 4. In summary, respondents were asked questions relating to the three TPB components that influence their intention to facilitate complex and dynamic interactions in research and extension, including their formation of attitudes towards the exhibition of this behaviour, the subjective norms (SN) (salient referents) that influence their decision to facilitate complex and dynamic interactions, together with their motivation to comply with those referents, and the perceived behavioural control (PBC) which includes factors that enhance or discourage the facilitation of complex and dynamic interactions in research and extension programmes.

Results of the initial elicitation process were closely examined by the researcher, and those related to the facilitation of complex and dynamic interactions of innovation programmes were identified and used for the design of the questionnaire for the quantitative survey. For attitudes, SN, and PBC, a total of seven outcome beliefs, seven salient referents, and three control beliefs were identified, as can be seen in Boxes 7.1, 7.2, and 7.3 respectively.

Box 7.1: Outcome beliefs used for the calculated attitudes relating to facilitating complex and dynamic interactions

1. Complex and dynamic interaction enhances access to knowledge sources, information and markets by smallholder farmers.
2. It enhances the effectiveness and sustainability of innovations on rice
3. It fosters capacity development of agricultural innovation actors
4. It is difficult to obtain commitment of diverse agricultural innovation stakeholders
5. Differing interests/objectives of diverse stakeholders make it difficult to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders.
6. Facilitating complex and dynamic interactions of diverse agricultural innovation stakeholders in research and extension is time consuming
7. It is difficult to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders in research and extension.

Box 7.2: Control beliefs used for the calculated perceived behavioural control

1.The lack of capacity to facilitate complex and dynamic interactions
2. The lack of adequate financial resources
3. The lack of cooperation from and behaviour of other actors

Box 7.3: Salient referents used for the calculated subjective norm

1. Employer
2. Supervisor
3. Professional colleagues
4. Donors
5. Farmers
6. Community leaders
7. Family members

7.2.1 Research and Extension Professionals' Stated Intentions to Facilitate Complex and Dynamic Interactions among Stakeholders

Respondents' intentions were measured using three items. These included asking if they: i) intended; ii) wanted; or, iii) expected to facilitate complex and dynamic interactions among diverse actors in agricultural innovation processes. Their responses were scored on a Likert-type scale ranging from 1-5, with 1 denoting "disagree strongly" and 5 denoting "agree strongly" with the statements. These were then recoded in SPSS using a 5-point bipolar scale ranging from -2 to +2. Details of the methodology can be found in Chapter 4.

Reliability analysis of the scale used was calculated using Cronbach's Alpha Reliability Coefficient. This gave a reliability coefficient of 0.902, which shows that the internal consistency of the scale used is highly reliable. As presented in Table 7.1 below, further analyses show that majority of the respondents have a positive intention to facilitate complex and dynamic interactions in innovation processes, as the majority either agreed (59.6%) or agreed strongly (11.2%). Meanwhile, up to 22.5% of respondents were undecided, and only a few (6.7%) had a negative intention toward such facilitation. The mean intention for all respondents was 0.73 (in a possible range of -2 to +2), with MAFFS staff having the highest mean score (0.81), followed by NGOs (0.75), and SLARI (0.60). These results suggest a generally positive intention to facilitate complex and dynamic interactions by research and extension professionals in innovation processes, although it does not seem high enough for professionals from SLARI and NGOs compared to those from MAFFS. MAFFS professionals had the highest intention, which cannot be unconnected with the fact that they see themselves as pace-setters and, therefore, feel more obliged to ensure the effectiveness of agricultural innovation programmes by adopting techniques that would ensure this.

Table 7.1:Respondents' intention to facilitate interactions among diverse innovation actors

Intention to facilitate interactions (n=89)			**Mean Intention by Organisation (n=89)**		
	Frequency	%	Organisation	Mean Intention	Std Deviation
Strongly disagree	2	2.2	MAFFS	0.813	1.0298
Disagree	4	4.5	SLARI	0.600	0.7071
Undecided	20	22.5	NGO	0.750	0.6222
Agree	53	59.6			
Strongly agree	10	11.2			
Total	**89**	**100.0**	**Total**	0.730	0.8085

Source: Field Survey, 2017

Table 7.2 below shows the results of mean comparisons between respondents' mean stated intentions and their socio-economic characteristics, and the correlation that exists between selected socio-economic characteristics and their intentions to facilitate complex and dynamic interactions in agricultural innovation processes. The results show that female professionals had a higher positive mean intention (0.80) than their male counterparts (0.36), suggesting that females are more likely to do facilitate complex interactions than their male counterparts.

Research and extension professionals over 50 years old had the highest mean stated intention (1.13) to facilitate complex interactions compared to those of younger ages. However, the youngest cadre of professionals (18-30 years) had the second highest mean stated intention (0.77), while those from 31-40 years and 41-50 years had mean stated intentions of 0.62 and 0.58, respectively. The results seem to suggest a decreasing intention with age, but the two extremes constitute the highest mean intentions. This contrasts slightly with earlier findings, reported in Chapter 6, which showed an overall decrease in intention of respondents as age increased. It can be argued that the youngest and oldest cadres of professionals may be more aware of the importance of facilitating complex interactions among diverse actors for a number of reasons. The younger ones may be new graduates, which may mean they are highly aware of current trends in agricultural innovation processes, while their oldest counterparts may have accumulated some field experience that has increased their understanding of the importance of facilitating interactions among diverse actors for successful innovation processes and systems. A positive, but insignificant, association ($r=0.091$; $p>0.05$) exists between respondents age and their intention to facilitate complex and dynamic interactions in innovation processes.

Further, the mean stated intention differs between middle and frontline research and extension professionals, with the middle professionals having a higher mean stated intention (0.77) than their frontline counterparts (0.66). This is possibly due to the fact that middle level professionals may be more aware of the usefulness of engaging diverse agricultural innovation actors, largely due to their positions in the management cadre, compared to their frontline counterparts. However, a positive but insignificant association ($r=0.055$; $P<0.05$) exists between respondents' managerial hierarchy and their intention to facilitate complex and dynamic interactions.

The results also show that a positive but insignificant association ($r=0.165$; $p>0.05$) exists between respondents' experience in research and extension activities and their intention to facilitate complex and dynamic interactions. Also, the mean stated intention was highest for respondents with research and extension experience between 11-15 years (1.40), followed by those with experience from 16-20 years (1.0). Those with fewer years of experience had a lower mean stated intention – 0.67 for each of those with 1-5 and 6-10 years of experience. This is possibly due to the fact that respondents with a higher number of years of experience may feel more confident to facilitate interactions among diverse actors, compared to those with fewer years of experience.

Table 7.2: Correlation between selected socio-economic characteristics of respondents and their mean intention to facilitate complex interactions in research and extension

Socio-economic characteristics	Categories	Frequency (n=89)	Mean stated Intention	Correlation with Intention (P-value in parenthesis)
Sex	Male	75	0.800	-
	Female	14	0.357	
Age of respondents	18-30yrs	17	0.765	0.091 (0.394)
	31-40yrs	37	0.622	
	41-50yrs	19	0.579	
	Above 50yrs	16	1.125	
Managerial hierarchy of respondent	Frontline	32	0.656	0.055 (0.606)
	Middle	57	0.772	
Years of experience in research and extension	1-5yrs	64	0.672	0.165 (0.122)
	6-10yrs	15	0.667	
	11-15yrs	5	1.400	
	16-20yrs	5	1.000	
Membership in professional networks	Yes	33	0.636	-
	No	56	0.786	
Do you have a farming background	Yes	81	0.716	-
	No	8	0.875	
Level of education of respondent	College Certificate	12	1.250	-0.410** (0.000)
	College Diploma	20	0.900	
	Bachelor's Degree	41	0.707	
	Master’s degree	16	0.188	
Speak community language	Yes	68	0.735	-
	No	21	0.714	
Other sources of income	Yes	29	0.621	-
	No	60	0.783	

** Correlation is significant at the 0.01 level (2-tailed).

Furthermore, respondents who are members of professional networks had a lower mean stated intention (0.64) compared to non-members (0.79). This is surprising as one would expect that members of professional networks would have an influence on one's capacity and willingness to facilitate interactions among diverse actors. Similarly, surprising findings were also observed with respect to respondents farming background. Those with a farming background had a lower mean stated intention (0.72), while those without a farming background had a higher mean stated intention (0.88).

Surprisingly, the results show that respondents with a college certificate had the highest mean intention (1.25) to facilitate interactions compared to respondents with any other qualification, including those with higher qualifications (Bachelor's or Master's degrees). The results even showed a decreasing mean intention with increasing levels of qualification – the higher the qualification, the lower the intention. This is surprising, because one would expect that highly qualified professionals would have a higher mean intention. Consistently, a negative and significant association ($r=-0.410$; $p<0.01$) exists between respondents' level of education and the mean intention to facilitate complex and dynamic interactions among diverse actors in innovation processes.

Research and extension professionals who can speak the local language of their communities of operation had a higher mean stated intention (0.74) to facilitate complex and dynamic interactions than their counterparts who cannot (0.71). This cannot be unconnected with the confidence they have in being able to mobilise community stakeholders with little or no communication constraints. On the other hand, respondents with another source of income had a lower mean intention (0.62) compared to those who do not (0.78).

7.2.2 Respondents' Attitudes towards the Facilitation of Complex Interactions in Research and Extension

The four items used to measure the stated attitudes of respondents were analysed for reliability using Cronbach's alpha reliability coefficient. The alpha coefficient is 0.797, which shows there is internal consistency of the items used and that the scale may be considered 78% reliable.

The nature of attitude held by respondents towards the facilitation of complex and dynamic interactions are shown in Table 7.3. The majority of respondents (71.9%) had an overall positive attitude, 27.0% had a neutral attitude, and only 1.1% had a strongly negative attitude. NGOs had a higher positive attitude (31.4%) compared to their MAFFS (22.5%) and SLARI (18.0%) counterparts. Consistently, the overall mean attitude for all respondents is 1.0 (out of a possible range of -2 to +2). Similarly, disaggregation by gender and organisation show that all three organisations have a highly positive attitude towards the facilitation of complex and dynamic interactions in innovation processes, with the mean attitudes for MAFFS, SLARI, and NGOs being 0.84, 0.80 and 1.31, respectively. However, respondents from NGOs had a more positive attitude (1.31) than their MAFFS (0.84) and SLARI (0.80) counterparts.

7.2.2.1 Stated Attitudes of Respondents

Table 7.3:Respondents' attitude towards facilitating complex interactions disaggregated by organisation

	MAFFS		SLARI		NGOs		Whole Sample	
ATTITUDE	F	%	F	%	F	%	F	%
Strongly negative	1	1.1	0	0.0	0	0.0	1	1.1
Negative	-	-	-	-	-	-	-	-
Neutral	11	12.4	9	10.1	4	4.5	24	27.0
Positive	11	12.4	12	13.5	14	15.7	37	41.6
Strongly positive	9	10.1	4	4.5	14	15.7	27	30.3

Source: Field Survey, 2016/17

On a gender basis (Table 7.4), male respondents had a more positive mean attitude (1.01) towards interactions than their female counterparts (0.93). A similar trend of male respondents having a higher positive attitude towards such facilitation than their female counterparts is observed within SLARI and NGOs, only in MAFFS did female professionals have a higher mean attitude (1.14) than their male counterparts (0.76).

Table 7.4:The mean attitude of respondents by organisation and gender

Name/category of organisation	Sex of Respondent	Mean	Std. Deviation	Correlation with intention		
MAFFS (n=32)	Male	0.760	0.9256		Attitude	Intention
	Female	1.143	1.0690	Attitude	1.00	**0.440****
	Total	0.844	0.9541			
SLARI (n=25)	Male	0.870	0.6944	Intention	**0.440****	1.000
	Female	0.000	0.0000			
	Total	0.800	0.7071			
NGO (n=32)	Male	1.370	0.7415			
	Female	1.000	0.0000			
	Total	1.313	0.6927			
Total (n=89)	**Male**	1.013	0.8301			
	Female	0.929	0.8287			
	Total	1.000	0.8257			

Source: Field Survey, 2016/17

Finally, a positive and significant association ($r=0.440$; $p<0.001$) exists between respondents' attitude and their intentions to facilitate complex and dynamic interactions in innovation processes. This generally positive attitude suggests that research and extension professionals are aware of the positive effects of this facilitation and the overall impact it may have on the achievement of their broad objectives in their respective organisations. This also suggests that, all other conditions being equal, there is a high tendency for facilitation of interactions by these professionals, evident in a highly positive attitude towards the behaviour.

7.2.2.2 Calculated Attitudes of Respondents for the Facilitation of Complex and Dynamic Interactions in Innovation Processes

The Calculated Attitude (CA) towards the facilitation of complex and dynamic interactions was derived from the summation of the product of the values of the seven outcome belief statements elicited during the FGDs and their outcome evaluation. The individual outcome attitude score was derived from the product of the individual belief strengths of each belief statement (bi) and their corresponding outcome evaluation measure (e_i). These gave the outcome attitude for each belief statement (b_i*e_i) whose values ranged from -4 to +4. These outcome attitudes were then summed up ($\sum b_i*e_i$) to give the calculated attitude of respondents towards the facilitation of complex and dynamic interactions in innovation processes.

Outcome belief strength, outcome evaluation and attitude disaggregated by organisation

As shown in Table 7.6, the calculated attitude for respondents' facilitation of complex and dynamic interactions in innovation processes is 3.63, out of a possible range of -28 to +28. This shows an almost neutral attitude and is consistent with earlier findings, reported in the preceding sections; i.e., respondents have a generally positive attitude towards the facilitation of complex and dynamic interactions in innovation processes. A further disaggregation of the results by organisation showed that respondents from NGOs and SLARI had a higher positive mean attitude (4.71 and 4.48 respectively) compared to their counterparts at MAFFS (1.90). These findings contrast slightly with those in Section 7.2.2.1 in which NGOs showed the highest stated attitude, followed by MAFFS and SLARI. Here, MAFFS had the lowest, but still positive, calculated attitude. These results show that research and extension actors hold a positive attitude towards the facilitation of complex and dynamic interactions in innovation processes, and imply, where all other conditions are met or remain equal, that research and extension professionals have a likely tendency to facilitate these dynamic interactions.

A number of beliefs held by respondents could contribute to the formulation of negative attitudes, and some to the formulation of positive attitudes. As shown in Table 7.6, up to five belief statements have an overall negative outcome attitude, which implies a tendency of weakening respondents' motivation or favourable attitude towards the facilitation of complex and dynamic interactions in research and extension. Beliefs, including obtaining the commitment of diverse agricultural innovation stakeholders, the differing interests/objectives of diverse innovation stakeholders, and the general difficulties associated with mobilisation of innovation actors, are key factors that would likely impede research and extension actors' willingness to facilitate complex and dynamic interactions in innovation processes on rice.

It is interesting to note that most of these beliefs are consistent with the literature on some of the key challenges that could deter facilitation, as indicated by Klerkx et al. (2012). This, therefore, suggests that these beliefs can potentially impede the facilitation of complex interactions in innovation processes among research and extension professionals in Sierra Leone and beyond.

Table 7.5: Comparison of mean outcome belief strength (bi), outcome evaluation (ei) and attitude disaggregated by organisation*

Outcome belief statements	MAFFS			SLARI			NGOs			TOTAL		
	Belief strength (b_i)	Outcome evaluation (e_i)	**Outcome Attitude (b_i* e_i)**	Belief strength (b_i)	Outcome evalutaion (e_i)	**Outcome Attitude (b_i* e_i)**	Belief strength (b_i)	Evaluation of outcome (e_i)	**Outcome Attitude (b_i* e_i)**	Belief strength (b_i)	Outcome evaluation (e_i)	**Outcome Attitude (b_i* e_i)**
1. Complex and dynamic interaction enhances access to knowledge sources, information and markets by smallholder farmers.	0.63	1.03	**0.84**	1.08	1.44	**1.68**	1.53	1.75	**2.81**	1.08	1.40	**1.79**
2. It enhances the effectiveness and sustainability of innovations on rice	0.75	1.16	**0.97**	1.20	1.36	**1.88**	0.97	1.69	**1.63**	0.96	1.40	**1.46**
3. It fosters capacity development of agricultural innovation actors	0.69	1.00	**0.66**	1.16	1.28	**1.52**	1.06	1.13	**1.13**	0.96	1.12	**1.07**
4. It is difficult to obtain commitment of diverse agricultural innovation stakeholders	0.47	-0.28	**-0.38**	0.20	0.12	**-0.04**	-0.10	-0.34	**-0.29**	0.19	-0.19	**-0.25**
5. Differing interests/objectives of diverse stakeholders make it difficult to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders.	0.47	0.16	**0.22**	0.40	-0.20	**-0.32**	0.71	-0.09	**-0.71**	0.53	-0.03	**-0.26**
6. Facilitating complex and dynamic interactions of diverse agricultural innovation stakeholders in research and extension is time consuming	0.81	-0.34	**-0.22**	0.68	0.20	**0.08**	-0.37	0.03	**0.28**	0.35	-0.06	**0.04**
7. It is difficult to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders in research and extension.	0.53	-0.06	**-0.19**	0.44	-0.32	**-0.32**	0.03	0.12	**-0.19**	0.33	-0.07	**-0.22**
Calculated attitude ($\sum b_i * e_i$): Possible range -28 to +28			**1.90**			**4.48**			4.71			3.63

Source: Field Survey, 2016/17

* Possible range of -2 to +2.

Correlation of calculated attitude with research and extension professionals' intentions to facilitate complex and dynamic interactions in innovation processes

The correlation between research and extension professionals' intentions to facilitate complex and dynamic interactions and their calculated attitude is presented in Table 7.6, below. Overall, a positive and significant association ($r=0.287$; $p<0.01$) exists between respondents calculated attitude and their intentions. This largely conforms with findings in the preceding section, and also corroborates the level of positivity of respondents' attitudes towards this facilitation. The majority of outcome attitudes had a positive association, however, only three had a significant association with their intention, including the belief that complex and dynamic interactions: enhance the effectiveness and sustainability of innovations on rice ($r= 0.296$; $p<0.01$); foster capacity development of agricultural innovation actors ($r=0.298$; $p<0.01$); and are time consuming ($r=0.224$; $P<0.05$). Two belief statements, including difficulty due to differing interests of innovation actors ($r=-0.006$; $p>0.05$) and difficulty associated with the general mobilisation of actors ($r=-0.022$; $p>0.05$), had outcome attitudes with a negative, insignificant association with respondents' intentions to facilitate interactions. It is clear from these findings that a number of belief statements are supportive, and are therefore likely to motivate research and extension actors. These include beliefs such as their ability to: enhance the effectiveness and sustainability of innovations on rice; foster capacity development of agricultural innovation actors; and increase access to knowledge sources, information, and markets by smallholder farmers.

Table 7.6: Correlation between research and extension professionals' intention to facilitate complex interactions and their calculated attitude

Outcome belief statements	Belief strength (b_i)	Outcome evaluation (e_i)	Outcome Attitude **(b_i* e_i)**
1. Complex and dynamic interaction enhances access to knowledge sources, information and markets by smallholder farmers.	-0.004	0.023	0.045
2. It enhances the effectiveness and sustainability of innovations on rice	0.285**	0.195	0.296**
3. It fosters capacity development of agricultural innovation actors	0.378**	0.111	0.298**
4. It is difficult to obtain commitment of diverse agricultural innovation stakeholders	0.295**	-0.352**	0.036
5. Differing interests/objectives of diverse stakeholders make it difficult to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders.	0.291**	-0.224*	-0.006
6. Facilitating complex and dynamic interactions of diverse agricultural innovation stakeholders in research and extension is time consuming	0.152	0.018	0.224*
7. It is difficult to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders in research and extension.	0.139	-0.181	-0.022
Calculated Attitude (∑bi*e_i): Possible range -52 to +52			0.287**

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

7.2.3 Perceived Behavioural Control

The perceived behavioural control examined in this study is explained in the following subsections.

7.2.3.1 Identification of Factors that Enhance or Constrain the Functioning/Facilitation of Complex and Dynamic Interactions

In the TPB, the PBC strives to elicit some of the factors that determine the extent to which the behaviour is under the individual's control – normally called control factors. This is achieved by examining the individual's perceptions about the ease or difficulty associated with them performing the behaviour in question, as well as other factors that they consider relevant in enhancing or deterring their performance of the behaviour (Ajzen & Madden, 1986; Paul Sparks & Guthrie, 1998). In this study, the PBC is used to help identify factors and perceptions that may constrain or enhance research and extension professionals' intentions to facilitate complex and dynamic interactions in research and extension programmes. These factors and perceptions have been disaggregated, consistent with the TPB, into direct (stated) and indirect (calculated) PBC, as follows.

7.2.3.2 The Stated Perceived Behavioural Control by Respondents' Organisation and Gender

The stated PBC was determined by responses made by research and extension professionals to statements which assess the extent to which: they feel confident; they perceive the process to be easy or difficult; they have control over decisions; and, they feel it is up to them to facilitate complex and dynamic interactions in innovation processes.

The Cronbach Alpha reliability coefficient for the four items was 0.524, which means there is some internal consistency within the items and that the scale could be considered reliable. In Table 7.7, the overall mean PBC for all respondents is slightly negative (-0.079), with female respondents having a higher and positive (0.714) PBC than their male counterparts (-0.227). At organisational level, NGO respondents had the highest PBC (0.125) compared to MAFFS (-0.063) and SLARI (-0.360). This suggests that MAFFS and SLARI respondents do not feel confident in the facilitation of complex and dynamic interactions. This is possibly due to the fact that NGO activities seemingly involve the engagement of diverse actors. For instance, based on the researcher's experience, the operations of an NGO in a given locality normally involves its approval as relevant from MAFFS officials, community leaders, the local council, and other NGOs. This may mean that NGO personnel think they already have experience in the engagement of different stakeholders in innovation processes, therefore, doing so in complex and dynamic interactions will be much easier for them. Hence, they showed the highest positive PBC over other respondents from SLARI and MAFFS – the latter being governmental institutions with minimum requirements to seek approval from other actors for the implementation of their programmes.

Finally, the overall mean value for respondents PBC (as can be seen above) is slightly negative. This value is slightly below zero (0) out of a range of -2 to +2. This suggests that respondents have limited control over the facilitation of complex and dynamic interactions in their innovation processes considering their perceptions of the ease of facilitation and the control they have over decisions about the performance of the behaviour. This may be partly explained by to the need for them to seek approval from their employers, donors, or supervisors. This may be a constraining factor in their control over the performance of the behaviour. The next sub-section, which examines the indirect perceived behavioural control, sheds further light on other factors that could be influencing this. A further examination of the SN, including the identification of people important to respondents who can influence their facilitation of complex and dynamic interactions, and the extent to which they can do so, which is carried out in later sections, will help in this direction.

Table 7.7:Respondents mean stated Perceived Behavioural Control by organisation and gender

Name/category of organisation	Gender	Mean stated PBC	Std. Deviation
MAFFS (n=32)	Male	-0.200	1.2247
	Female	0.429	0.5345
	Total	-0.063	1.1341
SLARI (n=25)	Male	-0.478	0.7903
	Female	1.000	0.0000
	Total	-0.3600	0.8602
NGO (n=32)	Male	-0.037	0.1925
	Female	1.000	0.0000
	Total	0.125	0.4212
Whole sample (n=89)	**Male**	-0.227	0.8475
	Female	0.714	0.4688
	Total	-0.079	0.8690

Source: Field Survey, 2016/17

Belief Statements Underpinning Respondents Direct PBC for Facilitating Complex and Dynamic Interactions

The belief statements underlying respondents PBC are shown in Table 7.8, below. Although respondents feel confident to facilitate interactions, they think it is not easy to do so. This has contributed to the low Cronbach's alpha coefficient for the direct PBC. Up to half of respondents agreed or agreed strongly that they are confident about the facilitation of complex and dynamic interactions in research and extension programmes. However, a noticeable proportion of respondents were either neutral (30.3%), or disagreed (13.5%). For the other three items measured, fewer than half of the respondents agreed, or agreed strongly, that the facilitation of complex and dynamic interactions is easy, the decision to do so being within their control, or that it is entirely up to them to do the facilitating. A good proportion of respondents were either neutral or disagreed over the three statements. This was also supported by the very low means (close to 0) for all the four statements measured.

This corroborates the overall low mean value of respondents PBC over the facilitation of complex and dynamic interactions in research and extension programmes across the three organisations. This suggests that respondents have relatively low control over the performance of the behaviour, which cannot be unconnected with their perceived low level of control over the decision to exhibit the behaviour and their perception of it being difficult to exhibit.

Table 7.8:Respondents' PBC beliefs for facilitating complex and dynamic interactions

I am confident that I can facilitate complex interactions if I wanted to (PBC1) **(n=89) (Mean =0.38).**			For me to facilitate complex interactions in research and extension is easy (PBC2) **(n=89) (Mean =-0.20)**		The decision to facilitate complex interactions is beyond my control[15] (PBC3) **(n=89) (Mean =0.15).**		Whether or not I facilitate complex interactions is entirely up to me (PBC4) **(n=89) (Mean =-0.26).**	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**
Strongly disagree	5	5.6	13	14.6	13	14.6	17	19.1
Disagree	12	13.5	19	21.3	17	19.1	23	25.8
Neutral	27	30.3	36	40.4	20	22.5	23	25.8
Agree	34	38.2	15	16.9	22	24.7	18	20.2
Strongly agree	11	12.4	6	6.7	17	19.1	8	9.0

Source: Field Survey, 2016/17

Mean comparison, and correlations between respondents' socio-economic characteristics and their stated Perceived Behaviour Control (PBC)

In Table 7.9 below, the mean stated PBC was disaggregated by respondents' socio-economic characteristics and correlation of each characteristic to the stated PBC. The results show that younger respondents (18-30 years) had a higher and positive mean PBC (0.353) compared to their older counterparts, who had negative mean PBC. However, the overall association between age and the stated PBC, though positive, was insignificant. On the other hand, respondents with the lowest research and extension experience (1-5 years) had the highest mean PBC (0.016) compared to those with more years of experience. However, an insignificant, though positive, association ($r=0.125$; $p>0.05$) exists between respondents' years of experience and their stated PBC. Further, middle-level research and extension professionals had a higher

[15] The scores were reverse coded because the statement was negatively worded.

and positive mean PBC (0.031) compared to their frontline counterparts (-0.140), with a negative and significant association between respondents' managerial hierarchy and their stated PBC. This is possibly because middle level respondents may have a better influence over decision making in their respective organisations compared to frontline professionals, who are lower down in the hierarchy.

Table 7.9:Mean comparison of stated PBC and correlation between selected socio-economic characteristics of respondents and their stated PBC

Socio-economic characteristics	Categories	Frequency	Mean stated PBC	Correlation with stated PBC
Age of respondents	18-30yrs	17	0.353	**0.097**
	31-40yrs	37	-0.108	
	41-50yrs	19	-0.158	
	Above 50yrs	16	-0.375	
Management hierarchy	Middle	32	0.031	-0.195*
	Frontline	57	-0.140	
Years of experience in research and extension	1-5yrs	64	0.016	**0.125**
	6-10yrs	15	-0.067	
	11-15yrs	5	-1.000	
	16-20yrs	5	-0.400	
Membership in professional networks	Yes	33	0.182	-0.042
	No	56	-0.232	
Do you have a farming background	Yes	81	-0.074	-0.010
	No	8	-0.125	
Level of education of respondent	College Certificate	12	-0.079	-0.489**
	College Diploma	20	-0.150	
	Bachelor's Degree	41	0.024	
	Master's degree	16	-0.125	
	PhD	3		
Other sources of income in addition to job	Yes	29	0.172	0.179
	No	60	-0.200	
Speak community language	Yes	68	-0.015	-0.146
	No	21	-0.286	
Organisation	MAFFS	32	-0.063	0.120
	SLARI	25	-0.360	
	NGO	32	0.125	

*Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Further, respondents who indicated they were members of a professional network had a higher mean stated PBC (0.182) compared to their counterparts (-0.232); but with a negative and insignificant association between belonging to a professional network and respondents stated PBC (r=-0.042, P>0.05).

Interestingly, a negative but significant association exists between respondents' level of education and their stated PBC (r=-0.489, P<0.01); the mean stated PBC of respondents with a Bachelor's degree was the highest (0.024). This is interesting because one would expect that people who are highly educated would have a higher PBC as they are likely to be in leadership positions which would allow them to influence decisions at every level in their organisations. On this basis, respondents with a Master's degree should have had a higher mean PBC than those with lower qualifications. However, it is possible, in this case, that some professionals are better educated than their supervisors, and therefore have limited control over decisions about their activities irrespective of their qualifications. For example, in SLARI, most researchers are younger graduates who are newly employed and are still under the supervision of older employees who are usually less academically qualified than the new recruits. This seems to be a trend across most institutions in Sierra Leone due to an increasing awareness among younger professionals of the essence of education.

Further, respondents' background in farming had a negative and insignificant association (r=-0.010; P>0.05), while both those with and without a background in farming had a negative mean PBC. Also, respondents with other sources of income had a higher stated mean PBC (0.172) compared to those who do not (-0.200), and with an overall positive, though insignificant, association (r=0.179; P>0.05) between respondents mean stated PBC and having other sources of income. This suggests that research and extension professionals who have other sources of income are more likely to have control over the facilitation of complex and dynamic interactions compared to their counterparts. This is in contrast to findings in the previous chapter where respondents with no other sources of income had the highest mean PBC compared to their counterparts. Additionally, respondents' ability to speak the community language and the organisations to which they belong both had an insignificant association with their stated PBC.

Overall, apart from respondents' managerial hierarchy and level of education, which both had a negative association, the remainder of the socio-economic characteristics of respondents do not have a significant association with respondents mean stated PBC. This, therefore, suggests that most respondents' characteristics do not largely influence their perceived behavioural control over the facilitation of complex and dynamic interactions in research and extension activities.

Correlations between Stated PBC and Respondents' Characteristics and their Intention to Facilitate Complex and Dynamic interactions

In Table 7.10, the association between statements measuring respondents PBC and their intention to facilitate complex and dynamic interactions are presented. The results showed that a positive and significant association ($r=0.309$, $P<0.01$) exists between respondents' confidence in the facilitation of complex and dynamic interactions (PBC1), and their intention to exhibit the behaviour in the next 12 months. On the other hand, a negative and insignificant association exists between respondents intention and their perception on how easy it is (PBC2) to facilitate complex and dynamic interactions ($r=-0.021$; $P>0.05$), and on whether they think it is up to them (PBC4) to do so ($r=-0.024$; $P>0.05$); while a positive and significant association exists between respondents perception of their control over the decision (PBC3) to facilitate complex and dynamic interactions and their intention ($r=0.479$; $P<0.01$). These results seem to suggest that respondents' confidence and their control over such decisions can significantly influence (enable or constrain) their intention, and subsequently, use of the behaviour in research and extension programmes. In practice, it means that the more confident research and extension professionals are, and the more control they have over the decision, the more likely they are to adopt the facilitation of complex and dynamic interactions in their activities.

Table 7.10:Correlation between stated PBC and intention to facilitate complex interactions

	Intention	PBC1	PBC2	PBC3	PBC4
Intention	1.000	0.309**	-0.021	0.479**	-0.024
PBC1		1.000	0.280**	0.210*	0.255*
PBC2			1.000	-0.159	0.375**
PBC3				1.000	-0.272*
PBC4					1.000

	Average PBC	Intention
Average PBC	1.000	**-0.182**
Intention	**-0.182**	1.000

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

7.6.3.3 The Indirect PBC

The indirect attitude was measured using the summated product of the control beliefs and power of control as related to the facilitation of complex and dynamic interactions. As described in Chapter 4, the control beliefs were generated by respondents during the elicitation part of the study. These statements were then incorporated into the structured questionnaire for the generation of data to compute the calculated or indirect PBC. A total of three *control beliefs* (i.e., factors that constrain or encourage research and extension professionals in facilitation of complex and dynamic interactions) were identified (see Box 7.2), including: 1) the lack of capacity to facilitate complex and dynamic interactions; 2) the lack of adequate financial resources; and, 3) the lack of cooperation from, and the behaviour of, other actors.
These were scored on a 5-point bipolar Likert scale ranging from -2 to +2. The *power of control* factors, on the other hand, involved the rating of the relative importance of each salient control belief statement by respondents, and these were also scored on a 5-point bipolar scale ranging from -2 to +2.

The results in Table 7.11, below, show that the control belief statements about lack of capacity and lack of adequate financial resources had positive means of 0.61 and 0.79, respectively. This suggests that these are likely to be factors that could constrain respondents' ability to facilitate complex and dynamic interactions; being positive means agreeing that the factors are constraining. However, a negative mean (-0.31) for the belief statement about the lack of cooperation from, and the behaviour of, other actors, means that respondents generally disagreed with this statement, meaning it could not be considered a constraining factor.

However, the mean PBC for two of the statements had a negative association with respondents' intentions. For the *lack of capacity* and *financial resources* statements there was a negative and significant association; this further supports these as factors that could constrain respondents' ability to facilitate complex and dynamic interactions.

Overall, the calculated PBC is mildly negative (-2.73, out of a possible range of -12 to +12), with a negative and significant association with respondents' intentions. This suggests that the belief statements are generally constraining factors towards respondents' ability to facilitate complex and dynamic interactions.

Table 7.11:Mean control beliefs, power of control beliefs and perceived behavioural control and correlation with intention to facilitate complex and dynamic interactions

Control beliefs statements (n=122)	Mean control belief (C_b)	Mean power of control beliefs (P_b)	Behavioural control ($\sum C_b*P_b$)	Correlation (r) with intention
1. The lack of capacity to facilitate complex and dynamic interactions	**0.61**	-0.72	-0.60	-0.230*
2. The lack of adequate financial resources	**0.79**	-1.28	-1.71	-0.431**
3. The lack of cooperation from and behaviour of other actors	**-0.31**	1.24	-0.43	-0.054
Calculated PBC **($\sum C_b*P_b$), range: -12 to +12**			**-2.73**	**-0.419****

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

7.2.4 Subjective Norm

The SN for this study was computed using the direct (stated) and indirect (calculated) methods. In the direct method, the following four key questions were asked of respondents:

1) "*Most people who are important to me think that I should facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders".*

2) "It is expected of me that I facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders.

3) "I feel under social pressure to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders".

4) "People who are important to me want me to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders".

The responses were recorded on a Likert scale ranging from 1 to 5 and then recoded after the data collection to a 5-point bipolar Likert scale ranging from -2 to +2.

In the indirect or calculated SN, respondents were asked:

1) to indicate the likelihood of the salient referents identified in the elicitation process (employer, supervisor, colleagues, family members, donors, community leaders, and farmers) wanting to facilitate complex and dynamic interactions; and then

2) to indicate the likely motivation for them to comply with the advice of these referents over the next 12 months in their facilitation of complex and dynamic interactions in research and extension programmes.

The responses were also recorded using a Likert scale ranging from 1 to 5 and then recoded into a 5-point bipolar Likert scale ranging from -2 to +2. The ensuing results of both methods are presented next.

7.2.4.1 Direct Measure of Subjective Norm (stated subjective norm)

The Cronbach's Alpha Reliability coefficient used for the four statements which measured the direct or stated SN is 0.698, this indicates that there is up to 70% consistency in the statements and that the scale can be considered reliable. The mean SN for all respondents is 0.35 (see Table 7.12) out of a range of -2 to +2. This showed a positive mean direct SN, meaning that the salient referents are likely to be in favour of respondents' facilitation of complex and dynamic interactions. Interestingly, male respondents had a higher mean SN (0.400) than their female colleagues (0.071), though this was not statistically significant. A similar trend of males having higher mean SN than their female counterparts was observed across the three cohorts of organisations studied – MAFFS, SLARI, and NGOs.

However, the mean stated SN across the three organisations is different. MAFFS had the highest mean SN (0.438), followed by NGOs (0.406), and SLARI (0.160). The low mean SN for SLARI mean that the salient referents for respondents from SLARI offer less favourable support towards respondents' facilitation of complex and dynamic interactions in research and extension programmes. This is consistent with the findings in earlier sections, such as having the least mean attitude, intention, and PBC, compared to MAFFS and NGOs.

Table 7.12: Respondents mean stated subjective norm by organisation and gender

Name/category of organisation	Sex of Respondent	Mean stated SN	Std. Deviation
MAFFS	Male	0.520	.9626
	Female	0.143	.3780
	Total	0.438	.8776
SLARI	Male	0.174	.8869
	Female	0.000	.0000
	Total	0.160	.8505
NGO	Male	0.481	.7530
	Female	0.000	.0000
	Total	0.406	.7121
Whole sample	Male	0.400	.8699
	Female	0.071	.2673
	Total	0.348	.8133

Source: Field Survey, 2016/17

In Table 7.13, statements that make up the direct/stated SN are shown. Less than half the respondents agreed (31.5%), or agreed strongly (9.0%), that the people who are important to them want them to facilitate complex and dynamic interactions in research and extension programmes. A relatively high proportion of respondents (37.1%) were unsure, while 10.1% and 12.4% disagreed or disagreed strongly, respectively, that people who are important to them want them to do so. Further, more than half of respondents agreed (44.9%) or agreed strongly (19.1%) that they are expected to undertake this facilitation. However, a good number of respondents were unsure (27.0%), while only 6.7% and 2.2% disagreed or disagreed strongly, respectively, that this was expected of them. On the other hand, more than half the respondents were either unsure (30.3%) or disagreed (30.3%) that they are under social pressure to facilitate these interactions; while only 22.5% and 7.9% agreed or agreed strongly, respectively, with this. Also, a higher proportion of respondents agreed (52.8%) or agreed strongly (7.9%0 that their salient referents think they should facilitate complex and dynamic interactions in research and extension programmes.

Overall, most respondents were either neutral (39.3%), or agreed (41.6%), that their salient referents have a favourable influence on them to facilitate complex and dynamic interactions in research and extension programmes. The high percentage of respondents' neutrality must have contributed to a low overall mean for the stated SN.

Table 7.13:Direct Subjective Norms of Respondents

	SN1 (People important to me want me to) **(n=99) (Mean**=0.15)		**SN2** (It is expected of me) **(n=89) (Mean= 0**.72)		**SN3** (I am under social pressure) **(n=89) (Mean = -** 0.10**)**		**SN4** (People important to me think) **(n=89) (Mean =0**.51)		**Average stated SN (n=99) (Mean = 0**.35)	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**
Strongly disagree	11	12.4	2	2.2	8	9.0	4	4.5	1	1.1
Disagree	9	10.1	6	6.7	27	30.3	8	9.0	12	13.5
Unsure	33	37.1	24	27.0	27	30.3	23	25.8	35	39.3
Agree	28	31.5	40	44.9	20	22.5	47	52.8	37	41.6
Strongly agree	8	9.0	17	19.1	7	7.9	7	7.9	4	4.5

Source: Field survey, 2016/17

The Stated Subjective Norm disaggregated by respondents' socio-economic characteristics

The results in Table 7.14 show that younger respondents had a higher mean stated SN than their older colleagues, but a negative and significant association exists between respondents' ages and their SN. This implies that their beliefs about the influence on them of their social referents decreases with age. Respondents mean subjective norm increases with the years of experience in research and extension, and a positive and significant association exists between the two, suggesting that respondents' years of experience influence the way they think their salient referents will influence their decisions in innovation processes.

Further, respondents who did not have a farming background or another source of income (in addition to their jobs) had a higher mean stated SN than their counterparts. Interestingly, the SN tended to decrease with the level of education, and this is supported by a negative, yet significant, association between the two. It can be argued that the more educated an individual is, the less social pressure they tend to be under, given the belief that they are able to function more independently compared to the less educated. Consistently, Frontline level respondents (who are mostly less educated) had a higher mean stated SN than their middle-level counterparts. While the mean SN for male respondents was higher than that for females (see Table 7.15), no specific pattern was observed across the various age brackets of respondents with respect to their mean stated SN. The youngest and oldest respondents had the highest mean stated SN, while middle-aged respondents had a lower mean stated SN. Respondents who were not members of professional networks and those who have no background in farming had higher mean stated SN compared to their counterparts. Also, respondents from MAFFS had a higher mean stated SN (0.438), slightly higher than that of NGOs (0.406), and of SLARI

(0.160). It is interesting to note that, apart from respondents' years of experience and level of education, all other of their socio-economic characteristics (see Table 7.15) had no significant association with their mean stated SN, suggesting that these characteristics had little or no influence on respondents mean stated SN. Practically, this may mean that the extent to which respondents' important others would want them to facilitate complex and dynamic interactions in research and extension programmes is largely independent of factors such as age, gender, membership of professional networks, organisation, having a farming background, or having other sources of income.

Table 7.14:Mean stated SN disaggregated by selected socio-economic characteristics of respondents

Socio-economic characteristics	Categories	Frequency	Mean stated SN	Correlation with stated SN
Sex	Male	75	0.400	-0.207
	Female	14	0.071	
Age of respondents	18-30yrs	17	0.647	0.206
	31-40yrs	37	-0.027	
	41-50yrs	19	0.211	
	Above 50yrs	16	1.063	
Years of experience in research and extension	1-5yrs	64	0.156	0.440**
	6-10yrs	15	0.667	
	11-15yrs	5	1.000	
	16-20yrs	5	1.200	
Membership in professional networks	Yes	33	0.333	0.028
	No	56	0.357	
Do you have a farming background	Yes	81	0.346	-0.007
	No	8	0.375	
Level of education of respondent	College Certificate	12	1.000	-0.489**
	College Diploma	20	0.800	
	Bachelor's Degree	41	0.293	
	Master's degree	16	-0.563	
Other sources of income in addition to job	Yes	29	0.207	0.172
	No	60	0.417	
Hierarchical managemt level	Middle	32	0.188	0.134
	Frontline	57	0.439	
Speak community language	Yes	68	0.368	-0.069
	No	21	0.286	
Organisation	MAFFS	32	0.438	0.014
	SLARI	25	0.160	
	NGO	32	0.406	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlation between the respondents stated subjective norm and their intention to facilitate complex and dynamic interactions

The subjective belief statements used for the calculated stated SN are shown in Table 7.15, below. A positive and significant association exists between three of the four respondents' normative belief statements and their intention to facilitate complex and dynamic interactions. However, a higher positive and significant association exists between respondents who indicated that people important to them think they should facilitate complex and dynamic interactions and their intention, than the rest of the other normative belief statements.

Overall, a positive and significant association (r=0.456; P<0.01) exists between respondents mean stated SN and their intention to facilitate complex and dynamic interactions in research and extension. This means that respondents' intentions, and subsequently their facilitation of complex and dynamic interactions in research and extension, can be positively influenced by people they consider important, including their employers, supervisors, colleagues, donors, community leaders, farmers, and family members. This largely supports the notion that research and extension professionals' motivation to facilitate complex and dynamic interactions may be contingent on the commitment and approval of these salient referents, and not only dependent on respondents' attitudes towards, and PBC over, the exhibition of the behaviour.

Table 7.15:Correlation between stated SN and intention to facilitate complex interactions

	Intention	SN1	SN2	SN3	SN4
Intention	1.000				
SN1	0.354**	1.000			
SN2	0.468**	0.356**	1.000		
SN3	0.095	0.183	0.265*	1.000	
SN4	0.497**	0.481**	0.523**	0.445**	1.000

	Average SN	Intention to facilitate interactions
Average SN	1.000	0.546**
Intention to facilitate interactions	**0.546****	1.000

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

7.2.4.2 The Indirect Subjective Norm for Facilitating Interactions

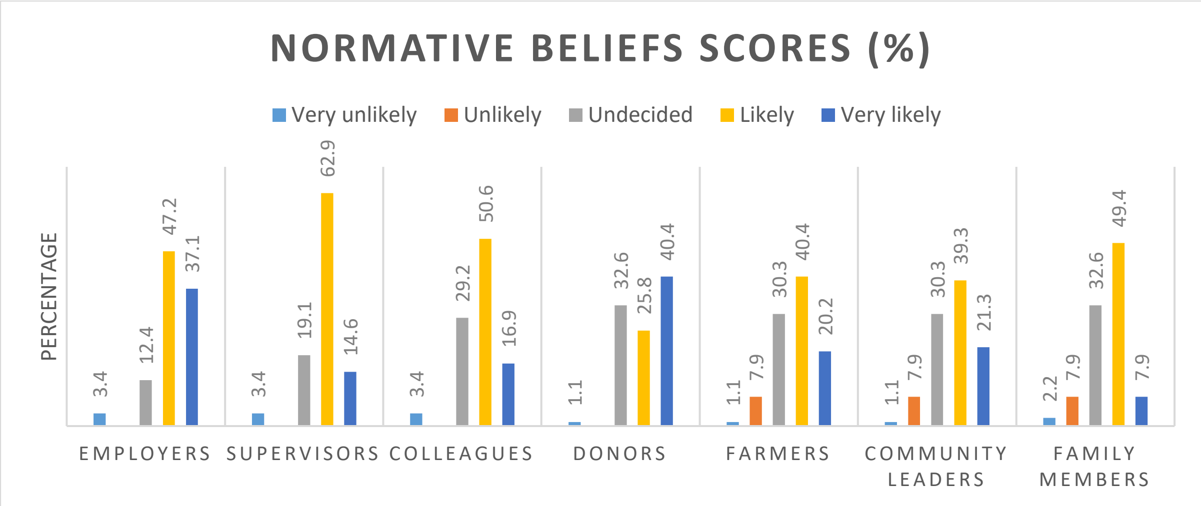
The calculated SN was generated by summing the product of the subjective beliefs (normative beliefs) strength and their corresponding motivation to comply. The subjective beliefs scores were obtained by asking respondents to state the likelihood of their salient referents wanting them to facilitate complex and dynamic interactions in research and extension. Their responses are shown in Figure 7.1, below. Also, their motivation to comply with these social referents was examined and the results are presented in Figure 7.2. The key messages are that respondents strongly believe it is their employers, donors, supervisors, and colleagues who most want them to facilitate interactions, and it is the advice of these actors with which they are most likely to comply in doing so, as opposed to community leaders, farmers, and family members.

In Figure 7.1 most respondents indicated that their employers will likely (47.2%) or very likely (37.18%) want them to facilitate complex and dynamic interactions in the next 12 months. Only a few said they were undecided (12.4%), or that it was very unlikely (3.4%) that their employers would want them to do so. Similarly, well over half of respondents indicated that their supervisors will likely (62.9%) or very likely (14.6%) want them to facilitate complex and dynamic interactions, while only a few were undecided (19.1%), and 3.4 % said it was very unlikely that their supervisors would want them to facilitate complex and dynamic interactions in research and extension.

Also, the majority of respondents indicated that it is likely (50.6%) or very likely (15.9%) that their professional colleagues would want them to facilitate complex and dynamic interactions in the next 12 months, while only a small proportion of them indicated that their colleagues would be very unlikely (3.4%) to do so. Further, the majority of respondents indicated that it is likely (25.8%) or very likely (40.4%) that donors would want them to facilitate complex and dynamic interactions in research and extension, only 1.1% indicated that donors would be very unlikely to do so. On the other hand, a similar trend was observed for respondents' perceptions of farmers and community leaders. More than half of respondents indicated that it is likely (40.4, 39.3%) or very likely (20.2, 21.3%) that farmers and community leaders, respectively, would want them to facilitate complex and dynamic interactions in research and extension. Only a small proportion of respondents indicated that this is unlikely (7.9%) or very unlikely (1.1%). However, a reasonable number of respondents (30.3%) were undecided. This similarity in respondents' perceptions about farmers and community leaders is possibly because the two sets of referents overlap; farmers can be community leaders and vice-versa.

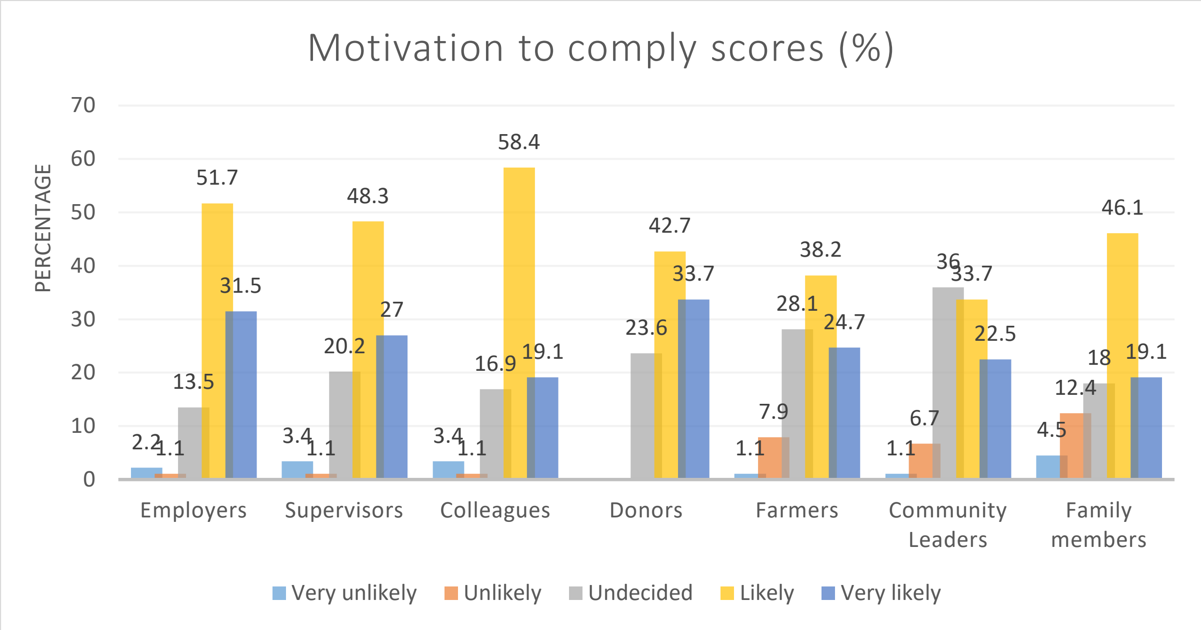
Finally, up to half of respondents indicated that it is likely (49.4%) or very likely (7.9%) that their family members would want them to facilitate complex and dynamic interactions in research and extension programmes. Only a few indicated that it is unlikely (7.9) or very unlikely (2.2%) that their family members would want them to do so. A high proportion of respondents were undecided on the matter (32.6%). This is possibly because they perceive their family members to have little or no knowledge about research and extension programmes, particularly in relation to the use of an AIS approach, and would, therefore, have little influence on respondents' decisions about their activities.

Figure 7.1:Respondents normative belief scores used in the calculated SN



In Figure 7.2 below, scores for the respondents' motivation to comply with the advice of their salient referents are shown. The clear majority of respondents indicated that they are likely (51.7%) or very likely (31.5%) to comply with the advice of their employers to facilitate complex and dynamic interactions in research and extension. Only a few said they would be unlikely (1.1%) or very unlikely (2.2%) to comply with such advice. A similar trend is observed for all salient referents studied. The majority of respondents indicated they are likely or very likely to comply with the advice of supervisors, colleagues, donors, farmers, community leaders, and family members for the facilitation of complex and dynamic interactions in research and extension programmes (see Figure 7.2). Only a few respondents responded negatively and indicated it to be unlikely or very unlikely for them to comply with the advice of these salient referents. This suggests that these salient referents have the potential to influence the intention, and subsequently the behaviour, of respondents; in this case, to facilitate complex and dynamic interactions in innovation processes.

Figure 7.2:Respondents motivation to comply with the salient referents



The Calculated Subjective Norm and its Correlation with Respondents' Intention to Facilitate Complex and Dynamic Interactions

The calculated subjective norm (see Table 7.16) for all respondents was moderately positive (9.045, out of a range of -28 to +28). This shows that the salient referents can have a positive influence on respondents' facilitation of complex and dynamic interactions in their activities. Consistently, the scores for all salient referents on the subjective belief strength, motivation to comply, and their SN are positive. However, scores for employers and donors are the highest compared to other salient referents. This suggests that respondents perceive their employers and donors to have the highest influence on their intention to facilitate complex and dynamic interactions in research and extension processes. This is simply due to the fact that employers, for instance, outline their expectations of each staff member and this includes their day to day activities. For donors, they largely influence the activities on which their monies are to be spent. Therefore, these two referents could have a huge impact on research and extension professionals' activities, including the likelihood of them facilitating complex and dynamic interactions in their activities.

Overall, a positive and significant association ($r=0.213$, $p<0.05$) was found to exist between the calculated SN and respondents' intention to facilitate complex and dynamic interactions in research and extension programmes. Similarly, a positive and significant association was found between the SN of employers and supervisors and respondents' intention to do so. In general, a positive and significant association between the calculated subjective norm and respondents' intentions suggests that the salient referents identified can largely enhance respondents' intentions, and subsequently their facilitation of complex and dynamic interactions in research and extension programmes.

Table 7.16: Subjective belief, motivation to comply, and subjective norm and their correlation with intention to facilitate complex interactions

	Subjective belief strength (sb_j)	Motivation to comply (m_j)	Outcome Subjective Norm (sb_j*mj)	Correlation (r_s) with intention
Employer	1.15	1.09	1.753	0.356**
Supervisor	0.85	0.94	1.360	0.237*
Professional colleagues	0.78	0.90	1.250	0.161
Donors	1.04	1.10	1.517	0.086
Farmers	0.71	0.78	1.157	0.102
Community leaders	0.72	0.70	1.124	0.168
Family members	0.53	0.63	0.865	0.109
Calculated Subjective Norm ($\sum sb_j*m_j$): Range -28 to +28			**9.045**	**0.213***

** Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

7.2.5 Regression Results of Respondents' Intentions to Facilitate Complex and Dynamic Interactions with the Basic TPB Variables

In order to investigate the validity of the TPB, a hierarchical linear regression was run with intention as the dependent variable, and then attitude (ATT_FAC), SN (SN_FAC), and PBC (PBC_FAC) in the first step, then with the addition of selected farmer characteristics in the second step. The results are presented in Table 7.17. Respondents' SN had the highest influence on their intention to facilitate complex and dynamic interactions, followed by their attitudes. Respondents' PBC had a negative influence on their intentions. The results further showed that a respondent's attitude and SN had significant and positive influence, while their PBC had a negative and significant influence on their intention to facilitate complex and dynamic interactions in the next 12 months.

This is consistent with findings in earlier sections which showed that a positive and significant association exists between respondents' attitude and SN, while a negative and insignificant association exists between their PBC and their intention to facilitate complex and dynamic interactions.

Further, the addition of a selection of respondents' socio-economic characteristics mediated the influence of the TPB variables on intention. Only respondents' ability to speak the community language had a positive and significant influence on intention. All other added characteristics had no significant association. However, the added characteristics of respondents significantly influenced the relationship between the TPB variables and their intention to facilitate complex and dynamic interactions in research and extension processes. This resulted in an increase in the coefficients of the TPB variables (attitude, SN, and PBC) of respondents, but does not change the way each variable influences their intention. The SN still had the highest influence, followed by attitude, and then the PBC.

This suggests that respondents' characteristics have a minimal mediation effect on the TPB variables as they relate to their intention to facilitate complex and dynamic interactions in research and extension programmes.

Table 7.17:Results of the hierarchical regression analysis on intention to facilitate complex and dynamic interactions, with basic TPB variables only in the first step, and farmer characteristics added in the second step

Variables	Standardized Coefficients	Sig.	R^2
ATT_FAC	0.374	0.000	
PBC_FAC	-0.255	0.001	
SN_FAC	0.503	0.000	
			0.489
ATT_FAC	0.562	0.000	
PBC_FAC	-0.335	0.001	
SN_FAC	0.655	0.000	
Hierarchical level	-0.027	0.768	
Sex of Respondent	0.001	0.996	
Category of organisation	-0.122	0.250	
Age of Respondents	0.130	0.252	
Level of education	0.210	0.126	
Speak community language	-0.291	0.005	
Farming background	0.061	0.460	
Membership in professional networks	0.186	0.087	
Other sources of income	0.012	0.902	
Years in Research and Extension	-0.231	0.062	
			0.591

7.3 Summary of Findings

This chapter presents findings that emerged from data collected with the aim of examining respondents' beliefs and attitudes towards the facilitation of complex and dynamic interactions in research and extension programmes as a key behaviour of a functioning AIS approach. To achieve this, several variables were examined. These included the socio-economic characteristics of research and extension professionals (respondents) and their influence on those professionals' beliefs and attitudes, and the TPB variables used to understand respondents' beliefs and attitudes towards the facilitation of complex and dynamic interactions in research and extension.

The key findings are that respondents' level of education and years of experience are the key socio-economic characteristics associated with their intention to facilitate complex and dynamic interactions. Findings on the TPB variables revealed interesting information. The three key variables used to understand and predict the key beliefs and attitudes which influence middle and frontline research and extension professionals' intentions over the next 12 months, showed some interesting relationships. Most respondents had a positive intention (0.73), attitude (1.00), and SN (0.35) to facilitate interactions (means are out of a possible range of -2 to +2). However, their PBC was relatively low (-0.08). Respondents from MAFFS had the highest mean intention and SN, followed by NGOs and SLARI; while NGOs had the highest mean attitude and PBC, followed by MAFFS and SLARI. Also, male respondents had a higher mean intention, attitude, and SN than their female counterparts, while female respondents had a higher PBC than male respondents.

Overall, a significant and positive association was found to exist between respondents' attitudes and SN and their intention to facilitate complex interactions, while a negative and insignificant association exists between respondents PBC and their intention to do so. The regression results showed a similar trend where the SN and attitude of respondents had a positive and significant influence on respondents' intention (with subjective norm having the highest influence), while the PBC had the least, and negative, influence on respondents' intentions to facilitate complex and dynamic interactions in research and extension.

In addition to beliefs forming the direct attitudes, other underlying beliefs that have contributed to respondents' positive attitudes include beliefs that complex and dynamic interaction enhances access to knowledge sources, information, and markets by smallholder farmers and the effectiveness and sustainability of innovations on rice; and that it fosters capacity development of agricultural innovation actors. Similarly, the perceived cooperation and behaviour of other actors was one of the underlying beliefs that has contributed to respondents' perceived control over the facilitation of interactions.

On the other hand, beliefs held by respondents that have contributed to negating their attitudes towards the facilitation of complex and dynamic interactions include: the difficulty associated with obtaining the commitment of diverse agricultural innovation stakeholders; the perceived differing interests/objectives of diverse innovation stakeholders; and the perceived difficulty associated with mobilising innovation actors for complex and dynamic interactions. Also, their control over the facilitation of these interactions was negated by underlying beliefs, such as the perceived lack of capacity and adequate financial resources to facilitate complex and dynamic interactions.

Finally, the following salient referents were also believed to positively and significantly affect research and extension professionals' ability and willingness to facilitate complex and dynamic interactions in research and extension activities: employers; supervisors; colleagues; donors; farmers; community leaders; and family members. Donors and employers have greater influence than the other referents.

CHAPTER 8 : THE INFLUENCE OF RESEARCH AND EXTENSION PROGRAMMES ON SMALLHOLDER RICE FARMERS' INNOVATION PROCESSES

8.1 Introduction

Agricultural research and extension programmes are considered important in stimulating the innovative capacity of smallholder farmers. They are perceived to serve as the source and conduit for improved agricultural technologies and techniques for smallholder farmers. Murray (2007) noted that agricultural extension is a philosophy based on the development of individual farmers and facilitation of interaction within the various sectors of the rural community to avoid imbalanced development. Similarly, Nadeem and Mustaq (2010) found that agricultural research has a positive and significant impact on smallholder productivity. Evidently, a wide variety of support exists in the literature regarding the usefulness of research and extension to agricultural development and, by extension, to national development. Such support is based on the premise that research and extension programmes can influence smallholder farmers' innovation processes which will, in turn, impact their productivity and, subsequently, their wellbeing and the overall development of their communities. However, in Sierra Leone, where two-thirds of the population are farmers, limited knowledge exists about the influence of research and extension programmes on smallholder farmers' innovation processes and the subsequent impact on their innovative capacity. The main objective of this chapter is, therefore, to understand the key influences that research and extension actors have had on smallholder farmers' innovation processes in Sierra Leone in the last ten years.

A detailed description of the methodology used has been reported in Chapter 4. However, for clarity a summary is first provided. Farmers from eight (8) communities in four districts (Kambia, Port Loko, Tonkolili, and Koinadugu) in Northern Sierra Leone were targeted for the study. In the first phase, qualitative techniques, e.g., FGDs and KIIs, were used to elicit information that informed the design of the questionnaires. The second phase sampled 25 rice farmers per community, resulting in a total of 200 respondents across the eight communities being targeted. The key questions (sections) examined in the questionnaire, and subsequently in this chapter, include farmers' socio-economic characteristics and their relation to farmers' poverty profiles, the innovations smallholder farmers have effected in their farming systems in the past ten years, and the key drivers, or reasons, for them to do so. The key actors and their roles in the promotion of these innovations, the constraints associated with them, and the factors which influence smallholders' ability to innovate were also examined. Further, smallholder farmers' behavioural intentions towards innovation were also identified and analysed. This chapter presents and interprets findings on these themes.

8.2 Socio-Economic Characteristics of Smallholder Farmers in Study Area

The socio-economic characteristics of smallholder farmers are presented in Table 8.1 and 8.1b below. The results show that the majority of respondents across the four districts studied were males, 75.5% compared to only 24.5 % females. This suggests the dominance of males in agricultural development programmes in the country and the silencing of their female counterparts when it comes to participation. The results further suggest a fairly consistent distribution of farmers in terms of age of the respondents; they ranged from 18 years old through to 50 and over. However, a slightly higher number of respondents (31%) were within the age bracket 31-40 years, which is considered the prime age for active engagement in agricultural activities. The majority of respondents were illiterate (40.5%), added to this number were 18% who could read and write Arabic, but not English. A few had primary (22%) and secondary level education (15%), while a negligible number indicated they had attended a vocational institution (3.5%) or university (1.0%). All those who indicated they had attended a vocational institution or university were from Port Loko District, which hosts the Port Loko Teachers College. The college has recently been transformed into a university, and this possibly made it easier for these respondents to attain this level of education. These results generally support the existing level of illiteracy in the country, this was highlighted by research and extension professionals in Chapter 5. Up to 94.5% of respondents were married, only 2.0% were single, and 3.5% were widowed. This demonstrates the importance accorded to marriage in rural farming communities in Sierra Leone. It is also possibly due to the dependence on family labour for agricultural innovation processes and activities; married individuals command more respect and are more likely to engage in extensive farming activities than their single counterparts. Further, the majority of household heads are male (85%), compared to female (15%). This is consistent with the culturally defined gender roles in Sierra Leone where men are seen as the household leaders, and that women can usually only lead in the absence of a male counterpart.

Table 8.1:Socio-economic characteristics of smallholder farmers

Soico-economic Characteristics	Category	Name of District								TOTAL (n=200)	
		Kambia (n=50)		Port Loko (n=50)		Tonkolili (n=50)		Koinadugu (n=50)			
		Frequency (F)	Percentage (%)	F	%	F	%	F	%	F	%
Sex											
	Male	43	21.5	36	18.0	36	18.0	36	18.0	151	75.5
	Female	7	3.5	14	7.0	14	7.0	14	7.0	49	24.5
Age											
	18-30yrs	9	4.5	29	14.5	7	3.5	2	1.0	47	23.5
	31-40yrs	13	6.5	9	4.5	16	8.0	24	12.0	62	31.0
	41-50yrs	12	6.0	5	2.5	13	6.5	10	5.0	40	20.0
	Above 50yrs	16	8.0	7	3.5	14	7.0	14	7.0	51	25.5
Education											
	None	14	7.0	13	6.5	35	17.5	19	9.5	81	40.5
	Primary	7	3.5	15	7.5	5	2.5	17	8.5	44	22.0
	Secondary	10	5.0	6	3.0	8	4.0	6	3.0	30	15.0
	Vocational college	0	0.0	6	3.0	1	0.5	0	0.0	7	3.5
	University	0	0.0	2	1.0	0	0.0	0	0.0	2	1.0
	Arabic	19	9.5	8	4.0	1	0.5	8	4.0	36	18.0
Marital status											
	Married	49	24.5	46	23.0	46	23.0	48	24.0	189	94.5
	Single	1	0.5	3	1.5	0	0.0	0	0.0	4	2.0
	Widow(er)	0	0.0	1	0.5	4	2.0	2	1.0	7	3.5
Gender of household head											
	Male	47	23.5	39	19.5	38	19.0	46	23.0	170	85.0
	Female	3	1.5	11	5.5	12	6.0	4	2.0	30	15.0
Primary source of income											
	Agricultural activities	50	25.0	43	21.5	49	24.5	50	25.0	191	95.5
	Non-agricultural activities	0	0.0	7	3.5	1	0.5	0	0.0	8	4.0
Secondary source of income											
	Agricultural activities	16	8.0	17	8.5	48	24.0	33	16.5	114	57.0
	Non-agricultural activities	34	17.0	33	16.5	2	1.0	17	8.5	86	43.0
Type of land tenure											
	Own	17	8.5	34	17.0	40	20.0	14	7.0	105	52.5
	Rented land	13	6.5	9	4.5	0	0.0	5	2.5	27	13.5
	Leased land	0	0.0	4	2.0	0	0.0	9	4.5	13	6.5
	Owned by family	19	9.5	3	1.5	1	0.5	22	11.0	45	22.5
	Communal	1	0.5	0	0.0	9	4.5	0	0.0	10	5.0
Use of produce after harvest											
	Eat and sell some	2	1.0	12	6.0	2	1.0	9	4.5	25	12.5
	Eat, sell and keep some as seeds	32	16.0	30	15.0	31	15.5	39	19.5	132	66.0
	Eat and keep some as seeds	16	8.0	6	3.0	15	7.5	2	1.0	39	19.5
	Eat all	0	0.0	2	1.0	2	1.0	0	0.0	4	2.0
Rear Animals											
	Yes	46	23.0	40	20.0	27	13.5	39	19.5	152	76.0
	No	4	2.0	10	5.0	23	11.5	11	5.5	48	24.0

Source: Field Survey, 2016/17

The vast majority of respondents depend on agriculture both as a primary (95.5%) and secondary (47%) source of income. This is a reflection of the importance of agriculture to the vast majority of rural inhabitants in Sierra Leone. The majority of farmland is individually owned (52.5%), followed by familial ownership (22.5%), rented land (13.5%), leased land (6.5%), and communal ownership (5.0%). This suggests an increased awareness among smallholder farmers of the likely advantages of owning, rather than renting, land. Renting is generally associated with many disadvantages, including the inability to engage in long-term investment in such land. The same applies to leased and some communal lands.

It was also found that smallholder farmers use their produce in a variety of ways after harvest. Most respondents (66.0%) indicated they not only use their produce for consumption, but also for sale and as seed. This is a possible reason for the food shortages which exist in most farming households in rural Sierra Leone as the mostly meagre produce is used for a variety of purposes in addition to household consumption. The trend is the same across all communities studied in the target districts. The next largest group are those respondents who produce only for consumption and seeds (19.5%) followed by those who produce only for consumption and sale (12.5%). In addition to crop production, the majority of respondents (76.0%) indicated they also rear animals as a source of livelihood. Animals are perceived to be an alternative source of income for most rural households, particularly in the lean season when most farming households suffer from hunger.

In Table 8.1b, the average distance from respondents' communities to the nearest Government agricultural institution was estimated. This was based on the assumption that the nearer farmers are to an agricultural institution, the more likely they are to be influenced by actors from those institutions in their innovation processes. The results show that more than half of respondents (52.0%) live between one and five kilometres from a Government agricultural institution. This comprises research and extension institutions such as SLARI and MAFFS line offices at district level. However, this is true only for Kambia and Port Loko Districts. In Tonkolili, only one community was within this distance, while the other was 10 kilometres or further away; in Koinadugu the majority live within six to 10 kilometres of a Government agricultural research or extension institution. This shows that the majority of respondents live relatively close to public agricultural institutions, a necessary condition for access to the services they provide for farmers.

Further, rice is the most popular crop cultivated by the majority of farmers in both lowland (96.4%) and upland ecologies (56.7%). While rice is the dominant crop in the lowlands, seconded by a negligible number of cassava (2.0%), in the uplands several crops, such as cassava (22.3%), palm oil (10.2%), and potatoes (3.8%), were reported by a relatively high number of respondents to be grown in addition to rice. This is consistent with national statistics which show that rice is the most widely grown crop in the country, followed by cassava and potato, excluding permanent crops (MAFFS, 2012; SLPHC, 2004). With respect to household size, the mean number of people per household was 11.42, with the mean number of children per household being the highest (4.59), compared to adult females (3.36) and adult males (3.46). This overall household size contradicts the average national estimates in Sierra Leone, which is six persons per household. This is possibly due to the farming families' dependence on family labour for their farming activities. On the other hand, the average farm size is small (3.91 acres), consistent with the national average estimates. The high subsistence nature of smallholder farming in the country is a possible reason for this relatively small acreage of farm. Further, the average monthly income for respondents was estimated at $US47.013 in the dry season (November to April) and $US35.707 in the rainy season (May to October). The higher average income in the dry season is possibly due to the fact that the harvest, and subsequent sale, of their farm produce is normally done during these months (November to April). Generally, this average income of respondents is low, supporting the fact that smallholder farmers in the country are among the poorest cadre of the populace.

The most important crops grown by respondents for household consumption and income are shown in

Table 8.2 below. Interestingly, farmers grow a wide variety of crops, both for consumption and income. However, cassava, rice, potato, and groundnut are the four key groups grown for both purposes. The majority of respondents grow cassava for income (81.5%), followed by rice (68.0%), potato (44.0%) and groundnut (41.0%). On the other hand, nearly all respondents grow rice, primarily for household consumption (95.5%), followed by cassava (88.5%), potato (59.0%), and groundnut (18.0%). This trend is similar in all four districts studied. These results suggest that smallholder farmers use crops for a variety of purposes. No one crop is grown exclusively for a specific purpose. Crop usage tends to depend on smallholder farmers' circumstances and the amount produced.

Table 8.1b: Socio-economic characteristics of smallholder farmers

Soico-economic characteristics	Category	Kambia (n=50)		Port Loko (n=50)		Tonkolili (n=50)		Koinadugu (n=50)		TOTAL	
		Frequency (F)	Percentage (%)	F	%	F	%	F	%	F	%
Distance to nearest Govt. agric. institution											
	In community	0	0.0	2	1.0	0	0.0	3	1.5	**5**	**2.5**
	1-5KM	28	14.0	41	20.5	25	12.5	10	5.0	**104**	**52.0**
	6-10KM	22	11.0	6	3.0	0	0.0	22	11.0	**50**	**25.0**
	Above 10KM	0	0.0	1	0.5	25	12.5	15	7.5	**41**	**20.5**
Main lowland crop											
	Rice	50	25.5	44	22.4	50	25.5	45	23.0	**189**	**96.4**
	Cassava	0	0.0	4	2.0	0	0.0	0	0.0	**4**	**2.0**
	Potato	0	0.0	1	0.5	0	0.0	1	0.5	**2**	**1.0**
	Vegetables	0	0.0	0	0.0	0	0.0	1	0.5	**1**	**0.5**
Main upland crop											
	Rice	2	1.3	25	15.9	30	19.1	32	20.4	**89**	**56.7**
	Cassava	10	6.4	13	8.3	5	3.2	7	4.5	**35**	**22.3**
	Potato	0	0.0	5	3.2	0	0.0	1	0.6	**6**	**3.8**
	Groundnut	0	0.0	2	1.3	1	0.6	0	0.0	**3**	**1.9**
	Oil palm	16	10.2	0	0.0	0	0.0	0	0.0	**16**	**10.2**
	Pepper	1	0.6	2	1.3	0	0.0	0	0.0	**3**	**1.9**
	Okra	0	0.0	1	0.6	0	0.0	0	0.0	**1**	**0.6**
	Millet	0	0.0	1	0.6	0	0.0	0	0.0	**1**	**0.6**
	Yam	0	0.0	0	0.0	0	0.0	3	1.9	**3**	**1.9**
Mean number of people in household											
	Adult Male	2.98		4.18		2.52		4.16		**3.46**	
	Adult Female	3.34		4.16		2.46		3.50		**3.36**	
	Children (0-17yrs)	4.46		5.56		4.20		4.14		**4.59**	
	Total number in household	10.78		13.90		9.18		11.80		**11.42**	
Mean size of farmland (acres)	-	5.00		2.46		3.50		4.70		**3.91**	
Mean household income (US$/6months)	November to April	87.307		40.139		34.640		25.691		**47.013**	
	May to October	46.667		34.750		26.675		34.699		**35.707**	

Source: Field Survey, 2016/17

Table 8.2:Important crops for smallholders' household income and consumption

Soico-economic Characteristics	Category	Name of District								TOTAL	
		Kambia (n=50)		Port Loko (n=50)		Tonkolili (n=50)		Koinadugu (n=50)			
		Frequency (F)	Percentage (%)	F	%	F	%	F	%	F	%
Most important crop for household income											
	Cassava	41	20.5	42	21.0	33	16.5	47	23.5	162	81.5
	Potato	19	9.5	18	9.0	19	9.5	32	16.0	87	44.0
	Rice	18	9.0	48	24.0	22	11.0	48	24.0	136	68.0
	Groundnut	12	6.0	30	15.0	30	15.0	10	5.0	82	41.0
	Pepper	26	13.0	5	2.5	10	5.0	0	0.0	41	20.5
	Oil palm	14	7.0	0	0.0	0	0.0	0	0.0	14	7.0
	Other Vegetables	2	1.0	0	0.0	17	8.5	12	6.0	31	15.5
	Maize	1	0.5	2	1.0	11	5.5	0	0.0	14	7.0
Most important crop for household food											
	Cassava	38	19.0	45	22.5	49	24.5	46	23.0	177	88.5
	Potato	29	14.5	28	14.0	30	15.0	32	16.0	118	59.0
	Rice	47	23.5	49	24.5	49	24.5	48	24.0	191	95.5
	Groundnut	1	0.5	22	11.0	3	1.5	10	5.0	36	18.0
	Pepper	4	2.0	2	1.0	0	0.0	0	0.0	6	3.0
	Vegetables	0	0.0	0	0.0	7	3.5	11	5.5	18	9.0
	Maize	0	0.0	0	0.0	7	3.5	0	0.0	7	3.5

Source: Field Survey, 2016/17

8.3 The Poverty Profile of Respondents: Evidence from the PPI Indicators

Poverty in Sierra Leone, as indicated in Chapter 1, is rife; it has been one of the contributing factors which limit smallholder farmers' productive capacities (World Bank, 2013; MAFFS, 2010). It is against this background that this study examined the poverty situation in the target districts as this is expected to play a role in the innovative tendencies of the target respondents.

The Progress out of Poverty Index (PPI) Scorecard was used to determine the poverty incidence among respondents in the study area. Developed by the Grameen Foundation in 2005, the PPI scorecard is a simple poverty measurement tool that is gaining popularity among development practitioners working with the poor in the developing world, and is currently being used in over 50 countries (Peachey, 2014). The scorecard constitutes 10 verifiable questions based on household assets and other basic characteristics. The answers to the questions are scored and compared with a set of poverty likelihood tables specific to the country under investigation. This helps provide scores which indicate the likelihood that the survey respondent is living above or below the national poverty line, or other internationally recognized poverty lines (e.g., $US1.25 per day purchasing power parity (PPP)). Some of the poverty likelihood categories used to calculate the poverty incidence in the sampled households of this study are shown in Figure 8.1:Poverty likelihoods of the PPI Scores in Sierra Leone below. The PPI scores from the surveys were carefully matched with the ranges in the poverty likelihoods for Sierra Leone for various categories in order to precisely determine the percentage of poverty incidence in various categories among the sampled respondents.

Figure 8.1:Poverty likelihoods of the PPI Scores in Sierra Leone

Category Likelihoods according to Sierra Leone PPI Score

PPI Score	National Poverty Line		National Food Poverty Line		75% of the National Poverty Line	
	Total Below the National Poverty Line	Total Above the National Poverty Line	Total Below the National Food Poverty Line	Total Above the National Food Poverty Line	Total Below the 75% of the National Poverty Line	Total Above the 75% of the National Poverty Line
0-4	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%
5-9	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%
10-14	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%
15-19	97.3%	2.7%	47.3%	52.7%	88.5%	11.5%
20-24	97.6%	2.4%	45.2%	54.8%	82.9%	17.1%
25-29	98.6%	1.4%	48.0%	52.0%	90.3%	9.7%
30-34	90.5%	9.5%	33.1%	66.9%	69.2%	30.8%
35-39	85.2%	14.8%	35.1%	64.9%	70.3%	29.7%
40-44	81.3%	18.7%	25.3%	74.7%	58.2%	41.8%
45-49	74.1%	25.9%	16.9%	83.1%	47.6%	52.4%
50-54	57.3%	42.7%	12.8%	87.2%	36.5%	63.5%
55-59	45.0%	55.0%	5.8%	94.2%	28.2%	71.8%
60-64	28.2%	71.8%	1.4%	98.6%	13.8%	86.2%
65-69	21.3%	78.7%	1.5%	98.5%	9.9%	90.1%
70-74	15.4%	84.6%	0.8%	99.2%	3.1%	96.9%
75-79	10.5%	89.5%	0.0%	100.0%	8.9%	91.1%
80-84	4.1%	95.9%	0.0%	100.0%	1.9%	98.1%
85-89	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%
90-94	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%
95-100	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%

Source: Progress out of Poverty Index for Sierra Leone website.

8.3.1 The Socio-economic Indicators used for Measuring the PPI Scores of Respondents

Ten socio-economic indicators were used for generating the PPI scores of respondents (see Table 8.3). The indicators examined respondents' household size, schooling of children, economic activities, and household property. Table 8.2 gives the frequencies and their percentages for each of the indicators prior to scoring them for comparison against the national PPI poverty likelihoods.

The study found that the majority of respondents (56.5%) had 10 or more members in their households, followed by those with seven, eight, or nine (20.5%). This is consistent with findings Section 8.2. Interestingly, the trend is the same across the four districts sampled. The large sizes of these farming households are likely to translate to high incidences of poverty among these respondents. In terms of children's education, the majority of respondents (86.5%) indicated they either have children of school-going age attending school, or they do not have children of that age; only 13.5% indicated otherwise. This is seemingly a favourable indicator that could likely earn respondents a high point on the PPI scorecard. The majority of respondents indicated that females, either as head or as spouse of the head of the household, are engaged in agriculture, forestry, or mining (48%) or that they do not have a female as head or spouse in the household (34%). This further indicates that the majority of respondents are farmers or are engaged in agricultural-related activities for their livelihoods. Further, the majority of respondents (75.5%) had three or more rooms in their households. Only a few (6.5%) indicated to have only one room. The flooring in the houses of the majority of respondents (58.5%) was made of earth, mud, stone, brick, or other material, except in Port Loko District where a reasonable number of respondents (21.5%) said their floors were made of wood or concrete. This suggests some degree of poverty among the sampled households.

The toilets of most sampled households (87.5%) were either bucket, common pit, or VIP; this was consistent among the four districts studied. Similarly, the majority of respondents (95.5%) used sources other than electricity for lighting; only 4.5% of respondents indicated they used electricity for lighting. However, it is likely that this 4.5% mean they get electricity for lighting from generators because the sampled communities are not connected to any form electricity grid - national or regional. About half of respondents (50.5%) indicated they have a radio in their household, while a reasonable number (27.5%) had none. More respondents in Kambia and Port Loko had two or more radios in their households. Also, the majority of respondents (88.0%) used wood as a source of lighting for their households, followed by charcoal (10.5%). This demonstrates the rural nature of the sampled households and their likely connection to poverty. Lastly, the construction material used by respondents to build their houses was mostly mud, mudbricks, or wood (55.5%), followed by cement or corrugated iron (26.0%). This seems to be consistent across the four districts studied. These results depict the general characteristics of rural communities in Sierra Leone, a reason for which most of these households are mostly in constant touch with poverty. These indicators have been very useful in the determination of the incidence of poverty in various categories among the sample respondents, as presented in the subsequent sections.

Table 8.3:Socio-economic indicators used in PPI Scorecard of respondents

Soico-economic Characteristics	Category	Name of District: Kambia (n=50) Frequency (F)	Kambia (n=50) Percentage (%)	Port Loko (n=50) F	Port Loko (n=50) %	Tonkolili (n=50) F	Tonkolili (n=50) %	Koinadugu (n=50) F	Koinadugu (n=50) %	TOTAL F	TOTAL %
Members in household											
	Ten or more	22	11.0	34	17.0	21	10.5	36	18.0	113	56.5
	Seven, eight or nine	12	6.0	7	3.5	17	8.5	5	2.5	41	20.5
	Six	6	3.0	3	1.5	6	3.0	2	1.0	17	8.5
	Five	1	0.5	4	2.0	4	2.0	3	1.5	12	6.0
	Four	3	1.5	2	1.0	0	0.0	1	0.5	6	3.0
	One, two or three	6	3.0	0	0.0	2	1.0	3	1.5	11	5.5
Children ages 6 to 13 attending school	Yes, or no one aged 6 to 13	46	23.0	46	23.0	48	24.0	33	16.5	173	86.5
	No	4	2.0	4	2.0	2	1.0	17	8.5	27	13.5
Activity of female head or spouse											
	No female head or spouse	5	2.5	12	6.0	16	8.0	35	17.5	68	34.0
	Agriculture, forestry, mining or quarrying	32	16.0	17	8.5	33	16.5	14	7.0	96	48.0
	Other, or does not work	13	6.5	21	10.5	1	0.5	1	0.5	36	18.0
Rooms in the household											
	One	4	2.0	6	3.0	0	0.0	3	1.5	13	6.5
	Two	2	1.0	16	8.0	0	0.0	18	9.0	36	18.0
	Three or more	44	22.0	28	14.0	50	25.0	29	14.5	151	75.5
Flooring in household											
	Earth, mud, stone, brick or other	31	15.5	7	3.5	48	24.0	31	15.5	117	58.5
	Wood, or Cement, Concrete	19	9.5	43	21.5	2	1.0	19	9.5	83	41.5
Type of toilet in HH											
	Bush, river, none or other	7	3.5	1	0.5	1	0.5	2	1.0	11	5.5
	Bucket, common pit, or VIP	42	21.0	41	20.5	49	24.5	43	21.5	175	87.5
	Private pit, Common Flush, or flush toilet	1	0.5	8	4.0	0	0.0	5	2.5	14	7.0
Source of lighting											
	Generator, kerosene, gas lamp, candles, torch light, or other	49	24.5	47	23.5	50	25.0	45	22.5	191	95.5
	Electricity	1	0.5	3	1.5	0	0.0	5	2.5	9	4.5
Number of radios											
	None	7	3.5	9	4.5	27	13.5	12	6.0	55	27.5
	One	24	12.0	26	13.0	19	9.5	32	16.0	101	50.5
	Two or more	19	9.5	15	7.5	4	2.0	6	3.0	44	22.0
Fuel used	Wood, or other	49	24.5	32	16.0	49	24.5	46	23.0	176	88.0
	Charcoal	1	0.5	18	9.0	1	0.5	1	0.5	21	10.5
	Gas, kerosene, or electricity	0	0.0	0	0.0	0	0.0	3	1.5	3	1.5
Construction material of walls											
	Stone, burnt brick or other	3	1.5	6	3.0	18	9.0	10	5.0	37	18.5
	Mud, mudbricks or wood	38	19.0	17	8.5	30	15.0	26	13.0	111	55.5
	Cement, sandcrete or corrugated iron sheets	9	4.5	27	13.5	2	1.0	14	7.0	52	26.0

Source: Field Survey, 2016/17

8.3.2 Level of Poverty Incidence among Respondents Disaggregated by District

Table 8.4 shows the number of respondents in each bracket of poverty incidence measured using a variety of criteria, including: the national food poverty line; the international US$1.25/day PPP; and the national poverty line. These were measured based on the number of respondents above and below a set of poverty incidence criterion – either nationally or internationally.

The majority of respondents (66.5%) were between 25-49% below the national food poverty line, followed by a reasonable number (31%) between 0-24% below, and only a very small number (2.5%) between 75-100% below that line. On the other hand, the majority of respondents (56.0%) were between 75-100% above the national food poverty line, 41.5% were between 50-74% above the national food poverty line. A few were only 0-24% above the national food poverty line. These results largely suggest that the majority of respondents are not food poor. This cannot be unconnected with the fact that the majority are subsistence farmers who grow crops primarily for household consumption purposes.

Estimates for the national poverty line (see Table 8.3) show that the majority of respondents (69.0%) were between 75-100% below the national poverty line, followed by 23% who were 50-74% below, and only 0.5% between 0-24% below. Consistently, the vast majority of respondents (69%) were only living between 0-24% above the national poverty line, 23% were between 24-50% above, while only 0.5% were between 75-100% were above. This is largely a depiction of the existence of poverty in varied forms among the sampled respondents. Further, the poverty incidence was assessed based on the international poverty line of US$1.25 per day PPP. The majority of respondents (66.5%) were between 50-74% below this international poverty line, 18.5% were between 25-49% below, while 13.5% were between the 75-100% below. On the other hand, the majority of respondents (66.5%) were between 25-49% above the international poverty line, 18.5% were between 50-74% above, and only 1.5% were between 75-100% above. Interestingly, these findings were largely consistent across the four districts studied, although Kambia and Port Loko districts showed a relatively better position in terms of poverty compared to Tonkolili and Koinadugu districts. On the whole, poverty is largely prevalent among the target respondents of the study. The subsequent sections present further details/analyses on the level of poverty (averages) which exist in the target districts.

Table 8.4:Level of poverty incidence disaggregated by district

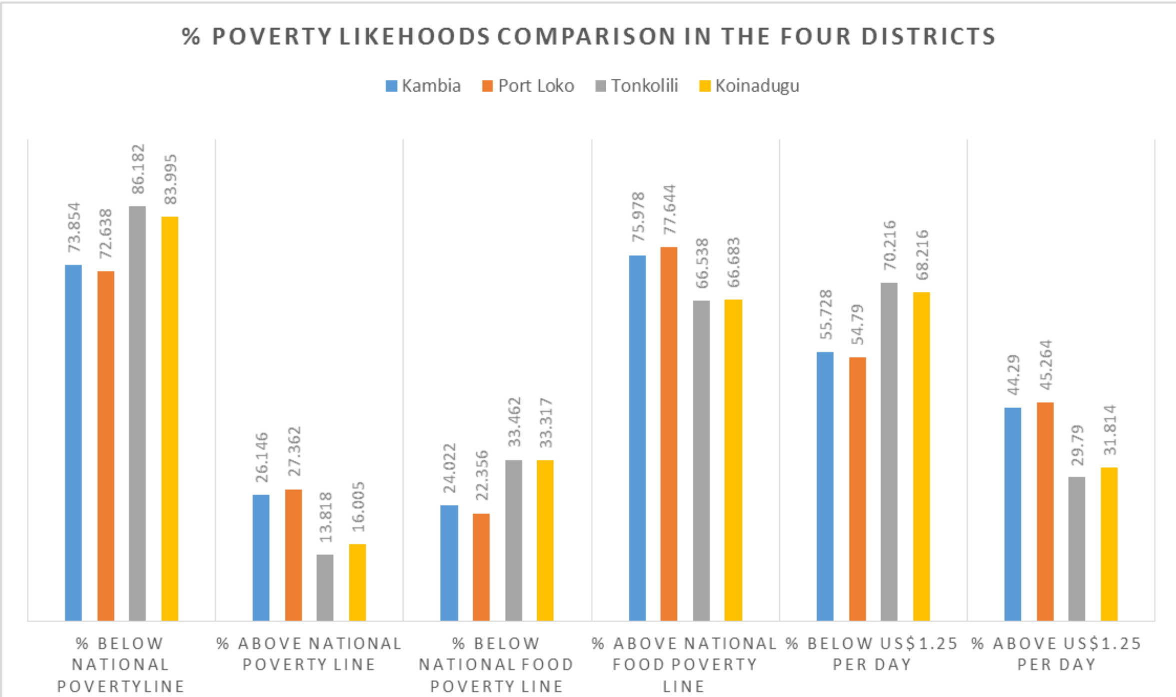
Measure	Category	Kambia F	Kambia %	Port Loko F	Port Loko %	Tonkolili F	Tonkolili %	Koinadugu F	Koinadugu %	Total F	Total %
% Below National Food Poverty Line											
	0-24%	20	10.0	24	12.0	2	1.0	16	8.0	62	31.0
	25-49%	29	14.5	26	13.0	48	24.0	30	15.0	133	66.5
	75-100%	1	0.5	0	0.0	0	0.0	4	2.0	5	2.5
% Above National Food Poverty Line											
	0-24%	1	0.5	0	0.0	0	0.0	4	2.0	5	2.5
	50-74%	10	5.0	13	6.5	38	19.0	22	11.0	83	41.5
	75-100%	39	19.5	37	18.5	12	6.0	24	12.0	112	56.0
% Below US$1.25/day											
	0-24%	0	0.0	3	1.5	0	0.0	0	0.0	3	1.5
	25-49%	17	8.5	12	6.0	1	0.5	7	3.5	37	18.5
	50-74%	29	14.5	29	14.5	43	21.5	32	16.0	133	66.5
	75-100%	4	2.0	6	3.0	6	3.0	11	5.5	27	13.5
% Above US$1.25/day											
	0-24%	4	2.0	6	3.0	6	3.0	11	5.5	27	13.5
	25-49%	29	14.5	29	14.5	43	21.5	32	16.0	133	66.5
	50-74%	17	8.5	12	6.0	1	0.5	7	3.5	37	18.5
	75-100%	0	0.0	3	1.5	0	0.0	0	0.0	3	1.5
% Below National Poverty Line											
	0-24%	0	0.0	1	0.5	0	0.0	0	0.0	1	0.5
	25-49%	4	2.0	7	3.5	0	0.0	4	2.0	15	7.5
	50-74%	16	8.0	16	8.0	2	1.0	12	6.0	46	23.0
	75-100%	30	15.0	26	13.0	48	24.0	34	17.0	138	69.0
% Above National Poverty Line											
	0-24%	30	15.0	26	13.0	48	24.0	34	17.0	138	69.0
	25-49%	16	8.0	16	8.0	2	1.0	12	6.0	46	23.0
	50-74%	4	2.0	7	3.5	0	0.0	4	2.0	15	7.5
	75-100%	0	0.0	1	0.5	0	0.0	0	0.0	1	0.5

Source: Field Survey, 2016/17

8.3.3 Comparison of Poverty Incidence among Respondents by District

In Figure 8.2, the average poverty incidence per district among the sampled respondents are shown. Marked differences were observed on the various criteria used for measuring the incidence of poverty among respondents in the four districts. With respect to living below the national poverty line, the majority of respondents in all the four districts were living below the national poverty line (see Figure 8.2), with the highest average percentage in Tonkolili district (86.18%), and the lowest in Port Loko District (72.64%). On the contrary, Port Loko District had respondents with the highest average percentage (27.36%) above the national poverty line, while Tonkolili had the lowest average percentage (13.82%). On the other hand, the majority of respondents across the four districts live above the national food poverty line, with Port Loko having the highest average percentage (77.64%) of respondents, followed by Kambia (75.98%), Koinadugu (66.68%), and lastly Tonkolili district (66.54%). Consistently, the number of those living below the food poverty line were generally small, with the highest average of respondents in this condition in Tonkolili district (33.46%), followed by Koinadugu (33.32%), Kambia (24.02%), and Port Loko districts (22.36%).

Figure 8.2:Comparison of poverty incidence among respondents by district



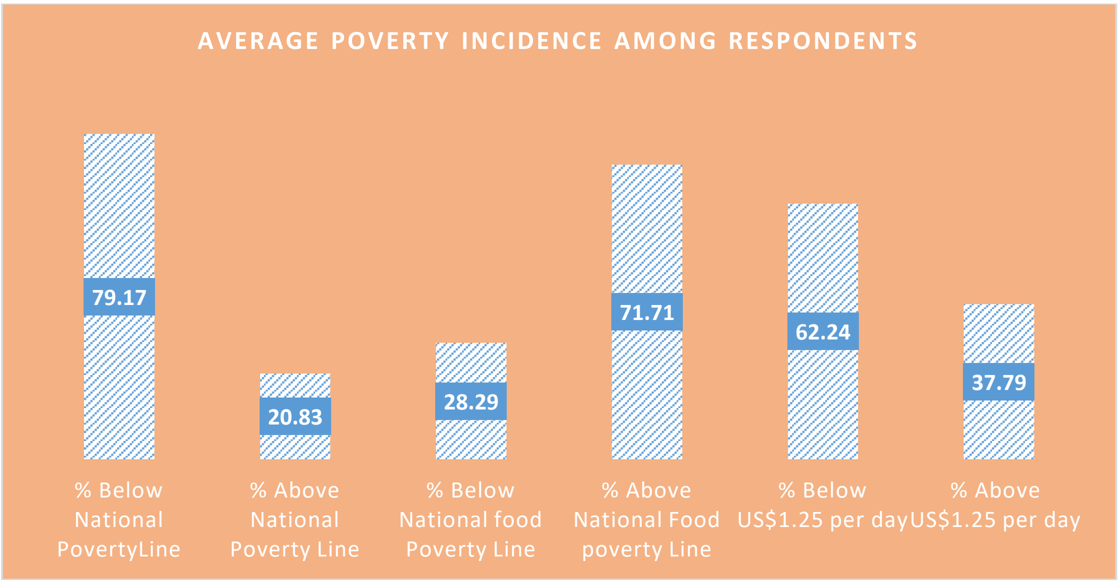
With respect to the international measurement of poverty, based on the US$1.25 per day, the majority of respondents in all four districts studied showed prevalence of poverty, with more than half living on less than this figure. Tonkolili showed the highest percentage (70.22%), followed by Koinadugu (68.22%), Kambia (55.73%), and Port Loko district with the lowest (54.79%). However, Port Loko (45.26%) and Kambia districts (44.29%) showed the highest average of respondents living on more than the US$1.25 per day, with the lowest averages in Tonkolili (29.79%) and Koinadugu districts (31.81%). These results suggest a high incidence of poverty among respondents in the target districts and that target respondents of the study are generally poor; however, poverty seems to be more prevalent in Tonkolili and Koinadugu districts than in Port Loko and Kambia. This is consistent with national statistics from the Sierra

Leone Population and Housing Census (2004) and World Bank (2013) reports on poverty in the country, in which the former two districts were identified to be poorer than the latter two.

8.3.4: Average Poverty Incidence among Respondents

Consistent with findings in the preceding sections, the average incidence of poverty among respondents generally showed that respondents were better off in terms of food poverty, but worse off in terms of poverty measures, such as the national poverty line and the international poverty line (see Figure 8.3). It can be seen that up to 79.17% and 62.24% of respondents were below the national and international poverty lines, respectively, compared to 20.83% and 37.79% of respondents above these lines, respectively. However, more than half of respondents were above the national food poverty line (71.71%) compared to only 28.29% who were below.

Figure 8.3:Average incidence of poverty among respondents in study area



These results suggest that while poverty may be holistically endemic among smallholder farmers in the target communities, and possibly in the districts, they are more likely to have access to food for the better part of the year, and this makes them slightly less food poor. This also supports the fact that the respondents are farmers who are likely producing food for their household consumption, among other purposes.

8.4 Smallholder Farmers' Innovations in the Past Ten Years

Farmers' innovations within the period of time of the study (10 years) were categorised into three subgroups – pre-production, production, and post-harvest innovations. Pre-production innovations are those that the farmers undertake prior to starting their farming operations;

production innovations are those carried out during the farming operations, and these are largely agronomic practices; and post-harvest innovations are those carried out by farmers after harvesting and through to marketing of their produce. In this study, the latter two types of innovations were first identified by the researcher during the first phase of the data collection as a result of FGDs with farmers in the target communities. The findings informed the design of the questionnaires used to generate the data of which the analysis provided the information presented in this section.

8.4.1 Pre-production Innovations

The key pre-production innovations studied were the key rice varieties used by smallholder farmers in their farming activities in the past ten years. These were divided into improved and local varieties. Improved rice varieties (IRVs), according to this study, are those rice varieties whose original sources are research and extension actors working with farmers, while local varieties are those from other sources with names other than those recognised. Interestingly, respondents reported growing a number of IRVs that have been promoted by research and extension actors in the country. However, NERICA (49.5%), ROK 5 (21.5%) and Pa Kiamp (21.5%) are the three key IRVs that were largely cultivated among sample respondents (see

Table 8.5). ROK 5 was more popular in Kambia and Koinadugu Districts than in Port Loko and Tonkolili, while NERICA was grown in all four districts. Pa Kiamp was mostly grown by respondents in Tonkolili and Port Loko, but not in Koinadugu districts. Some IRVs were exclusively grown in some districts and not others. For instance, CCA and 3 Month were only mentioned by respondents in Port Loko district; ROKs 22, 23, 24, and 25 were only grown in Kambia District. Respondents in Tonkolili district only grew NERICA, Pa Kiamp, and ROK 14, while those in Koinadugu indicated that they only grew the IRVs NERICA and ROK 5 in the past ten years. The majority of IRVs have been grown by respondents in Kambia district. This is possibly due to their closeness to RARC, whose key mandate is to develop and disseminate these varieties (SLARI, 2011).

A wide array of local rice varieties (LRVs) were indicated to have been grown by farmers in the last ten years. The 26 LRVs shown in

Table 8.5 were among the most popular varieties, the total number of varieties mentioned (over 76) would have produced an extremely lengthy, and unnecessary, list. The most widely grown LRV identified was *Pa Gbassay* (24.0%), grown in all but one district (Koinadugu). This was followed by varieties such as *Yukureh* (20.0%) and *Seniwer* (19.0%), both of which were only grown in Koinadugu district. A key observation was that a clear distinction exists among the local varieties grown by farmers in the target districts. Some varieties are specific or are largely grown by one district and not others. For example, respondents from Koinadugu district only indicated they had grown *Yukureh, Seniwer, Yarrduka,* and *Morovia*. Kambia and Port Loko districts share a common local variety grown in the past ten years, while Tonkolili farmers seems to also have varieties unique to their district. However, it was observed that most of these local varieties shared similar features, e.g., grain colour, size, and growth duration. It is highly likely that some of these varieties change names as they move from one community to the next. For example, one of the respondents in a KII in Tonkolili district mentioned that a friend from Kailahun District gave him a new rice variety which he deliberately named after his friend. He argued that this will always remind him of the source of the variety, and more so if other farmers in the community grow it. This is a possible reason for the myriad of different names given to these local varieties.

It is worth noting that most of these varieties were those some of the respondents indicated to have tried or used within the time frame of the study. The use of some has been discontinued for a variety of reasons, and these are discussed in subsequent sections of this chapter.

Figure 8.4:Photos of a sample of rice varieties taken during data collection in Kambia

Farmer in Port Loko displaying NERICA rice variety (Photo credit: Researcher)

A collection of local rice varieties being dried on bare ground in Kambia (Credit: Researcher)

Table 8.5:Pre-production innovations

Innovation	Name	Name of District: Kambia (n=50)		Port Loko (n=50)		Tonkolili (n=50)		Koinadugu (n=50)		Total (200)	
		Frequency (F)	Percentage (%)	F	%	F	%	F	%	F	%
Improved Rice Varieties											
	NERICA	27	13.5	45	22.5	16	8.0	11	5.5	99	49.5
	Pa Kiamp	3	1.5	16	8.0	24	12.0	0	0.0	43	21.5
	CCA	0	0.0	7	3.5	0	0.0	0	0.0	7	3.5
	3 Month	0	0.0	17	8.5	0	0.0	0	0.0	17	8.5
	ROK 3	9	4.5	10	5.0	0	0.0	0	0.0	19	9.5
	ROK 5	21	10.5	4	2.0	0	0.0	18	9.0	43	21.5
	ROK 10	27	13.5	0	0.0	0	0.0	0	0.0	27	13.5
	ROK 14	18	9.0	2	1.0	1	0.5	0	0.0	21	10.5
	ROK 22	3	1.5	0	0.0	0	0.0	0	0.0	3	1.5
	ROK 23	1	0.5	0	0.0	0	0.0	0	0.0	1	0.5
	ROK 24	13	6.5	0	0.0	0	0.0	0	0.0	13	6.5
	ROK 25	1	0.5	0	0.0	0	0.0	0	0.0	1	0.5

Local Varieties										
	Pa Bunch	5	2.5	15	7.5	0	0.0	0	0.0	20	10.0
	Pa Gbassay	17	8.5	28	14.0	3	1.5	0	0.0	48	24.0
	Pa DC	0	0.0	21	10.5	3	1.5	0	0.0	24	12.0
	Pa Katikundor	0	0.0	1	0.5	3	1.5	0	0.0	4	2.0
	Pa Mamudu	22	11.0	1	0.5	0	0.0	0	0.0	23	11.5
	Pa Kambia	1	0.5	9	4.5	0	0.0	0	0.0	10	5.0
	Pa Thedeh	3	1.5	2	1.0	0	0.0	0	0.0	5	2.5
	Pa Alias	12	6.0	0	0.0	0	0.0	0	0.0	12	6.0
	Pa Kalisedu	18	9.0	0	0.0	0	0.0	0	0.0	18	9.0
	Panafatu	0	0.0	0	0.0	9	4.5	0	0.0	9	4.5
	Pajarrkay	0	0.0	0	0.0	10	5.0	0	0.0	10	5.0
	Pa Milk	0	0.0	0	0.0	6	3.0	0	0.0	6	3.0
	Pa Butter	0	0.0	0	0.0	3	1.5	0	0.0	3	1.5
	Yenkeyanka	0	0.0	15	7.5	0	0.0	0	0.0	15	7.5
	Yukureh	0	0.0	0	0.0	0	0.0	40	20.0	40	20.0
	Seniwer	0	0.0	0	0.0	0	0.0	38	19.0	38	19.0
	Morovia	0	0.0	0	0.0	0	0.0	19	9.5	19	9.5
	Pa Gbass	5	2.5	5	2.5	3	1.5	0	0.0	13	6.5
	Yarrduka	0	0.0	0	0.0	0	0.0	28	14.0	28	14.0
	Munafa	0	0.0	9	4.5	0	0.0	0	0.0	9	4.5
	Bathus	8	4.0	0	0.0	0	0.0	0	0.0	8	4.0
	Buttercup	2	1.0	2	1.0	0	0.0	0	0.0	4	2.0
	Pachaime	6	3.0	1	0.5	1	0.5	0	0.0	8	4.0
	Pafant	1	0.5	9	4.5	2	1.0	0	0.0	12	6.0
	Abu Tonko	7	3.5	0	0.0	0	0.0	0	0.0	7	3.5
	Tanis	4	2.0	0	0.0	0	0.0	0	0.0	4	2.0

Source: Field Survey, 2016/17

8.4.2 Production Innovations

The key innovations on agronomic practices (production) identified hinged on those that research and extension actors have promoted in the study area for the period under study. They are the System of Rice Intensification (SRI) and the Technical Package on Rice (TP-R). Before the introduction of these innovations, farmers followed conventional or traditional methods of rice cultivation. These included techniques of planting immediately after ploughing (no puddling); no weeding; the use of nursery plots before land/plot preparation; planting five to eight seedlings per hill; leaving little spacing between seedlings; and transplanting after 30 days in the nursery plot, among others. Findings from the study show that some of the agronomic innovations promoted by external actors had a higher acceptance rate than others. Innovations such as puddling[16] (77.5%), weeding of inland valley swamps (IVS) (73.5%), land preparation before nursery planting (51.5%), shallow planting of

[16] Puddling is the act of softening ploughed land with standing water until the soil becomes muddy. It provides standing water for the crops and a soft seedbed for planting rice. It also helps reduce the growth of weeds.

seedlings (50.5%), and reduced seedlings per hill (50.0%) were among the most widely implemented innovations farmers have tried in the past ten years (see

Table 8.6). Also, innovations such as reduced nursery time for seedlings, i.e., early transplanting of seedlings from the nursery to the farm (IVS) (39.5%); increased spacing between seedlings (33.5%); construction of bunds/water control/swamp development (32.5%); and the use of chemical (32.0%) and organic (30%) fertilisers are among the popular innovations smallholder farmers indicated to have tried in their farming enterprises in the past ten years. Priming of seeds before planting (26.0%), crop rotation[17] (17.0%), and fencing around farms (1.0%) were also mentioned by respondents. A detailed assessment of the number of days seedlings spend in the nursery before being transplanted and the number of seedlings planted by farmers (see Table 8.7) showed that majority of respondents (22.0%) currently transplant their seedlings after 21 days in the nursery, followed by those who transplant after 14 days (6.5%), and then those who do so after 30 days (5.0%). With respect to the number of seedlings per hill, the majority of respondents (31.5%) indicated to now plant three seedlings/hill, followed by those who plant two seedlings/hill (6.0%).

While it may be difficult to ascertain which of these innovations are more aligned to either the SRI or TP-R as they share a number of common agronomic innovations, it can be reasonably suggested that the TP-R innovations seem to be more popular and accepted than the former. For example, more farmers indicated that they now transplant their rice seedlings within the first 21 days compared to those doing so within the first 14 days, also no farmers indicated they plant only one seedling/hill. The latter innovations are specific to SRI. The key reasons for farmers' acceptance of certain innovations and not others are discussed in subsequent sections of this chapter. Undoubtedly, farmers are more motivated to try innovations which have clear benefits to them, are less risky, affordable, and easy to try.

Figure 8.5:Female farmers demonstrating spacing of seedlings before and after mentoring from NGO and MAFFS actors in an FGD in Bendukura, Koinadugu District

[17] "Crop rotation is the systematic planting of different crops in a particular order over several years in the same growing space. This process helps maintain nutrients in the soil, reduce soil erosion, and prevents plant diseases and pests" (source: https://www.maximumyield.com/definition/317/crop-rotation)

Spacing before mentoring from external actors

Spacing after mentoring from external actors

Table 8.6: Production Innovations

Innovations Name	Kambia (n=50) Frequency (F)	Percentage (%)	Port Loko (n=50) F	%	Tonkolili (n=50) F	%	Koinadugu (n=50) F	%	Total F	%
1. Land preparation before nursery	20	10.0	22	11.0	35	17.5	26	13.0	**103**	**51.5**
2. Shallow transplanting of seedlings	40	20.0	22	11.0	32	16.0	7	3.5	**101**	**50.5**
3. Reduced nursery time	19	9.5	33	16.5	26	13.0	1	0.5	**79**	**39.5**
4. Weeding of Inland Valley Swamps	34	17.0	33	16.5	34	17.0	46	23.0	**147**	**73.5**
5. Priming of seeds	8	4.0	12	6.0	25	12.5	7	3.5	**52**	**26.0**
6. Reduced seedlings per hill	26	13.0	28	14.0	21	10.5	25	12.5	**100**	**50.0**
7. Construction of bunds in lowlands (swamp development)	6	3.0	15	7.5	34	17.0	11	5.5	**65**	**32.5**
8. Puddling	45	22.5	29	14.5	35	17.5	46	23.0	**155**	**77.5**
9. Increased spacing between stands of seedlings	22	11.0	14	7.0	6	3.0	25	12.5	**67**	**33.5**
10. Use of organic manure	1	0.5	17	8.5	4	2.0	38	19.0	**60**	**30.0**
11. Use of chemical fertilizers	23	11.5	20	10.0	3	1.5	18	9.0	**64**	**32.0**
12. Crop rotation	0	0.0	7	3.5	11	5.5	16	8.0	**34**	**17.0**
13. Fencing around farms	0	0.0	1	0.5	1	0.5	0	0.0	**2**	**1.0**

Source: Field Survey, 2016/17

Table 8.7:Nursery duration and number of seedlings planted per hill by farmers

Nursery duration (in days) (n=200)	**F**	**%**	**Number of seedlings/hill (n=200)**	**F**	**%**
12	1	0.5	**2**	12	6.0
14	13	6.5	**3**	63	31.5
15	4	2.0	**4**	4	2.0
20	2	1.0	**5**	4	2.0
21	44	22.0	**6**	3	1.5
25	1	0.5	**7**	1	0.5
30	10	5.0	**8**	1	0.5
35	1	0.5	**10**	2	1.0
40	5	2.5	**11**	1	0.5

Source: Field Survey, 2016/17

8.4.3 Post-Harvest Innovations used by Smallholder Farmers

The study identified a total of 13 post-harvest innovations currently being used by respondents in their various districts (Table 8.8). The three top innovations mentioned by more than half of the respondents were: early threshing of their rice, as opposed to leaving it on the farm for months after harvest (69.0%); storing their rice in town[18] after threshing, as opposed to storing it in the bush (68.5%); and using commercial/ABC rice mills in their own or in nearby communities, as opposed to manually pounding the rice paddy (67.5%). The two former innovations are those promoted mainly through the TP-R system, while the latter is mainly promoted through the ABCs[19] and some private traders. These innovations are mostly popular because farmers perceive them to reduce post-harvest losses (i.e., the two former innovations) and to minimise the drudgery associated with manual pounding of rice (the latter). Further, the storage of husk rice in jute bags mixed with wood ash to control pests (57.0%); the use of drying floors (44.5%); the storage of rice with pepper (32.5%); and the storage of rice seeds in local baskets (19.5%) were also reported by respondents as post-harvest practices they have effected in their farming system within the last ten years. However, post-harvest innovations relating to ABCs, such as the storage (2.0%) and sale (1.5%) of rice in the ABC, and the use of an ABC thresher (1.5%), were only mentioned by a few respondents. These results suggest that most of the post-harvest innovations used by respondents within the study period were those promoted through the TP-R programme. Those from the ABC programme did not seem to be popularly used by farmers. This cannot be unconnected with scarcity and distance to access of these innovations from the homestead. Certainly, the distance to the ABCs, and the non-functioning of the machinery in most of them, means they cannot meet the post-harvest needs of the farmers. In fact, respondents from Kambia district did not indicate using innovations from the ABC at all. More details on the constraints faced by respondents in relation to these innovations are discussed subsequent sections.

[18] The key benefits are to prevent damage from pests and safeguard against thieves.

[19] These were market and processing centres constructed by the MAFFS nationwide to ameliorate smallholder rice farmers' post-harvest constraints.

Table 8.8: Post-harvest Innovations in use by respondents

Innovations Name	Name of District: Kambia (n=50)		Port Loko (n=50)		Tonkolili (n=50)		Koinadugu (n=50)		Total	
	(F)	(%)	F	%	F	%	F	%	F	%
1. Treatment of stored rice with pepper	8	4.0	30	15.0	4	2.0	23	11.5	**65**	**32.5**
2. Early threshing (1 or 2 days after harvesting)	27	13.5	38	19.0	27	13.5	46	23.0	**138**	**69.0**
3. Threshing by trampling with feet rather than flailing with sticks	16	8.0	29	14.5	31	15.5	2	1.0	**78**	**39.0**
4. Storing of rice seed in community store	1	0.5	3	1.5	14	7.0	5	2.5	**23**	**11.5**
5. Use of rice mill as opposed to manual pounding	48	24.0	27	13.5	25	12.5	35	17.5	**135**	**67.5**
6. Rice sales in ABC	0	0.0	1	0.5	0	0.0	2	1.0	**3**	**1.5**
7. Storing rice in town after threshing as opposed to storing in the bush/farm	45	22.5	27	13.5	36	18.0	29	14.5	**137**	**68.5**
8. Using drying floor as opposed to drying on the bare ground	1	0.5	18	9.0	25	12.5	45	22.5	**89**	**44.5**
9. Use of threshers	0	0.0	3	1.5	0	0.0	0	0.0	**3**	**1.5**
10. Storing rice in ABC	0	0.0	1	0.5	0	0.0	3	1.5	**4**	**2.0**
11. Storing paddy rice in jute bag plus wood ash	39	19.5	19	9.5	13	6.5	43	21.5	**114**	**57.0**
12. Storing rice seeds in plastic containers for storing rice	0	0.0	5	2.5	5	2.5	15	7.5	**25**	**12.5**
13. Storing rice seeds in local baskets for safe keeping	16	8.0	0	0.0	23	11.5	0	0.0	**39**	**19.5**

Source: Field Survey, 2016/17

8.5: Drivers for Smallholder Farmers' use Innovations from External Actors

The study identified several drivers for respondents' (smallholder farmers) use of innovations promoted by research and extension actors in their communities. These drivers are categorised into three levels – pre-production, production, and post-harvest innovations. Respondents were required to assess the level of importance of each driver or reason stated for using/trying a particular innovation.

8.5.1 Drivers of Pre-Production Innovations (New Rice Varieties)

A number of factors were identified which drive respondents' use of new rice varieties, be they improved or local. The key ones respondents perceived to be crucial are shown in Table 8.9 below. All reasons were considered to be of some importance to all respondents, none was identified to be of no importance.

Table 8.9:Drivers for pre-production innovations (new rice varieties)

Reason/Driver	Level of importance to respondents: No importance		Very Little Importance		Medium Importance		Great importance		Very Great Importance	
	Frequency (F)	Percentage (%)	F	%	F	%	F	%	F	%
1. Early maturity of NERICA or other short duration varieties	-	-	1	0.5	3	1.5	22	**11.0**	135	**67.5**
2. Better tillering and growth of seedlings	-	-	2	1.0	1	0.5	70	**35.0**	102	**51.0**
3. Opportunity to grow vegetables or other crops earlier than normal due to early maturity of the variety	-	-	1	0.5	5	2.5	34	**17.0**	41	**20.5**
4. Improves household food security throughout the year	-	-	1	0.5	2	1.0	74	**37.0**	64	**32.0**
5. Good taste	-	-	1	0.5	7	3.5	67	**33.5**	46	**23.0**
6. Enhances opportunity for double cropping	-	-	-	-	4	2.0	26	**13.0**	41	**20.5**
7. To increase yield/productivity	-	-	-	-	2	1.0	49	**24.5**	99	**49.5**
8. To increase household income	-	-	1	0.5	3	1.5	103	**51.5**	54	**27.0**
9. Reduces indebtedness of farm family	-	-	3	1.5	60	30.0	58	**29.0**	33	**16.5**
10. To ascertain the yield capacity of new local variety being planted by other farmers	-	-	52	26.0	19	9.5	12	**6.0**	18	**9.0**
11. Lack of/limited alternatives	-	-	9	4.5	18	9.0	13	**6.5**	16	**8.0**
12. To improve viability of seeds	-	-	1	0.5	6	3.0	15	**7.5**	21	**10.5**

Source: Field Survey, 2016/17

Some of the key drivers respondents considered to be of great or very great importance to them growing new rice varieties (and their respective percentages), include: better tillering and growth of those seed varieties (35.0%, 51.0%); the potential to increase household income (51.5%, 27.0%); the early maturity of the varieties (11.0%, 67.5%); the potential to improve household food security (37.0%, 32.0%); the potential to increase yield/productivity (24.5%, 49.5%); the good taste of the varieties (33.5%, 23.0%); enhancement of the opportunity to undertake double cropping due to their early maturity (13.0%, 20.5%); and the opportunity to grow vegetables earlier than normal (17.0%, 20.5%). Other drivers mentioned by a few respondents included: reduction of indebtedness of the household; ascertainment of the yield capacity of new local varieties; the lack of alternatives; and the viability of the varieties. It is clear that there are a number of factors that influence respondents' decisions to grow a particular variety, most of which are closely linked to increases in productivity, income, food security, and some agronomic attributes. Most importantly, some of these drivers are not borne only by IRVs as respondents indicated that their use of some local varieties is the result of some of these same drivers.

Box 8.1: Important Points on Drivers of Smallholder Farmers' Use of New Rice Varieties

Drivers, such as early maturity, opportunity to grow vegetables, reduction of indebtedness of the farming household, opportunity for double cropping, increasing household income, etc. were mostly linked with the early maturity of the varieties cultivated by farmers. For instance, farmers indicated that varieties that mature early will prevent them from incurring more debts while awaiting the harvesting of some longer duration varieties., This makes it easier to for them to harvest earlier and do perform second cropping of the same variety on their IVS before the dry season; or to cultivate other crops, like such as those vegetables which can be harvested earlier before the general vegetable harvest season, of vegetables for example, and therefore which normally attracts higher prices as a consequence. Also, drivers such as increased household income and food security were linked with to the rice varieties' tillering ability and yield capacity. This was based on the premise that varieties that are high tillering and yielding varieties increased productivity, which in turn increased farmers access to food and as well as the opportunity to sell some produce for the income required for non-food items/services. Some farmers indicated reverting to growing certain varieties due to the lack of alternatives; that is, they know of the existence of better varieties than the ones they grow, but cannot access them. They therefore go with the saying that "if the preferable is not available, then the available is preferable".

8.5.2: Drivers of Production Innovations (Agronomic Practices)

Respondents identified a number of drivers they considered important to them for the use of the agronomic innovations promoted by smallholder farmers in their communities (see Table 8.9). The drivers identified by respondents to be of great or very great importance (and their respective percentages) include the potential of the innovations to: increase their farm level yield (36.5%, 55.5%); increase the tillering ability of seedlings (44.5%, 36.0%); improve the germination rate of seeds (47.5%, 20.0%); enhance the growth rate of seedlings (29.0%, 45.0%); enhance fertiliser application (22.0%, 35.0%); minimise wastage of farm inputs (42.0%, 10.0%); ease land preparation and reduce pest infestation (29.0%, 22.0%); and enhance double cropping (7.0%, 16.5%). The tendency of the innovations to improve soil fertility, enhance water control in IVS, and help control animal pests from destroying rice nurseries were also among the drivers identified by a few respondents. It is evident from the findings that the majority of respondents identified the tendency of the innovations to increase the yield of their crops as the number one driver for trying the production innovations identified compared to other innovations. This further suggests that smallholder farmers pay premium importance to yield, including its obvious antecedents, as a key criterion for innovation. Be they pre-production or production innovations, it is the yield capacity that smallholder farmers consider paramount. This does not necessarily suggest that other drivers are not important, but that innovations that have the tendency to improve yield may be more important to them at pre-production and production stages of innovation. See Boxes 8.2 and 8.3 for more interesting reasons for respondents' willingness to innovate.

Table 8.10: Reasons/drivers for production innovations

Reason/Driver	Level of importance to respondents: No importance		Very Little Importance		Medium Importance		Great importance		Very Great Importance	
	F	(%)	F	%	F	%	F	%	F	%
1. Improves germination rate	-	-	1	0.5	2	1.0	95	**47.5**	40	**20.0**
2. Increases the tillering ability of seedlings	-	-	-	-	4	2.0	89	**44.5**	72	**36.0**
3. Increases yield	-	-	-	-	5	2.5	73	**36.5**	111	**55.5**
4. Eases land preparation and reduces weed infestation	-	-	3	1.5	16	8.0	58	**29.0**	44	**22.0**
5. Enhances the growth rate of seedlings	1	0.5	1	0.5	7	3.5	58	**29.0**	90	**45.0**
6. Enhances fertilizer application	-	-	10	5.0	12	6.0	44	**22.0**	27	**35.0**
7. To repel pests eg cutting grass			1	0.5	10	5.0	37	**18.5**	23	**11.5**
8. Enhances double cropping	1	0.5	-	-	-	-	14	**7.0**	33	**16.5**
9. Minimize wastage of inputs	-	-	2	1.0	15	7.5	84	**42.0**	20	**10.0**
1. Improves soil fertility			-	-	-	-	3	**1.5**	5	**2.5**
11. Enhances water control	-	-	-	-	-	-	4	**2.0**	1	**0.5**
12. Prevent animal pest from destroying nursery	-	-	-	-	-	-	-	-	1	**0.5**

Source: Field Survey, 2016/17

Box 8.2: Notes on smallholder farmers' reasons for using new agronomic practices (innovations)

It is important to note that some of the drivers stated in Table 8.9 are likely a result of more than one agronomic innovation. During the FGD and KII (qualitative) stage of the research, it was noted that the majority of smallholder farmers identified multiple innovations for a single driver, and multiple drivers for a single innovation. Notably, agronomic innovations, such as the increased spacing between seedlings, shallow planting of seedlings, reduced seedlings per hill, use of chemical and organic fertilizers, etc., were identified as innovations used in a bid to increase yield (driver). Also, innovations such as reduced nursery duration, reduced seedlings per hill, and increased spacing were linked with increasing the tillering capacity of seedlings as a driver for use by smallholders using them. On the other hand, some of the innovations were also linked with more than one driver. For instance, construction of bunds (water control) was linked with drivers which including included the ability to repel pests (e.g., cutting grass) from accessing IVS plots, and the ability to enhancing enhance double cropping due to water control, as well as enhancing the application of fertilizers in IVS since there is minimal erosion of the fertilizer when the entry and removal of water into the plot is controlled. This largely shows that some of the drivers indicated are not particularly unique to a specific innovation, rather, they could be linked with to multiple innovations that which farmers consider important to them.

Box 8.3: Farmer discloses the importance of TP-R innovations in their farming enterprises.

"… .you already begin to increase productivity before harvesting… ."; was a key phrase by one of the farmers in Robat, Kambia District. A lead farmer in his community disclosed to me during a KII in at his farm (see photo in figure 8.6) that he and his colleague farmers in the community and beyond have benefited immensely from applying principles of the TP-R in their farming activities. Before receiving mentoring from the Japanese International Cooperation Agency (JICA) and MAFFS on the TP-R, they used to spend a lot on seeds due to narrow planting distances between seedlings and planting too many seedlings per hill. They never knew the importance of constructing and maintaining bunds in their IVS. But However, with the mentoring from JICA and the MAFFS, they were now able to now innovate, that is drop discontinue their initial practices and take up the new ways suggested by these actors. "We accepted these innovations because we see some benefits in them", he said. "The number of bushels we initially required as seeds for planting has reduced considerably. "Now, you already begin to increase productivity before harvesting, because those seeds which you have saved can now add to the one you will be harvesting", he added. "So, I think, it is a good thing", he lamentedcelebrated. "As lead farmer, I am happy to help colleague farmers use these principles, because I am already benefiting from them", he concluded. In general, most farmers who participated in TP-R, had a positive view of some key production principles of the innovation in the

Figure 8.6:Farmer highlighting key agronomic advantages of TP-R innovation approach

8.4.3 Drivers of Post-harvest Innovations

The key drivers identified by respondents for the use of the post-harvest innovations promoted by external actors in the study area are presented in Table 8.11. Those which respondents considered to be of great or very great importance (and their respective percentages) were the potential of the innovations to: reduce post-harvest losses (44.0%, 30.0%): reduce drudgery associated with manual pounding of rice paddy (26.5%, 43.5%); improve the quality of rice processing (40.5%, 25.5%); improve the viability of seeds (25.0%, 19.0%); reduce the risk of pests and thieves (27.5%, 28.5%); and, minimise the risk of diverting/consuming rice seeds (15.0%, 16.5%). It can be seen from these results that most of the post-harvest innovations adopted by respondents were mainly driven by their potential to reduce post-harvest losses. Other drivers, such as the reduction of the drudgery associated with manual pounding, were linked mainly with the respondents' use of rice mills. While other drivers were important, based on these results it can be suggested that farmers were mainly driven by factors which reduce post-harvest losses from their farm output, reduce the drudgery associated with manual pounding, and improve the quality of rice paddy during processing. Invariably, some of these key drivers were mainly a combination of multiple innovations (FGDs and KII, 2016). For example, the treatment of rice with pepper was used to prevent pests from destroying the rice seeds, early threshing was used to prevent pests from destroying rice in the field or from being stolen, and threshing by trampling instead of flailing with stick was used to reduce the scattering and damaging of rice seeds. All of these are sources of postharvest losses, thus it can be seen that the drive to reduce post-harvest losses results in the use/adoption of more than one post-harvest innovation. Please refer to Box 8.4 for some interesting revelations from respondents regarding their post-harvest drivers.

Table 8.11:Reasons/drivers for post-harvest innovations

Reason/Driver	Level of importance to respondents: No importance		Very Little Importance		Medium Importance		Great Importance		Very Great Importance	
	F	%	F	%	F	%	F	%	F	%
1. Reduces drudgery associated with manual pounding of rice by women and children	1	0.5	1	0.5	12	6.0	53	**26.5**	87	**43.5**
2. Improves quality of rice by using dry floor – no impurities	-	-	4	2.0	7	3.5	81	**40.5**	51	**25.5**
3. Reduces postharvest losses	-	-	2	1.0	15	7.5	88	**44.0**	60	**30.0**
4. Improves viability of seeds	-	-	2	1.0	32	16.0	50	**25.0**	38	**19.0**
5. Minimizes the risk of consuming seeds when stored in community store/ABC	-	-	4	2.0	9	4.5	30	**15.0**	33	**16.5**
6. Reduces risk of pests and thieves	-	-	1	0.5	6	3.0	55	**27.5**	57	**28.5**
8. Reduces pest infestation	-	-	-	-	-	-	1	**0.5**	1	**0.5**

Source: Field Survey, 2016/17

Box 8.4: Respondents disclosures regarding post-harvest innovations

During the qualitative phase of data collection, it was noted that some respondents mentioned that before their participation in the TP-R programmes, they used to leave their paddy rice in the field for months after harvesting, stacked at specific points in on the farm until they are ready to thresh. Some never knew the risks associated with this and other practices, such as storing their rice after harvest in the bush, until their participation in the TP-R. This helped them identified identify some of the risks, including exposure to pests and thieves, as well as loss of quality of the seeds. For rice mills, farmers indicated the drudgery their family members use to go through with the manual pounding of rice and their happiness for at their access to rice mills in their own or in nearby communities. These are some of the reasons given for the wide acceptance/use of these innovations by respondents.

8.5 Actors Influencing Smallholder Farmers Innovation Processes and their Roles

The actors influencing smallholder farmers' innovation processes at community level were identified using a two-step process. First, a list of actors was developed during the qualitative phase of the data collection, this was used to design the questionnaire which subsequently generated the information presented here in the second step. Respondents were asked to indicate whether a particular actor on the list had helped them make changes to the way they farm, and if so, how helpful or not this was, and how important or not they think the actor had been in the process. Provision was made on the questionnaire for respondents to include additional actors they believe have facilitated their innovation processes, but who were not on the list. Findings from the survey are presented in Tables 8.10, 8.11, and 8.12 below. It is worth noting that this question was only applicable to respondents who indicated they had engaged in innovation in their farming enterprises within the past ten years.

8.5.1: Helpfulness of Various Actors in Smallholder Farmers' Innovation Processes

The various actors who respondents considered to have helped them make changes in the way they farm are shown in

Table 8.12. The results show that a number of actors have played a role in facilitating respondents' innovation processes. However, the top actors/facilitators, and what they provide, which respondents identified to have been helpful or very helpful in facilitating change in the way they farm (and their respective percentages) included: seeds from colleague farmers (43.0%, 24.5%); information or ideas from the radio (45.0%, 10.5%); information/ideas from colleague farmers (36.5%, 17.5%); information/ideas from MAFFS extension officers (32.0%, 18.0%); seeds from MAFFS extension officers (39.0%, 8.5%); own initiative (20.0%, 25.5%); information/ideas from NGO extension workers (25.0%, 11.5%); and seeds from NGO extension officers (24.5%, 10.0%). It is interesting to learn from these results that the majority of farmers indicated they have been influenced more by their colleagues and information from the radio than by MAFFS and NGO officials. This cannot be unconnected with the frequency of contact between the farmers and MAFFS and NGO actors. Given that their colleague farmers live close by and are mostly the first point of contact in time of need, it makes sense that they would receive more support from them than actors external to the community. The same applies to information from the radio. Radios are more or less permanently with the owner (farmer) and are readily accessible. Any information broadcast on the radio is generally easily accessed by the farmers without the extension agent or researcher having to be there physically. Next to colleague farmers and radio, in terms of helpfulness, are the extension staff from MAFFS. This is possibly due to the fact that the MAFFS have permanent district level offices and, at least in theory, have staff at chiefdom level called Block and Frontline Extension Workers. This is a possible reason for the perceived helpfulness of MAFFS officers to respondents' innovation processes. On the other hand, NGO projects are normally limited in scope and timeframe. This means that their presence and activities are likely not to be felt in communities targeted and possibly due to the length of intervention. Also, based on the researcher's experience and observation, most NGO staff live at a distance away from their beneficiaries and are seemingly overwhelmed by the number of farmers for which each extension officer is responsible. This may have contributed to their limited contact or perceived helpfulness of NGO officials compared to MAFFS staff or other farmers.

The results suggest that the farmers' own initiative was more helpful to respondents than their Agricultural Research Officers and Agro-dealers. This is also possibly due to the limited contact between research actors and farmers. Based on the researcher's observation and experience, research officials do not interact with farmers for mentoring or coaching purposes on agricultural innovations as much as MAFFS or NGOs do. Also, three of the innovations studied were not promoted by research institutes. These are possible reasons for the perceived absence of research officers in respondents' innovation processes.

Disaggregating the results by district showed similar results. No marked differences from the foregoing were found between the four districts studied. It is for this reason that the researcher has not presented disaggregated data by district.

Table 8.12:Actors/Facilitators of change among smallholder farmers

Innovations	Not helpful		No Opinion		A little Helpful		Helpful		Very Helpful	
	Frequency (F)	Percentage (%)	F	%	F	%	F	%	F	%
1. Information/ ideas from MAFFS Extension Officers	32	16.0	11	5.5	32	16.0	64	**32.0**	36	**18.0**
2. Information/ ideas from NGO Extension Officer	39	19.5	49	24.5	24	12.0	50	**25.0**	23	**11.5**
3. Seeds from MAFFS Extension Officer	36	18.0	16	8.0	26	13.0	78	**39.0**	17	**8.5**
4. Seeds from NGO Extension Officer	59	29.5	38	19.0	12	6.0	49	**24.5**	20	**10.0**
5. Seeds by colleague farmer	4	2.0	23	11.5	38	19.0	86	**43.0**	49	**24.5**
6. Information/ideas from colleague farmer	3	1.5	20	10.0	66	33.0	73	**36.5**	35	**17.5**
7. Own Initiative	19	9.5	17	8.5	72	36.0	40	**20.0**	51	**25.5**
8. Agro-dealers/Itinerant agricultural traders	99	49.5	28	14.0	11	5.5	27	**13.5**	12	**6.0**
10. Agricultural Research Officer	70	35.0	57	28.5	9	4.5	30	**15.0**	12	**6.0**
11. Information/ideas from the radio	6	3.0	11	5.5	57	28.5	90	**45.0**	21	**10.5**
12. Information/ideas from community leaders (Town chief, etc)	14	7.0	8	4.0	73	36.5	56	**28.0**	15	**7.5**

Source: Field Survey, 2016/17

8.5.2 Importance of Various Actors in Smallholder Farmers' Innovation Processes

The following are the actors identified by respondents who they considered important in making them change the way they farm (innovate) in their farming communities. This involves the provision of mentoring services, information, ideas, seeds, etc. The actors were assessed against five levels of importance, as can be seen in Table 8.12. The most important facilitators of innovation respondents identified by respondents to be of medium, great or very great importance to them (and their respective percentages) are: colleague farmers within the community (17.0%, 33.0%, 38.5%); colleague farmers outside the community (9.5%, 29.5%, 25.0%); MAFFS extension workers (15.0%, 24.0%, 25.0%); NGO extension workers (14.5%, 30.0%, 16.0%); lead farmers (15.0%, 21.5%, 23.5%); radio (27.0%, 22.0%, 7.0%); and community leaders/authorities (16.0%, 29.0%, 2.5%). Other actors identified as important, though to a lesser extent, included itinerant agricultural traders, agro-dealers, agricultural research officers, and officials of the ABCs and District Councils. The latter were largely indicated to be of no or little importance (x% and x%, respectively) to smallholder farmers' innovation processes (see Table 8.11). These results are largely consistent with those reported in the preceding section in that colleague farmers, both inside and outside respondents' communities, emerged as the top most important facilitators of change. Also, the other key actors, including MAFFS and NGO extension workers and radio, which were identified as being helpful or very helpful in smallholder farmers innovation processes, were similarly considered to be important or very important in respondents' innovation processes. The only difference is seen in the information gained from radio, this was considered to be more helpful than important to the respondents, i.e., radio was second only to seeds from colleague farmers as the most helpful actor identified. This variation in perceptions of an actor being either helpful or important is possibly due to the fact that one can be helpful to someone, but the importance attached to that help by the beneficiary may be different. For example, radio stations may be very helpful in providing information to farmers, however, farmers may still regard NGOs officials to be more important as they have the capacity to provide services which the radio cannot provide, e.g., one-to-one mentoring and opportunities for feedback, amongst others. Further, these results also assert the prominence (and dominance) of a particular set of actors in the innovation system among smallholder farmers in the study area. The key actors, so far identified, who are perceived to be positively influencing innovation of smallholder farmers in the study area are the farmers themselves, MAFFS, NGOs, and the media. The next section presents findings on respondents' perception of the sources of information they consider useful in their innovation processes.

Table 8.13:Importance of actors/facilitators of change to smallholder innovation processes

Actors/Facilitators	Importance of actors in farmers' innovation processes (n=200)								Very Great Importance	
	No importance		Very Little Importance		Medium Importance		Great Importance			
	(F)	(%)	F	%	F	%	F	%	F	%
1. MAFFS Extension Workers	52	26.0	9	4.5	30	15.0	48	24.0	50	25.0
2. NGO Extension Workers	44	22.0	26	13.0	29	14.5	60	30.0	32	16.0
3. Agro-dealers	124	62.0	9	4.5	9	4.5	33	16.5	4	2.0
4. Itinerant agricultural traders	48	24.0	46	23.0	45	22.5	36	18.0	2	1.0
5. ABC	125	62.5	27	13.5	10	5.0	11	5.5	3	1.5
6. Colleague farmers from the community	2	1.0	13	6.5	34	17.0	66	33.0	77	38.5
7. Colleague farmers outside the community	20	10.0	40	20.0	19	9.5	59	29.5	50	25.0
8. Agricultural research Officer	102	51.0	33	16.5	5	2.5	27	13.5	17	8.5
9. Lead Farmers in or outside community	19	9.5	43	21.5	30	15.0	43	21.5	47	23.5
10. Community Leaders/Authorities	54	27.0	33	16.5	32	16.0	58	29.0	5	2.5
11. District Council officials	154	77.0	6	3.0	1	0.5	11	5.5	7	3.5
12. Radio stations	33	16.5	37	18.5	54	27.0	44	22.0	14	7.0

Source: Field Survey, 2016/17

8.5.3 Sources of useful information for smallholder farmers' innovation processes

This section describes the key sources of information farmers consider useful in helping them innovate in their farming activities. Unsurprisingly, and consistent with earlier findings in this section, the key sources of information identified by more than half the respondents included colleague farmers from the community (96.0%), colleague farmers outside the community (85.0%), radio (79.0%), lead farmers in the community (78.5%), MAFFS extension workers (69.5%), NGO extension workers (68.5%), and community leaders (67.0%). Other actors identified by a relatively small number of respondents were: itinerant traders (42.0%); agricultural researchers (24.5%); Agro-dealers (21.5%); ABCs (9.5%); and District Councils officials (8.5%).

Similarly, respondents' perceptions on the usefulness of these sources of information were no different. The majority indicated that they receive useful or very useful information in relation to their innovation processes from: their colleague farmers (46.0%, 28.5%, respectively), MAFFS extension workers (30.0%, 32.0%), the lead farmer in the community (43.5%, 14.0%), NGO extension workers (34.0%, 20.5%), colleague farmers outside the community (36.5%, 19.0%); and radio (33.0%, 9.0%). Other actors identified by a few respondents as being sources of useful information for their innovation processes were: itinerant traders; agricultural research officers; community leaders; agro-dealers; and ABCs (see Table 8.14).

These findings are not markedly different from those reported in the preceding two sections. That is, farmers, MAFFS and NGO workers, and the media (radio stations) have again emerged as the key actors in terms of sources of information for respondents' innovation processes, and their information is also considered useful to smallholder farmers. It is interesting to note that even though radio stations were identified as an important source of information (79.0%), a relatively small number of respondents (33%, 9.0%) thought the information from radio was useful or very useful, respectively, in their innovation processes. This may be because even though information given over the radio may be connected to agriculture or farming, it may not necessarily be related to rice innovation processes for which the study set out to investigate. Farmers may, therefore, acknowledge radio as being a source of information, but are not likely to consider the information useful in their rice farming activities. This is also a possible reason for the low number of respondents indicating the radio to be important in their innovation processes in Section 8.5.2.

Overall, these findings are largely consistent with the findings in Sections 8.5.1 and 8.5.2. That is, the key actors identified by respondents as having largely influenced their innovation processes because they consider them helpful or important, and who pass on useful information which has impacted their innovations on rice within the time frame of the study are: farmers, including lead farmers; community leaders; MAFFS; NGOs; and the media. Interestingly, agricultural research officers were not generally considered as being important in the smallholder innovation processes. This may be linked with SLARI's focus on the generation, rather than dissemination, of technologies compared to their counterparts – NGOs and MAFFS. In fact, it is worth noting that most NGOs, and even MAFFS, depend on SLARI for IRVs, e.g., the ROK series and NERICAs, but the former are more active in extension than the latter.

Table 8.14:Source of information for farmers' innovation processes

Actors	Considered as a source of information (n=200)				Usefulness of information from actor in innovation processes									
	No		Yes		Not Useful		No opinion		A little Useful		Useful		Very Useful	
	(F)	(%)	F	%	F	%	F	%	F	%	F	%	F	%
1. MAFFS Extension Workers	61	30.5	139	69.5	43	21.5	9	4.5	24	12.0	60	30.0	64	32.0
2. NGO Extension Workers	62	31.0	137	68.5	48	24.0	11	5.5	28	14.0	68	34.0	41	20.5
3. Agro-dealers	156	78.0	43	21.5	91	45.5	44	22.0	12	6.0	35	17.5	5	2.5
4. Itinerant agricultural traders	114	57.0	84	42.0	53	26.5	45	22.5	25	12.5	46	23.0	16	8.0
5. ABCs	179	89.5	19	9.5	112	56.0	36	18.0	4	2.0	23	11.5	6	3.0
6. Colleague farmers from the community	8	4.0	192	96.0	3	1.5	1	0.5	42	21.0	92	46.0	57	28.5
7. Colleague farmers outside the community	30	15.0	170	85.0	7	3.5	19	9.5	55	27.5	73	36.5	38	19.0
8. Agricultural researcher	151	75.5	49	24.5	72	36.0	56	28.0	5	2.5	28	14.0	25	12.5
9. Community leaders	66	33.0	134	67.0	33	16.5	26	13.0	58	29.0	50	25.0	17	8.5
10. Radio station	41	20.5	158	79.0	18	9.0	23	11.5	63	31.5	66	33.0	18	9.0
11. Lead farmer in community	42	21.0	157	78.5	16	8.0	11	5.5	38	19.0	87	43.5	28	14.0
12. District Council Officials	182	91.0	17	8.5	100	50.0	57	28.5	3	1.5	6	3.0	10	5.0

Source: Field Survey, 2016/17

8.5.4 Roles of Actors in Facilitating Smallholder Rice Farmers' Innovation Processes

The key roles of the various actors identified by respondents are presented in Table 8.14 below. The actors and their roles were first identified during the qualitative data collection phase, they were then analysed for the design of the questionnaires for the quantitative phase of the study. The study found that a number of roles/activities were simultaneously performed by a variety of actors, albeit some actors were more renowned for certain roles than others. The key roles of the actors who have influenced smallholder farmers' innovation processes, according to respondents (see Table 8.14), included: sharing rice farming information/ideas; advising/mentoring on rice innovations; facilitating access by farmers to inputs through in-kind exchange of rice seeds; sharing general information on agriculture; facilitating access to markets for inputs and sales of produce; and establishing linkages between farmers, markets, and other actors. These were the key roles identified to have been carried out by most of the actors, however, differences exist among them which concern the performance of a given role towards farmers' innovation processes. The sharing of rice farming information among smallholder rice farmers was mostly seen by respondents as one of the key roles of a variety of actors, i.e., MAFFS extension workers (47.0%); colleague farmers in the community (44.5%); NGO extension officers (24.5%); radio (24.0%); community leaders/authorities (20.5%); lead farmers (19.5); and itinerant traders (13.5%). The information/ideas which were shared were mainly geared towards providing guidance to farmers on the various innovations promoted by research and extension actors. This is closely related to actors' roles in mentoring and advising, where the key actors associated with this role by respondents included: community leaders/authorities (30.5%); lead farmers (27.5%); agricultural officers (19.5%); radio (15.5%); MAFFS extension workers (14.0%); colleague farmers outside the community (13.0%); colleague farmers in the community (12.5%); and NGO extension staff (12.0%). Surprisingly, MAFFS and NGOs did not emerge as major actors in advising or mentoring smallholder farmers. It is possible that "advising" was the key word most frequently interpreted to respondents by enumerators during the data collection, hence the very low association of this role to the MAFFS and NGOs, as the smallholders mainly seek advice from community leaders and lead farmers. Similarly, the sharing of general information about agriculture was a key role associated with a number of actors, these included: radio (51.0%); colleague farmers in the community (28.0%); NGO extension workers (21.5%); lead farmers (16.0%); MAFFS extension workers (11.0%); agricultural research officers (10.0%); and colleague farmers outside the community (9.5%). Unsurprisingly, this role was most associated with radio and colleague farmers in the community. Radio, as mentioned in earlier sections, can target a large number of people at a given point in time, and a wide variety of information on agriculture beyond rice innovations can be shared through radio programmes. Consistently, farmers in the community also shared information about agriculture, beyond rice innovations, with each other more frequently than with external actors due to their proximity to their colleagues compared to those external actors.

The facilitation of in-kind exchange services of seed rice was another role that emerged as being performed by a number of actors, including: colleague farmers inside (47.0%) and outside (41.0%) the community; lead farmers (25.5%); MAFFS extension workers (8.5%); itinerant traders (7.5%); and NGO extension workers (5.5%). Consistent with the norm, and with findings from the qualitative data collection, farmers take the lead in this role. They facilitate in-kind exchange services, where smallholder farmers exchange other agricultural products/goods for rice seeds with either their colleagues or itinerant traders. According to some respondents, as revealed during the KIIs and FGDs (eg Konta Line and Rogbep), they normally exchange goods like palm oil, cassava, groundnut, etc. for rice seeds, usually at a time close to the inception of farming operations when some may have consumed their stock of seeds. Also, they make these exchanges for new rice varieties which they deem to be high yielding or which possess characteristics they desire. Other actors were not widely mentioned during the qualitative phase, albeit this data suggest a few others to be playing this role, e.g., MAFFS and NGOs.

The establishment of linkages between farmers and other actors, including traders, was more highly associated with lead farmers in the community (16.5%), followed by NGO workers (7.5%), agricultural research officers (7.0%), and community leaders/authorities (5.5%). These results suggest that community actors (e.g., lead farmers) were key to the establishment of links between farmers and other actors. NGO workers and researcher officers have also been identified as participating in this role. During the FGDs in Bendukura community, NGOs such as CRS were identified to have linked their project participants with markets, especially the ABCs and other itinerant rice traders. This is a possible reason for them being mentioned here.

Interestingly, MAFFS workers have not been prominently identified with this role. The results generally suggest that this role is primarily in the hands of the farmers themselves, which is a possible constraint in the rice value chain as farmers may, for example, lack bargaining power, to sell their produce at attractive prices. Further, facilitating smallholder farmers access to agricultural inputs was largely identified by respondents to be the role of itinerant traders

(33.0%), agro-dealers (19.0%), ABCs (6.5%), and NGOs (2.5%). This is possibly due to the fact that those smallholder farmers who find it difficult to save seeds from their produce depend largely on buying seeds and other inputs from traders who come intermittently to their communities. In larger communities, farmers can access inputs at open markets where these traders converge on a daily or weekly basis to sell these inputs. Agro-dealers provide similar services, but they are more localised and better trained, and they provide inputs which are normally of better quality than those of the itinerant traders. However, it was found during the FGDs that certified agro-dealers are few and far between and, where they do exist, their inputs are normally perceived to be more expensive than those of the itinerant traders.

Further, itinerant traders were identified as the major actors who facilitate purchases of rice outputs from smallholder farmers (33.5%). This shows that smallholder farmers have limited markets for their rice produce, which is a sufficient condition for the receipt of lower prices for their outputs. In cases where itinerant traders are aware of farmers' limited alternatives, exploitation is common, this is particularly so in Sierra Leone where most farmers are illiterate. A role uniquely identified with MAFFS (12.0%) and NGOs (13.0%) was the provision of rice seed to smallholder farmers. This is mostly connected with the recent distribution of NERICA rice seeds by MAFSS and NGOs to farmers across the country as a national recovery strategy after the Ebola outbreak. However, according to farmers in FGDs in Koinadugu, Kambia, and Tonkolili Districts, these seeds were given to them on a credit basis, with the cost to be repaid after harvest at an interest rate of about 25%. MAFFS officials, however, refuted this and claimed the repayment was interest-free (KII-FGD-ExtM). This controversy is possibly due to a contravention of policy. It is highly likely that the policy was to provide the loans on an interest-free basis, but that a small number of Ministry officials demand interest payments for their personal advantage.

Additionally, the facilitation of farmers' access to pesticides was mentioned by just a few respondents to be the role of Agro-dealers (4.5%) and MAFFS extension workers (1.0%), but of no other actors. This is possibly due to the limited use of pesticides in the study area as respondents largely indicated they were constrained from boosting their farming activities by a lack of financial resources (subsequent sections discuss farmers' constraints).

In summary, the key roles performed by some key actors to enhance respondents innovation processes on rice include: facilitating the sharing of rice farming information/ideas; advising/mentoring farmers on new methods of rice cultivation; facilitating smallholder farmers access to agricultural inputs and sales of their produce (by purchasing from them); facilitating in-kind exchange services of rice seeds; sharing general information on agriculture; enhancing access to processing facilities by smallholder farmers; and linking farmers to markets and/or other actors. However, some of these activities are more prominently performed than others, and some are performed by more actors than others. The key actors identified to have been performing these roles, in the order by which they most mentioned, included: MAFFS; the farmers themselves, i.e., colleagues inside and outside the community; community leaders; NGOs; itinerant traders; agro-dealers; research officers; and the media.

Table 8.15:Roles of Actors in Facilitating Smallholder Rice Farmers' Innovation Processes

Roles/activities in innovation processes	Actors																							
	MAFFS		NGOs		Agro-dealers		Itinerant Agric. Traders		ABCs		Colleague farmers in the community		Colleague farmers outside the community		Agricultural Research Officer		Lead Farmers		Community Leaders/Authorities		District Council Officials		Radio Station	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
Facilitating access to agricultural inputs (through sales)	2	1.0	5	2.5	38	19.0	66	33.0	13	6.5	3	1.5	1	0.5	-	-	-	-	1	0.5	-	-	-	-
Facilitating sales of rice produce	1	0.5	4	2.0	1	0.5	67	33.5	2	1.0	-	-	2	1.0	2	1.0	1	0.5	-	-	-	-	-	-
Sharing rice farming information/ideas	94	47.0	49	24.5	-	-	27	13.5	2	1.0	89	44.5	39	19.5	21	10.5	39	19.5	41	20.5	2	1.0	48	24.0
Enhancing access to processing facilities	7	3.5	48	24.0	-	-	-	-	30	15.0	3	1.5	5	2.5	4	2.0	-	-	1	0.5	-	-	-	-
Advising/Mentoring	28	14.0	24	12.0	-	-	1	0.5	4	2.0	25	12.5	26	13.0	39	19.5	55	27.5	61	30.5	-	-	31	15.5
Facilitating access to pesticides	2	1.0	-	-	9	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Linking farmers to markets/other actors	1	0.5	15	7.5	-	-	2	1.0	-	-	1	.5	4	2.0	14	7.0	33	16.5	11	5.5	2	1.0	1	.5
Facilitating in-kind exchange services of rice seeds	17	8.5	11	5.5	2	1.0	15	7.5	2	1.0	82	41.0	94	47.0	13	6.5	51	25.5	5	2.5	-	-	-	-
Sharing general information on agriculture/farming	22	11.0	43	21.5	6	3.0	-	-	1	.5	56	28.0	19	9.5	20	10.0	32	16.0	11	5.5	13	6.5	102	51.0
Facilitating access to inputs on credit basis	1	0.5	1	0.5	-	-	-	-	-	-	-	-	-	-	1	.5	-	-	-	-	-	-	-	-
Providing rice seed to farmers	24	12.0	26	13.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Enhancing farmers access to market prices of agricultural produce (including rice)	-	-	-	-	2	1.0	-	-	-	-	-	--	-	-	-	-	-	-	-	-	-	-	-	-

Source: Field Survey, 2016/17

8.5.5 Role Differentiation in Rice Innovation Processes in Smallholder Farmers' Households

The study further identified the typical roles played by different members of the family, from production through to marketing of their rice products. Understanding the roles played by different categories of household members is important for research and extension actors, as well as other development practitioners, in order to target participants for mentoring on certain innovation processes.

Findings showed that differences exist in terms of the various roles played by members of farm households in the study area (see Table 8.16). In terms of decision making, men emerged as the key decision makers in farming households. The majority of respondents indicated that men were responsible for making decisions about where to farm (73.0%), changes to the way they farm (innovate) (75%), and when and how much they sell (36.0%). A negligible number of respondents indicated that men and women jointly make such decisions with percentages of 18.0%, 14.0%, 33.0%, respectively. Women were shown to make decisions about to whom to sell (44.5%), however, a reasonable number of respondents indicated that men and women make this decision jointly (32.5%).

Regarding production and post-harvest activities, men were identified to be involved in: brushing of farms (79.5%); digging/ploughing (79.0%); puddling (59.0%); nursery preparation (57.0%); control of proceeds/income from household farms (67.5%); and control over use of produce in household (67.0%). Women mostly performed activities which included weeding (47.5%) and the choice of to whom to sell (44.5%). Children were mostly associated with activities such as milling/pounding of rice paddy (48.0%) and transportation from home to market (44.5%). Women were also largely associated with milling/pounding (24.0%) and transportation to market (25.5%). Activities that were largely identified by respondents to be carried out by men, women, and children jointly included: transplanting (48.5%); harvesting (42.0%); threshing (62.5%); transportation of rice paddy from farm to home (73.5%); and uprooting of seedlings from the nursery (51.0%).

These results suggest that men are normally the key actors of roles that are physically demanding, such as brushing, digging and puddling, and also those of making household decisions and controlling the household resources. Women are mostly the key actors in painstaking activities, such as weeding, threshing, harvesting, and carrying/transporting rice produce from farm to home and sometimes also to market. Women's lack of control in most rural farming communities was one of the major impediments to their participation in innovation programmes, and possibly also to their engagement in extensive agricultural activities compared to their male counterparts. Also, the dependence of women on their male counterparts for physically demanding activities contributes to thwart their innovation/farming activities. It can also be deduced from these findings that in farming households, children are not spared. They participate in a number of activities, and thereby contribute to the economic sustainability of their families.

Table 8.16:Role differentiation in farming among households members

Activities	**Level of Constraints (n=200)**											
	Majorly Men		**Majorly Women**		**Men and Women jointly**		**Women and children Jointly**		**Majorly Children**		**All-men, women and children**	
	F	%	F	%	F	%	F	%	F	%	F	%
1. Making decision on where to farm	146	73.0	8	4.0	36	18.0	1	0.5	1	0.5	8	4.0
2. Making decision on changes to the way you farm	150	75.0	12	6.0	28	14.0	-	-	1	0.5	9	4.5
3. Brushing	159	79.5	4	2.0	-	-	-	-	1	0.5	36	18.0
4. Digging/ ploughing	158	79.0	3	1.5	2	1.0	1	0.5	-	-	36	18.0
5. Puddling	118	59.0	14	7.0	8	4.0	18	9.0	5	2.5	37	18.5
6. Nursery Preparation	114	57.0	16	8.0	13	6.5	1	0.5	4	2.0	52	26.0
7. Transplanting	35	17.5	29	14.5	26	13.0	2	1.0	11	5.5	97	48.5
8. Weeding	10	5.0	95	47.5	6	3.0	2	1.0	25	12.5	62	31.0
9. Harvesting	66	33.0	14	7.0	26	13.0	7	3.5	3	1.5	84	42.0
10. Threshing	33	16.5	7	3.5	23	11.5	4	2.0	8	4.0	125	62.5
11. Transportation from farm to house	9	4.5	11	5.5	16	8.0	4	2.0	13	6.5	147	73.5
12.Transportation from home to market	7	3.5	51	25.5	8	4.0	2	1.0	89	44.5	43	21.5
13. Milling/pounding	9	4.5	48	24.0	15	7.5	2	1.0	96	48.0	30	15.0
14. Control of proceeds/income from farm produce	135	67.5	23	11.5	36	18.0	3	1.5	1	0.5	2	1.0
15. Control over use of produce in the household	134	67.0	26	13.0	35	17.5	-	-	3	1.5	2	1.0
16. Choice of who to sell to	38	19.0	89	44.5	65	32.5	-	-	3	1.5	5	2.5
17. Making decision on when and quantity to sell?	73	36.5	48	24.0	66	33.0	4	2.0	2	1.0	7	3.5
16. Uprooting of seedlings from nursery	17	8.5	20	10.0	23	11.5	1	0.5	37	18.5	102	51.0

Source: Field Survey, 2016/17

8.6 Constraints Smallholder Farmers Face with Innovations Promoted by Research and Extension Professionals

The key objective of this section is to identify the constraints smallholder farmers face in using the innovations promoted by research and extension actors in their communities in the past ten years. This addresses the research question "What are the key constraints associated with the innovative changes of farmers in rice farming?". In addition to addressing this research question, the section further explores the key reasons for respondents' unwillingness to use some external innovations, as well as those reasons they give for failing to continue to use them. The aim is to gain a thorough understanding of the limitations which thwart the use of these innovations by the target respondents.

Qualitative data were first generated in the target communities (as highlighted in the introduction to this chapter) and were then used to guide the development of the questionnaire which subsequently generated the data presented in this section.

8.6.1 Constraints of the Innovations

The key constraints faced by smallholder farmers in each of the key innovations promoted are presented in Table 8.17 below. These are respondents who indicated they currently use these innovations in their rice farming systems. Pre-production innovations, e.g., the use of new rice seed varieties, were associated with a number of constraints. IRVs (e.g., NERICA and others highlighted in Section 8.3.1) and new local varieties used by farmers were the key pre-production innovations. The results suggest that cost, accessibility, fertiliser requirements, and susceptibility to pests and disease are key constraints associated with IRVs, while local varieties are primarily associated with the low quality of their seeds and low yield.

Further, production innovations were also associated with a number of constraints by respondents who indicated to be currently using them. Line sowing was mainly associated with constraints such as being too technical (2.7%), time consuming (1.7%), and labour intensive (1.7%). These low percentages show that few respondents are currently using this innovation. Labour intensiveness (16.9%), lack of tools (8.2%), and lack of labour (7.4%) were the key constraints associated with puddling of IVS. Swamp development, involving the construction of bunds around IVS plots, was mainly associated with constraints such as high cost/expensive to implement (12.2%), labour intensive/tedious (4.2%), highly technical (2.7%), and high cost of labour (2.7%). Similarly, weeding of IVS was mainly associated with constraints such as: labour intensive/tedious (19.6%); lack of labour (15.5%); irritation of the skin (10.8%); coincidence with other farm activities (3.4%); and high cost of labour (2.1%). The use of chemical fertilizers was perceived to be expensive (21.6%) and scarce (0.7%), while the use of rice mills was constrained by excessive waiting times at peak periods (16.4%), high cost/ expensiveness (9.5%), and unavailability to the community (1.7%). The increased spacing of seedlings was identified with constraints which included the encouragement of weed growth (12.8%), and the problem of having to replace seedlings after transplantation (6.1%). The tendency to lose seedlings (12.2%), the poor growth of seedlings (2.4%), the need for replacement of seedlings (2.4%), and being time consuming (1.7%), were all constraints associated with reduced seedlings per stand. This included reduction to one, two, or three seedlings as per SRI or TP-R recommendations. The early threshing innovation was only associated with the early finish of farm produce in the household (14.8%), and the lack of labour (1.7%) at peak periods of the harvest. Threshing by trampling with the feet was associated with constraints such as being time consuming (4.8%), not having improved threshing equipment (3.4%), inflicting pain on the feet (1.7%), and being labour intensive (1.7%).

Findings in this section suggest that a number of constraints seem to be shared across a variety of innovations. Some of the common constraints identified for a number of innovations included: the high cost/expensiveness; inaccessibility to/scarcity of the innovation; the lack of labour for the use of the innovation, and its high cost; the time-consuming nature of the innovation and it being highly technical and difficult to use. This suggests that some of these innovations are not used, or if they are used, it is not on a large scale for any number of these reasons. Some innovations may be useful to the intended beneficiaries, but where the constraints in using them outweigh the advantages this could be sufficient reason for discontinuing their use. It is worth noting that some innovations, such as planting of single seedlings per stand, were not mentioned here because no respondent indicated to be currently using them. The subsequent sections explore reasons for respondents' discontinuation or failure to even try innovations. Box 8.5 provides further information on constraints faced by farmers with current innovations.

Box 8.5: Notes on key constraints faced by respondents with current innovations

During the FGDs and KIIs, respondents gave detailed explanations of the various constraints they face in using some of the innovations. This box summarises those associated with IRVs, line sowing, and swamp development.

IRVs, particularly NERICA, was were largely associated with two main constraints – scarcity and management practices. It was generally reported that most of the NERICAs were distributed to farmers mainly by the MAFFS for demonstration purposes only. This has been making it difficult for farmers to access the variety at scale since it was not commonly owned by farmers. In cases where NERICAs they are available, the cost is prohibitive for smallholder farmers. Another constraint largely associated with NERICAs is its management practices, such as including fertilizer requirements, the need for early transplanting, and water control. Some farmers reported that it is a requirement to use fertilizers for NERICAs cultivation in order for them to do well, they should be transplanted early enough to avoid flowering in the nursery, and that water must be controlled in the plots to avoid erosion of the seedlings since they are normally too very short and young at time of transplanting. Farmers see these requirements as constraining because, according to them, the fertilizers are expensive and scarce, early transplanting is difficult for them because of engagement in other farm and non-farm activities at that time, and water control is expensive and technical for them to undertake.

Line sowing was not indicated to be largely used by respondents. The few who indicated claimed to be using it identified constraints such as it being time consuming and technical to use. For example, one of the respondents in a KII highlighted that he finds it difficult to hire labour for transplanting their seedlings because no one will have the patience to going through the rigours of line sowing involved in a hired labour system, and if he uses line sowing that he can no longer use children to participate in the transplanting of seedlings, if he uses line sowing (KII_Kambia_District).

Swamp development was largely considered to be constraining in that it requires huge financial implications, commitment and expertise to be done achieved successfully and sustainably. Most respondents indicated that the MAFFS and other NGOs, such as IFAD, CRS, Concern, and JICA, etc had been developing swamps which they mostly use for the establishment of demonstration plots. The majority of the m (farmers) are constrained by the lack of financial resources to hire labour and even to buy the appropriate tools to develop their swamps. The lack of developed swamps was observed to be a major constraint affecting farmers use of a number of innovations, such as line sowing, increased spacing, and early transplanting of seedlings, in etc .

Table 8.17:Constraints faced by smallholder farmers in using external innovations

Constraints (n=148)	Innovations																							
	Improved Varieties		Local Varieties		Line sowing		Puddling		Swamp Development		Weeding		Inorganic Fertilizer		Rice Mill		Increased spacing of seedlings		Reduced seedlings		Early threshing		Threshing by trampling	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
Expensive	40	27.0	4	2.7	-	-	-	-	18	12.2	2	1.4	32	21.6	14	9.5	-	-	-	-	-	-	-	-
Scarcity/not accessible	38	26.0	5	3.4	-	-	-	-	-	-			1	0.7	-	-	-	-	-	-	-	-	-	-
Financial constraints	5	3.4	1	0.7	-	-	-	-	-	-	1	0.7	1	0.7	-	-	-	-	-	-	-	-	-	-
High cost of fertilizer	15	10.1	1	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bird scaring problems due to early maturity	4	2.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Agronomic practices/management practices are difficult	6	4.1	-	-	-	-	-	-	1	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scarcity of fertilizer	14	9.5	5	3.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
High cost of labour	1	0.7			-	-	1	0.7	4	2.7	3	2.1	-	-	-	-	-	-	-	-	-	-	-	-
Pest and diseases attack	16	10.8	2	1.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Require application of fertilizer	21	14.2	1	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Low resistance to pest and diseases	5	3.4	1	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Too much of water	11	7.4	2	1.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Requires lots of weeding	6	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Risk of being borrowed without repayment due to early harvesting	1	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lack of tools/equipment	4	2.7	1	0.7	1	0.7	12	8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	3.4
Poor viability	2	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Attractive to pests	2	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lack of labour	1	0.7	-	-	-	-	11	7.4	3	2.1	23	15.5	-	-	-	-	-	-			2	1.7	-	-

Lack of pesticides/herbicides	2	1.4	2	1.7	-	-	-	-	-	-	1	0.7	-	-	-	-	-	-	-	-	-	-	-	-
Labour intensive/Tedious	2	1.4	-	-	2	1.7	25	16.9	6	4.2	29	19.6	-	-	-	-	-	-	-	-	-	-	2	1.7
Low quality seed	-	-	35	23.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Low yield	-	-	15	10.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mostly impure/mixed seeds	-	-	1	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Highly technical	-	-	-	-	4	2.7	-	-	4	2.7			-	-	-	-	-	-	-	-	-	-	-	-
Time consuming	-	-	-	-	2	1.7	-	-	-	-	1	0.7	-	-	-	-	-	-	2	1.7	-	-	7	4.8
Poor growth of seedlings	-	-	-	-	1	0.7	-	-	-	-	-	-	-	-	-	-	-	-	3	2.4	-	-	-	-
Inflicts pain on the body/feet	-	-	-	-	-	-	1	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1.7
Irritates the skin/causes itching	-	-	-	-	-	-	-	-	-	-	16	10.8	-	-	-	-	-	-	-	-	-	-	-	-
Engagement in other farm activities	-	-	-	-	-	-	-	-	-	-	5	3.4	-	-	-	-	-	-	-	-	-	-	-	-
Not available in community	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1.7	-	-	-	-	-	-	-	-
Irregular service	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.7	-	-	-	-	-	-	-	-
Cost of transportation and fee	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.7	-	-	-	-	-	-	-	-
Waiting time is too long at peak periods	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24	16.4	-	-	-	-	-	-	-	-
Encourages weed growth	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	12.8	-	-	-	-	-	-
Need for replacement of seedlings	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	6.1	3	2.4	-	-	-	-
Tendency to lose seedlings is very high	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	12.2	-	-	-	-
Early finish of farm produce in household	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	14.8	-	-

Source: Field Survey, 2016/17

8.6.2 Reasons Smallholder Farmers do not Try/Use External Innovations

Further to the identification of the constraints respondents faced in using rice farming innovations, the study identified the reasons for not trying/using some of the innovations that have been promoted in their own or nearby communities by research and extension professionals. Interestingly, the results showed that some innovations currently used by some farmers have not been tried/used by others (see Table 8.18) for a number of reasons. Key among the innovations not tried by some farmers were: line sowing; single seedling/hill; NERICA and other IRVs; priming of seeds; early transplanting of seedlings; swamp development/water control; increased spacing of seedlings; rice mills; ABCs; and application of organic manure.

Line sowing has not been tried/used by the majority of smallholder farmers as they perceive it firstly, to be too: time consuming (19.5%), labour intensive (16.0%), technical or difficult to implement (12.0%); and, secondly they perceive a lack of: technical support (5.0%), training (9.5%), and labour (1.5%). Similarly, the planting of a single seedling per hill has not been tried by some farmers due to: fear of loss of seedlings to erosion or pests (18.0%); the perception of it being too technical or difficult to implement (6.0%); the lack of training (7.5%); the perception that it is difficult for seedlings to grow healthily (4.5%); and that the innovation encourages weed growth (2.0%), among others. NERICA (19.0%) and other IRVs (16.5%) have not been tried, and this is mainly due to their perceived scarcity or inaccessibility in respondents' communities.

Priming, i.e., soaking seeds in water before planting in the nursery, was not tried by some farmers for reasons which included: the perceived difficulty or technicality involved (10.5%); the belief this is unnecessary or a waste of time (6.0%); the lack of technical support (3.5%); the perception that it this is not ideal for a large quantity of seeds (2.0%); having trust in their seeds (1.5%); and this innovation not being practised in the community (1.5%). Moreover, early transplanting of seedlings has not been tried by some respondents for similar reasons, such as: the perception this is too technical or difficult to implement (14.0%); it is not necessary (3.0%); the belief that it is difficult for seedlings to develop (2.5%); the use of late varieties (1.5%); and lack of labour (1.5%).

The reduction of seedlings per stand was not tried by a number of respondents for reasons to do with: lack of training (8.0%); fear of seedlings being eaten/lost by pests/erosion (3.5%); encouragement of weed growth (2.0%); being too time consuming (2.0%); and the lack of fertilisers (1.0%). Swamp development, or the control of water in IVS, by the construction of bunds within and around the plots was not tried due to: the high cost involved (22.5%); being too difficult/technical to implement (8.5%); the lack of labour (1.0%); and farmers' perception that this tends to reduce farm size (1.0%). Further, some farmers had not tried increased spacing between seedlings on their farm because they believe it encourages weed growth (8.0%), they lack training (8.0%), it is too technical or difficult to implement (3.0%), and it is difficult for seedlings to develop under this innovation (1.0%).

Rice mills have not been tried/used by some farmers for reasons such as: unavailability or inaccessibility (24.5%); they are too expensive to use (1.0%) and the perception that the mills are faulty (1.0%). Consistently, ABCs have also not been used by some respondents due to their inaccessibility or unavailability (61.0%); unawareness of their existence (4.0%); and being too far away from respondents' communities (1.0%).

The use of organic manure promoted through the SRI system had not been tried/used by some respondents due to: the perception that it is labour intensive in its generation (10.0%); the lack of technical support (4.5%); and the belief that it is unnecessary or a waste of time (3.0%).

Evidently, most of the reasons which thwart smallholder farmers use of these innovations were common for some innovations. Those most commonly mentioned reasons were: scarcity of, or inaccessibility to, the innovation; its the high cost/expensiveness; the difficulty associated with its use; its labour intensiveness; the lack of technical training; the lack of fertilisers; the perception that the innovation is unnecessary; and the fear of losing the seedlings to pests, disease, and/or erosion. Unsurprisingly, some of these reasons are the same as the constraints currently faced by farmers in the use of some of these innovations. Reasons such as the lack of technical training, the difficulty associated with the use of the innovations, and the perception that the innovations are unnecessary, all suggest that there is a gap in interaction between the research and extension actors who promote these innovations and the smallholder farmers. Arguably, effective interaction and thorough mentoring of smallholder farmers would help ease any perceived difficulty, it would promote understanding of specific innovations and also deepen understanding of their relevance among the intended beneficiaries. Further, the reported inaccessibility of inputs, such as fertilisers and improved seeds, for smallholder farmers is evidence of a lack of linkages between the farmers and the markets, which suggests a weakness in the innovation system on rice in the target districts

Table 8.18: Reasons for smallholder farmers not trying/using external innovations

Reasons for not trying innovations (n=200)	Innovations not tried																							
	Line Sowing		Single Seedling		NERICA		Other IRVs		Priming		Early transplanting		Reduced seedlings		Swamp development in IVS		Increased spacing of seedlings		Rice mills		ABCs		Organic Manure	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
Not available/Scarcity	-	-	-	-	38	19.0	33	16.5	-	-	-	-	-	-	-	-	-	-	49	24.5	122	61.0	-	-
Time consuming	39	19.5	7	3.5	-	-	-	-	-	-	-	-	4	2.0	-	-	-	-	-	-	-	-	-	-
Labour intensive/tedious	32	16.0	3	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	10.0
It is too technical/difficult to do	24	12.0	12	6.0	-	-	-	-	21	10.5	28	14.0	-	-	17	8.5	6	3.0	-	-	-	-	-	-
Lack of labour	3	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Lack of technical support	10	5.0	-	-	-	-	-	-	7	3.5	-	-	-	-	-	-	-	-	-	-	-	-	9	4.5
Too short	-	-	-	-	1	1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lack of labour	-	-	4	2.0	-	-	-	-	-	-	3	1.5	-	-	2	1.0	-	-	-	-	-	-	-	-
Not necessary/waste of time	1	0.5	-	-	-	-	-	-	12	6.0	6	3.0	1	0.5	1	0.5	-	-	-	-	-	-	6	3.0
Not practiced by fore parents	1	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lack of training	19	9.5	15	7.5	-	-	1	1.5	-	-	-	-	16	8.0			16	8.0	-	-	-	-	-	-
The farm is large	1	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Not interested	-	-	1	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Waste of farm space	1	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reduces the farm size	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1.0	-	-	-	-	-	-	-	-
Far distance to nearest facility	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.5	2	1.0	-	-
It is expensive	-	-	-	-	-	-	-	-	-	-	-	-			45	22.5			2	1.0	-	-	-	-
Lack of financial resources	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.5	-	-
Have trust in my seeds viability	-	-	-	-	-	-	-	-	3	1.5	-	-			-	-	-	-	-	-	-	-	-	-
Fear of loss of seedlings eg eaten by fish, crabs, erosion etc	-	-	36	18.0	-	-	-	-	-	-	1	0.5	7	3.5	-	-	-	-	-	-	-	-	-	-
Difficult for seedlings to develop	-	-	9	4.5	-	-	-	-	-	-	5	2.5			-	-	2	1.0	-	-	-	-	-	-
Encourages weed growth	-	-	4	2.0	-	-	-	-	-	-	-	-	4	2.0	-	-	16	8.0	-	-	-	-	-	-
Lack of fertilizer	-	-	3	1.5	1	1.5	1	0.5	-	-	1	0.5	2	1.0	-	-	4	2.0	-	-	-	-	-	-
Not practised in this community	-	-	-	-	-	-	-	-	3	1.5	-	-	-	-	-	-	-	-	-	-	-	-	2	1.0
Faulty	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			2	1.0	1	1.0		
Not ideal for rented land	-	-	-	-	-	-	-	-	-	-	-	-			1	0.5	-	-	-	-	-	-	-	-
I use late varieties	-	-	-	-	-	-	1	1.5	-	-	3	1.5	-	-	-	-	-	-	-	-	-	-	-	-
Not ideal for large quantity of seeds	-	-	-	-	-	-	-	-	4	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Not ideal for mangroves	-	-	-	-	-	-	-	-	-	-	1	0.5	1	0.5			-	-	-	-	-	-	-	-

8.6.3 Reasons Smallholder Farmers Discontinue their use of Rice Innovations

A number of reasons were identified for why smallholders discontinue their use of some of the rice innovations promoted in their communities by research and extension professionals. Discontinuation of innovations means participants have used the innovation for at least one planting season, but decided to discontinue its use, either due to factors beyond their control or it not being cost effective. Most of the reasons advanced by smallholder farmers are similar to those for not using the innovations at all, and also for the constraints faced by those currently using the innovations. All respondents were asked to state which external innovations they have not tried, those they have tried and discontinued, and their reasons for both. This was based on findings from the FGDs and KIIs which showed that no farmer adopted all of the innovations promoted in their communities in their entirety.

Table 8.19 shows the number of various reasons respondents gave for discontinuing external innovations. Among the total sample of respondents, the reasons given for discontinuation of line sowing were: the perception it is too time consuming (15.0%); the lack of improved rice varieties (10.0%); it is too labour intensive (5.5%); and it is too technical or difficult to implement (1.0%). The planting of a single seedling per stand was mainly stopped because: farmers perceived it to be too time consuming (9.0%); improved seeds were unavailable (8.0%); there was a lack of fertiliser to ensure the healthy growth of the seedlings (3.5%); farmers believed it to be too labour intensive or tedious to implement (3.0%,); farmers' perceived it to be too difficult for seedlings to develop (2.5%); and also farmers risk averseness, evidenced by avoidance of the replacement of seedlings (2.5%). Similarly, NERICAs and other IRVs were mostly discontinued by farmers for reasons including: inaccessibility to the seed (26.0%, 20.0%, respectively), the fertilizer requirements (3.0%, 1.5%); the lack of fertilizer (2.0%, 1.5%); and the perception that these varieties are not ideal for their swamps, such as mangrove (1.5%, 0.5%). The priming of seeds before planting was discontinued mainly due to farmers' perception that the innovation is too time consuming (3.5%), and the belief that it is unnecessary (12.5%). The early transplanting of seedlings was discontinued by a few respondents for reasons such as: the lack of IRVs (2.0%); such activity coincides with other farm activities (2.0%); lack of financial resources (1.5%); and fear of the loss of seedlings to pests and erosion (1.0%). On a similar note, farmers have stopped the planting of just a few seedlings (reduced seedlings/hill) due to: the lack of IRVs (2.0%); the high cost of labour

(2.5%); the perception that it is labour intensive/tedious (1.5%) and time consuming (1.0%); the lack of fertiliser (1.0%); and the fear of the loss of seedlings to pests and erosion (1.0%).

Further, the control of water in IVS through swamp development was indicated to have been discontinued by some respondents for reasons such as: being too technical or difficult to implement (9.0%); the high cost of labour involved (4.0%); the high cost associated with carrying out the innovation (3.0%); and, the lack of tools (2.0%) and financial resources (1.0%). The practice of spacing seedlings was only discontinued by a few respondents who indicated that it encouraged weed growth (2.0%) and that it was too difficult to implement (1.5%). The use of rice mills was stopped by some respondents mainly due to the perceived high cost of their use (8.5%) and the belief that the available mill is defective (2.0%). In Box 8.6, a farmer gave some striking reasons for his discontinuation of some innovations.

Apart from the innovations of line sowing, planting a single seedling, and using NERICA and other IRVs, the number of respondents who have actually tried and discontinued the innovations are not as many as those who have not tried some of them at all. This suggests that some farmers automatically made decisions not to try some innovations at all given the many constraints they associate with them. Also, it is evident that some of the reasons identified are common across a number of innovations. These reasons include: the inaccessibility to improved seed varieties; the innovations being perceived as time consuming and labour intensive/tedious; the lack of fertilizers; the innovations being too difficult/technical; and the high cost associated with the innovations (see Table 8.19)

Box 8.6: Striking Reasons for Dropping of Innovations by Smallholder Farmers

In the KIIs, a farmer in Kambia District highlighted a key reason behind him dropping discontinuing the planting of just a few seedlings per stand and the spacing of seedlings as recommended as advised by both the Technical Package on Rice (TP-R) innovation approach in their community during the KIIs. The farmer's community, – Konta Line, has a mixed of mangroves and Inland Valley Swamp. While some farmers have access to both ecologies for rice cultivation, he this farmer only had access to mangroves. The advent of the TPR approach in their his community moved motivated him into trying some of the techniques promoted. In the first year following the establishment of the group demonstration plot, the farmer and some of his colleagues (who were not at the interview at the time) tried some of the techniques in on their farms. Key among the ones they tried was were the planting of just a few seedlings and their recommended spacing of their seedlings. He noted that after the a few weeks of transplanting that some spots had become bare and the planted seedlings either lying lay pale on the ground or being were washed away with by water torrents. His keen observation made him realize that crabs have had been playing no small role in eating/cutting down the stems of these seedlings. He noted that in the past years, although these crabs have had always been cutting these seedlings, however, the effect was not as glare obvious, and the result was worse with this innovationas it is with few seedlings and wide spacing, he said. This caused him (and others) to replace the seedlings, and they henceforth decided to revert to their old methods of rice cultivation.

Table 8.19:Reasons for dropping of rice innovations by smallholder farmers

Reasons for dropping innovations (n=200)	Innovations not tried																			
	Line Sowing		Single Seedling		NERICA		Other IRVs		Priming		Early transplanting		Reduced seedlings		Swamp development in IVS		Increased spacing of seedlings		Use of rice mills	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%	F	%
Lack of/unavailability of improved seeds	20	10.0	16	8.0	52	26.00	40	20.0	-	-	4	2.0	4	2.0	-	-	1	0.5	1	0.5
Time consuming	30	15.0	18	9.0	-		-	-	7	3.5	1	0.5	2	1.0	-	-	1	0.5	-	-
Labour intensive/tedious	11	5.5	6	3.0	1	0.5	-	-					3	1.5	-	-			-	-
It is too technical/difficult to do	2	1.0		-	-	-	-	-	1	0.5	-	-	-	-	18	9.0	3	1.5	-	-
Lack of labour			-	-	-	-	-	-	-	-	1	0.5	-	-	2	1.0	1	0.5	-	-
Require fertilizer application	-	-	-		6	3.0	3	1.5	-	-	-	-	-	-	-	-	-	-	-	-
High cost of labour	-	-		-	-	-	-	-					5	2.5	8	4.0	-	-	-	-
Not necessary/waste of time			-	-	-	-	-	-	25	12.5	-	-	-	-	-	-	-	-	-	-
To avoid replacement			5	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
It is expensive	-	-	-	-	-	-	2	1.0	-	-	-	-	-	-	6	3.0	-	-	17	8.5
Lack of financial resources	-	-	-	-	-	-	1	0.5	-	-	3	1.5	-	-	2	1.0	-	-	-	-
Fear of loss of seedlings eg eaten by fish, crabs, erosion etc	-	-		-	-	-	-	-	-	-	2	1.0	2	1.0	-	-	-	-	-	-
Difficult for seedlings to develop	-	-	5	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Encourages weed growth	-	-	1	0.5	-	-	-	-	-	-	-	-	-	-	-	-	4	2.0	-	-
Lack of fertilizer	-	-	7	3.5	4	2.0	3	1.5					2	1.0	-	-	1	0.5	-	-
Faulty mill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	2.0
Not ideal for rented land	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.5	-	-		
Coincides with other farm activities	-	-	-	-	-	-	-	-	1	0.5	4	2.0					-	-		
Not ideal for mangroves	-	-	-		3	1.5	1	0.5	-	-	-	-	-	-	-	-	-	-	-	-
Lack of tools	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	2.0	-	-	-	-

Source: Field Survey, 2016/17

8.7 Constraints which Limit Smallholders Farmers' Innovation Capacity

Further to understanding constraints specific to innovations promoted in the past ten years in smallholder farmers' communities, the study also sought to understand the general constraints they face and which are impeding their capacities to innovate. Consistently, data was elicited using a two-stage approach – qualitative through FGDs and KIIs, and then quantitative through the use of structured questionnaires. During the FGDs and KIIs, a list of factors smallholder farmers believed to be affecting their innovation processes were identified. These were then used to design the structured questionnaire, whose results are shown in Table 8.20 below.

Farmers revealed a myriad of factors that have played a major role in weakening their capacity to innovate – including trying/using new agricultural innovations, and the intensification and/or extensification of their farming operations.

The lack of financial resources was identified as a constraint (20.5%) or major constraint (64.5%) by the majority of smallholders, thereby limiting their ability to innovate. This suggests that the majority of smallholders are resource poor (financially challenged) and do not have adequate finances to engage in productive agricultural activities. This is likely to have an impact on their innovation capacity as resource poor farmers have largely been identified as more risk averse, which makes it difficult for them to move beyond their comfort zone and try new ideas or ways of farming until they are sure of the outcomes.

The high incidence of pests and disease was also one of the top factors farmers considered to be a constraint (36.0%) or a major constraint (56.0%) in rice innovation processes. This point was explored during the qualitative phase of the study, where farmers indicated that pests like birds and cutting grasses have been a threat to early maturing varieties like NERICAs. Since NERICAs, for instance, usually flower before the normal varieties cultivated and, coupled with their pleasant aroma, they attract many pests due to the pests lack of alternative at that time. For this reason, some farmers decide not to grow early maturing or scented varieties if they do not have children to scare the pests away. Also, the lack of chemicals available for the farmers to control pests and disease was also indicated to exacerbate this constraint since some IRVs are not highly resistant to disease.

Further, the lack of farmer "friendly" credit facilities was another factor identified by the majority of respondents to be a constraint (40.0%) or a major constraint (45.0%). Friendly credit facilities are those that take into account farmers' production cycles for the calculation of repayments. This apparent lack of access to these credit facilities adds support to the farmers' claims of their inability to access financial resources. This largely confirms that credit facilities tailored for smallholder farmers are acutely lacking and, where they do exist, they are not tailored to smallholder farmers' production cycle in a way which would allow them to meet the repayment instalments. In Sierra Leone, most of the credit institutions provide credit facilities for repayment on either a weekly or monthly basis. This makes it difficult for a farmer to benefit from such facilities since they cannot generate income on such a basis.

Furthermore, the lack of opportunities for smallholder farmers to share their feedback on innovations with research and extension actors was largely identified as a further constraint (55.0%) or major constraint (30.5%) which affected their innovative capacity. The lack of this opportunity has consequences in farmers not using innovations on the one hand, and on the other it prevents research and extension actors from modifying innovations to suit the context and needs of the target beneficiaries. This constraint also suggests limited interaction between research and extension actors and the farmers, as the opposite would have provided an opportunity to share feedback.

Taking up or using certain rice innovations is, to a large extent, a function of the availability of labour. The study found that the majority of smallholder farmers cumulatively face a constraint (49.5%) or a major constraint (27.0%) with the high cost of labour for their innovation processes. Consistent with earlier findings on farmers' financial constraints, this seems to confirm that the perceived high cost of labour maybe connected with the general financial constraints they face. This is a possible reason (as highlighted in earlier sections) affecting the use of certain innovations which require the use of labour for their functionality.

The smallholders also perceived that research and extension professionals lack knowledge of the real problems they face was a constraint (48.5%) or major constraint (26.5%) to their innovation processes. Clearly, understanding of smallholder farmers' problems by research and extension actors who facilitate innovation processes is important in order that such problems are adequately addressed, including enhancement of farmers' innovation capacity. The perceived lack of knowledge about these problems suggests the existence of ineffective interactions between the research and extension professionals and smallholder farmers.

Further, the low prices of agricultural produce were a major constraint identified by smallholder farmers to generally affect their innovation capacity; more than half the respondents indicated that low prices for their produce was a constraint (48.0%) or a major constraint (25.0%) to their innovation processes. This is possibly due to the connection between the price of farm outputs and the household income of farm families. If the prices for agricultural produce are low, the farm income of the smallholder is obviously affected. This then means that their capacity, and possibly their courage, to try innovations and increase their acreage under cultivation is seriously limited. The majority of farmers reported the unavailability of agricultural inputs and their subsequent high cost as being a constraint (47.0%, 32.0%) or a major constraint (29.0%, 47.5%), respectively, thereby affecting their general ability to innovate. Undoubtedly, trying innovations on rice, such as those promoted by research and extension actors, means they should be affordable and available for resource poor farmers. Similarly, trying other innovations also requires access to certain inputs, e.g., seeds, tools, and fertilisers, amongst others. The poor availability and cost of these inputs may limit farmers' ability to try new methods of farming or new technologies which would otherwise be beneficial to them.

An important constraint, identified by at least half of the respondents, was the lack of contact with extension staff. Poor contact was found to be a constraint (28.5%) or a major constraint (25.5%) limiting the innovation capacity of smallholder farmers. This is possibly due to the limited number of extension staff and the logistics required to facilitate their movement and interaction with the smallholder farmers in their communities. These reasons were given as major constraints which limit the effectiveness of the innovation system, and were identified from a research and extension perspective in Chapter 5. Thus, this finding seems confirmation of this constraint.

The lack of information about new agricultural technology/techniques was also identified by up to half of respondents as being a constraint (27.5%) or a major constraint (30.5%) limiting their ability to innovate. Unsurprisingly, the limited interaction between farmers and research and extension professionals is a possible reason for this. If the interaction between these two actors is limited, the result is limited flow of information on innovations to farmers. Even in cases where farmers may have the necessary information, such innovations are difficult to implement without mentoring from the originator of the information or technique. However, this finding also suggests that farmers mostly tend to depend on research and extension for information on new agricultural knowledge and techniques, after all it is not difficult for them to access such information when it originates from colleague farmers.

The lack of influence on household decisions was also identified by a large proportion of respondents as a constraint or a major constraint which limited their general ability to innovate. Consistent with earlier findings in Section 8.3.4, this could be linked more closely with women farmers who reported they have little control over decision-making processes in their households. This suggests that the inability to make decisions in the household could hamper a farmer's ability to decide, for example, which variety of rice to cultivate, or whether or not to try a new method or technique of rice cultivation. This is a common trend in most rural households in Sierra Leone where most of the key decisions on farming and beyond are largely taken by the head of the household, who in most cases are men.

Farmers lack of confidence in innovations was also mentioned by up to half of the respondents' cumulatively as a constraint (45.0%) or a major constraint (8.0%) limiting their innovation capacity. This is closely linked to farmers' risk averseness which normally prevents them from trying new technologies or methods of which the outcomes are not certain. This is particularly true for resource poor smallholder farmers who are financially insecure. Farmers falling into this category do not easily try innovations, they do not change from known ways or methods of which the outcomes are uncertain. Indeed, the majority of farmers targeted in this study are resource poor smallholders who may not be willing to try innovations if they are not absolutely sure of their outcomes.

Finally, the lack of access to markets was identified by a reasonable number of respondents as a constraint (25.0%) or a major constraint (22.0%) limiting their general ability to innovate. This cannot be unconnected with farmers' ability to access input markets for the purchase of improved inputs, such as new rice varieties, and also output markets for the sale of their rice produce. Based on findings revealed during the qualitative phase, it seems most farmers found it difficult to access improved rice varieties, fertilisers, and tools, amongst other items, to allow them to engage in productive agricultural activities and/or try new methods of rice cultivation. On the other hand, respondents indicated they did not have access to buyers of their produce after the harvest, and that the few buyers available set the terms of purchase, including prices, to the great detriment of the farmers. With little or no options, the farmers dance to the tune of the itinerant traders. The lack or limited access to market is therefore considered a limiting factor for smallholder farmers innovation capacity since it has implications for their access to innovations, as well as the income from their farming enterprises.

In summary, smallholder farmers in the target community faced a plethora of constraints that continue to limit their ability to innovate. Key among these constraints included: the lack of financial resources; the poor interaction between research and extension professionals and farmers; the high incidence of pests and disease; the high cost and poor availability of agricultural inputs; the high cost of labour; and the poor access to input and output markets. This clearly implies that serious efforts must be made to promote innovations among these farmers to address some of these constraints. Otherwise, they may play no small role in adversely affecting the uptake of those innovations among farmers.

Table 8.20: Constraints limiting smallholders' innovation capacity

FACTORS	Level of Constraints							
	Not constraining		Minor constraint		Constraint		Major constraint	
	F	%	F	%	F	%	F	%
Lack of contact with extension staff	45	22.5	47	23.5	57	28.5	51	25.5
Cost of inputs	4	2.0	37	18.5	64	32.0	95	47.5
Unavailability of inputs	4	2.0	44	22.0	94	47.0	58	29.0
Cost of labour	2	1.0	45	22.5	99	49.5	54	27.0
Unavailability of labour	20	10.0	85	42.5	70	35.0	25	12.5
Lack of opportunity to share ideas with other farmers	62	31.0	71	35.5	37	18.5	29	14.5
Lack of financial resources	26	13.0	4	2.0	41	20.5	129	64.5
Lack of "farmer friendly" credit facilities/loans	8	4.0	21	10.5	80	40.0	91	45.5
Lack of information on new agricultural technology/techniques	25	12.5	59	29.5	55	27.5	61	30.5
Lack of processing facilities	11	5.5	91	45.5	36	18.0	62	31.0
Lack of access to markets	29	14.5	77	38.5	50	25.0	44	22.0
Low prices of agricultural produce	7	3.5	46	23.0	96	48.0	51	25.5
Lack of opportunity to feedback to extension / research about innovations	11	5.5	18	9.0	110	55.0	61	30.5
Research and extension don't know the real production problems we face	17	8.5	33	16.5	97	48.5	53	26.5
Lack of confidence that the new activities will work	23	11.5	71	35.5	90	45.0	16	8.0
Fear of the risk associated with trying new things or techniques	33	16.5	76	38.0	68	34.0	23	11.5
High cost of new technologies (seeds, tools, fertilizers etc)	10	5.0	34	17.0	78	39.0	78	39.0
Lack of influence on household decision-making	56	28.0	32	16.0	89	44.5	23	11.5
Pest and diseases	4	2.0	6	3.0	72	36.0	118	59.0

Source: Field Survey 2016/17

8.8 Smallholder Farmers' Attitudes towards Innovation

This section seeks to further understand smallholder farmers' attitudes towards innovating in their farming enterprises. A series of questions reflecting both positive and negative attitudes towards innovation in rice farming were asked and a Likert scale was used which ranged from 1 to 5 (where 1 represented strongly disagree and 5 strongly agree) to determine the responses. The total frequencies and percentages (see

Table 8.21) and the means (see Table 8.22) were computed to help elicit this information.
It can be seen in

Table 8.21 that the majority of respondents agreed (35.0%) or agreed strongly (53.5%) that they constantly look for ways to improve their rice cultivation methods, techniques/products/services, while only 11.5% were neutral, and none disagreed. Also, the majority respondents agreed (54.0%) or agreed strongly (33.0%) that they frequently experiment with new farming ideas/techniques; 12.0% were neutral, while only 1.0% disagreed. Similarly, more than half of respondents (65%) agreed (45.0%) or agreed strongly (20.0%) that they typically generate unique ideas for solutions to their problems, while the rest (35.0%) were either neutral or disagreed. The majority of respondents also agreed (29.5%) or agreed strongly (43.0%) that they liked working in a group with other farmers to improve the way they farm, while the rest (27.5%) were either neutral or disagreed. The high level of agreement of respondents with these statements largely suggests a positive behaviour towards innovation as a solution to their rice farming problems. Further, the majority of respondents agreed (53.5%) or agreed strongly (30.5%) that they will actively pursue ways to improve their skills and or knowledge; they also agreed (65.5%) or agreed strongly (24.5%) that they make great efforts to improve upon existing ways of carrying out their farming activities. More than half the respondents (82.5%) also agreed (48.0%) or agreed strongly (34.5%) that they are interested in trying new ways to improve themselves or their farming enterprises, regardless of the cost. The vast majority of them also agreed (61.5%) or agreed strongly (27.0%) that if something cannot be done, they will find a way. The great degree of agreement to these statements depicts a clear willingness of smallholder farmers' supportive behaviour towards innovation. For instance, the farmers' agreement that if an activity cannot be completed or executed efficiently, they will find a way regardless, shows a tendency to innovate when necessary. Also, their agreement that they make great efforts to improve on existing methods is a clear indication of supportive behaviour towards innovation in their rice farming systems.

On the other hand, their agreement to certain other statements suggests that, although they may have supportive attitudes towards innovation, they are risk averse. For instance, more than half of respondents (54.0%) indicated that they will try new things only if they are guaranteed to work. Also, almost half (48%) agreed that they see no reason to improve on methods that work. This suggests, to a great extent, that some farmers do not want to take risks by engaging with innovations whose viability or productivity is unknown to them.

Table 8.21: Smallholder farmers' attitudes towards innovation in rice farming

Behaviours	Level of willingness to Innovate									
	Disagree Strongly		Disagree		Neutral		Agree		Strongly Agree	
	F	%	F	%	F	%	F	%	F	%
I am constantly looking for ways to improve my rice cultivation methods, techniques/ products/ services.	-	-			23	11.5	70	35.0	107	53.5
I like to frequently experiment with new farming ideas/techniques.	-	-	2	1.0	24	12.0	108	54.0	66	33.0
I typically generate unique ideas for solutions to my farming problems.	1	0.5	39	19.5	30	15.0	90	45.0	40	20.0
I will try new things only if they are guaranteed to work	8	4.0	57	28.5	27	13.5	75	37.5	33	16.5
I always try new activities/ methods/ practices regardless of whether I am guaranteed about results or outcomes.	24	12.0	55	27.5	21	10.5	72	36.0	27	13.5
I like working in a group with other farmers to improve the way I farm	5	2.5	8	4.0	42	21.0	59	29.5	86	43.0
In group activities, I will only work if everyone else is working	17	8.5	94	47.0	18	9.0	39	19.5	32	16.0
I actively pursue ways to improve my skills and/or knowledge. (i.e. trainings).	5	2.5	9	4.5	18	9.0	107	53.5	61	30.5
I make great effort to improve upon existing ways of doing things.	3	1.5	3	1.5	14	7.0	131	65.5	49	24.5
I am interested in trying new things to improve myself or my farming enterprise, regardless of costs	1	0.5	4	2.0	30	15.0	96	48.0	69	34.5
If something cannot be done, I find a way			7	3.5	16	8.0	123	61.5	54	27.0
I see no reason to improve something if it is working.	14	7.0	77	38.5	13	6.5	66	33.0	30	15.0
I will only try new techniques or technology if it is easy to do so	11	5.5	52	26.0	34	17.0	72	36.0	31	15.5

Table 8.22 shows the mean comparison of the attitude statements of respondents in the four districts. Out of a range of 1 – 5 (where 1 represents a less supportive attitude and 5 represents a highly supportive attitude), the majority of respondents indicated a supportive attitude with means mostly above 4.0. The only exceptions were the statements "I will try new things only if they are guaranteed to work", "I see no reason to improve something if it is working", and I will only try new techniques or technology if it is easy to do so". A score of 4.0 and above shows agreement with these statements which actually denotes a less supportive attitude towards innovations.

Table 8.22:Mean comparison of farmers' attitude statements by District

Behaviours	Mean behaviour towards innovation				
	Kambia	PortLoko	Tonkolili	Koinadugu	Total
I am constantly looking for ways to improve my rice cultivation methods, techniques/ products/ services.	4.72	4.68	4.66	3.62	**4.42**
I like to frequently experiment with new farming ideas/techniques.	4.66	4.32	4.20	3.58	**4.19**
I typically generate unique ideas for solutions to my farming problems.	4.34	4.10	2.60	3.54	**3.64**
I will try new things only if they are guaranteed to work	3.86	3.58	3.24	2.68	**3.34**
I always try new activities/ methods/ practices regardless of whether I am guaranteed about results or outcomes.	3.10	3.34	3.70	2.68	**3.21**
I like working in a group with other farmers to improve the way I farm	4.46	4.22	4.48	3.10	**4.06**
In group activities, I will only work if everyone else is working	3.54	2.98	2.60	2.38	**2.88**
I actively pursue ways to improve my skills and/or knowledge. (i.e. trainings).	4.34	4.14	4.04	3.68	**4.05**
I make great effort to improve upon existing ways of doing things.	4.54	4.14	4.04	3.68	**4.10**
I am interested in trying new things to improve myself or my farming enterprise, regardless of costs	4.36	4.46	4.24	3.50	**4.14**
If something cannot be done, I find a way	4.46	4.08	3.78	4.16	**4.12**
I see no reason to improve something if it is working.	4.18	3.10	2.20	2.94	**3.11**
I will only try new techniques or technology if it is easy to do so	4.02	3.26	2.34	3.58	**3.30**

Source: Field Survey, 2016/17

It can be noted, however, that the mean figure for statements such as, "I will always try new activities/methods/practices regardless of whether I am guaranteed about the results or outcomes" (3.21), and "I see no reason to improve something if it is already working" (3.11) are neutral on average, which implies that the farmers are not willing to change if they do not see the need to do so. While most respondents seem to have a generally supportive attitude towards innovation, respondents from Koinadugu district demonstrated the least supportive attitude for almost all the statements, compared to their counterparts in other districts.

8.9 Summary of Findings

This chapter set out to understand the extent to which research and extension programmes have influenced smallholder farmers' innovation capacities. It aimed to understand the farmers' innovation processes in the past ten years after setting the stage by first examining their characteristics, including their poverty profiles, their motivations for innovating, the actors who have influenced those innovations and their roles, as well as understanding the constraints they faced in the innovation processes. Finally, it examined their perceptions of the possible constraints which limit their general capacities to innovate from a broader context/perspective.

8.9.1 Socio-economic Characteristics of Respondents

Most respondents were male and within the prime age for effective engagement in agricultural activities. Illiteracy is rife among respondents, only a few had been educated to primary or secondary school level. Marriage was taken seriously among respondents, the vast majority were married, only a very small number were single or widowed.

Households were mainly male-headed, with the majority of respondents dependent on agriculture as their primary source of income. The majority of farmlands were individually owned, followed by rented, leased, and communal ownership. Respondents used their farm produce mainly to consume, to sell, or to use as seed, and that majority also rear animals as an alternative source of income and/or food. Rice was the most dominant crop grown by the majority of farmers in both lowland and upland ecologies, although it is more dominantly grown in the lowlands.

The size of respondents' households were very large (11.42 people on average), larger than the national estimates of a normal household of six persons/household based on the 2004 Population and Housing Census. However, current national estimates may be higher, but information on this is seemingly unavailable. Children are the most dominant in the majority of respondents' households, followed by adult males. Household incomes were higher in the dry season (US$47.013) than in the rainy season (US$35.707), with a generally low household income. Crops grown for income were mainly cassava, rice, potato, and groundnut; while those grown for household consumption were the same, but in a different order of importance, i.e., rice, cassava, potato, and groundnut.

With respect to the level of poverty incidence, the majority of respondents in the study area are living below the national poverty line, with most in this condition living in Tonkolili District and the fewest in Port Loko District. Also, based on the food poverty line, the majority of respondents live above the national food poverty line, with Port Loko District having the highest number of respondents in this condition, followed by Kambia, Koinadugu, and Tonkolili, respectively. Similarly, estimates based on the international poverty line of US$1.25/day showed that the majority of respondents in the four districts live below this line. Tonkolili District had the highest number of respondents living in this condition, followed by Koinadugu and Kambia, and Port Loko District had the fewest.

Overall, the results show that respondents were better-off in terms of food poverty, the majority were above this line, however they were worse-off in terms of the national and international poverty ($US1.25/day) with the majority living below these lines.

8.9.2 Innovations in the Past Ten Years

The study has identified a number of innovations that respondents have effected in their farming systems over the past ten years. These were divided into pre-production, production, and post-harvest innovations.

The pre-production innovations examined included both improved and local rice varieties. Interestingly, it was found that the majority of respondents reported growing a number of IRVs, however, the most widely grown of these were NERICA, ROK 5, and Pa Kiamp. A total of 12 IRVs were identified to have been grown by respondents in the past ten years. ROK 5 was more popular in Kambia and Koinadugu Districts than in Port Loko and Tonkolili, while NERICA was grown in all four districts. With respect to LRVs, a total of 76 were identified to have been grown by respondents, however, 26 of these were the most popular and were reported in this study as the remainder were mostly mentioned by only one respondent. The most widely grown LRV identified was *Pa Gbassay*, grown in all districts except Koinadugu. This was followed by varieties such as *Yukureh* and *Seniwer*, both of which were only grown in Koinadugu district. A key observation was that some local varieties were unique to particular districts. While four varieties were grown specifically in Koinadugu District, Port Loko and Kambia seem to have a few LRVs in common, while Tonkolili tended to also have varieties unique to it as a district.

Agronomic innovations that had the highest levels of acceptance or use among farmers included puddling, weeding of inland valley swamps (IVS), land preparation before nursery, shallow planting of seedlings, and a reduced number seedling per hill. Also, among the popular innovations smallholder farmers indicated to have tried in their farming enterprises in the past ten years, and listed in order of the numbers trying them, were: reduced nursery time for seedlings, i.e., early transplanting of seedlings from the nursery to the farm (IVS); increased spacing between seedlings; construction of bunds/water control/swamp development; and use of chemical and organic fertilisers. Other innovations mentioned by respondents included: priming of seeds before planting; crop rotation; and fencing around farms. Additionally, the study found that the majority of respondents currently transplant their seedlings after 21 days in the nursery, followed by those who transplant after 14 days, and then those who do so after 30 days; the majority also indicated that they now plant three seedlings/hill, followed by those who plant two seedlings/hill, none indicated they planted only one seedling per hill. It is reasonable to suggest, from these findings, that the TP-R innovations seem to be more popular and accepted than the SRI specific innovations.

The three top post-harvest innovations mentioned by more than half of the respondents included: early threshing of the rice paddy, as opposed to leaving the paddy on the farm for months after harvest; storing the rice in town after threshing, as opposed to storing it in the bush; and using rice mills, as opposed to manually pounding the rice paddy. Further, the storage of rice paddy in jute bags with wood ash, the use of drying floors, the treatment of rice paddy with pepper, and the storage of rice seeds in local baskets, were also often mentioned by respondents as post-harvest practices they have effected in their farming system within the last ten years. However, post-harvest innovations relating to ABCs (such as storing rice in an ABC, rice sales via ABC, and the use of a thresher from ABC) were only mentioned by a few respondents. These results suggest that most of the post-harvest innovations used by respondents within the study period were those promoted through the TP-R programme, with the exception of the use of rice mills which may have been accessed through the ABCs, in addition to those privately owned.

8.9.3 Drivers of Innovation Among Smallholder Farmers

A number of drivers were identified by respondents for them to innovate in their rice farming systems. These were also categorized into pre-production, production, and post-harvest drivers. The key drivers for planting new rice varieties included: better tillering and growth of those seed varieties; the potential to increase household income; the early maturity of the varieties; the potential to improve household food security; the potential to increase yield/productivity; the good taste of the varieties; enhancement of the opportunity to undertake double cropping due to their early maturity; and the opportunity to grow vegetables earlier than normal.

Similarly, the key drivers (listed in the order of the number of farmers identifying them) for using new production (agronomic) innovations included the potential of the innovations to: increase their farm yield level; increase the tillering ability of seedlings; improve the germination rate of seeds; enhance the growth rate of seedlings; enhance fertiliser application; minimise wastage of farm inputs; ease land preparation and reduce pest infestation; and enhance double cropping. The tendency of the innovations to improve soil fertility, enhance water control in IVS, and help to control animal pests from destroying rice nurseries were also among the drivers identified by a few respondents.

On the other hand, the key drivers for respondents use of post-harvest innovations included the potential of the innovations to: reduce post-harvest losses, reduce the drudgery associated with manual pounding of paddy, improve the quality of rice processing; improve the viability of seeds; reduce risk from pests and thieves; and minimise the risk of diverting/consuming rice seeds. The results generally suggest that most of the drivers of post-harvest innovations by respondents seem to align more with the TP-R system than they do with ABC, implying that the former innovation package could have had a higher acceptance among respondents than the latter.

8.9.4 Actors and the Roles which Influence Smallholder Farmers Innovation Processes

The key actors/facilitators of innovation in the target communities were examined mainly by the extent to which they were perceived by respondents to be helpful, important, and a source of information. With respect to farmers' perceptions of their helpfulness, the top actors/facilitators identified, in order, were: colleague farmers; radio; MAFFS extension officers, their own initiative; and NGO extension officers. With respect to importance of the actors to smallholder farmers, the key actors identified in order of perceived importance were: colleague farmers inside and outside the community; MAFFS extension workers; NGO extension workers; lead farmers; radio; community leaders/authorities; itinerant agricultural traders; agro-dealers; agricultural research officers; ABCs; and District Council officials.

Consistently, the key sources of information identified by respondents, in order of most used to least used, included: colleague farmers inside and outside the community; radio; lead farmers in the community; MAFFS extension workers; NGO extension workers; community leaders; itinerant traders; agricultural researchers; Agro-dealers; ABCs; and District Councils officials. With regards to the usefulness of information, the most useful sources identified by respondents, in order, included information from: colleague farmers and MAFFS extension workers; the lead farmer in the community; NGO extension workers; colleague farmers outside the community; and radio. Other actors were also identified as being sources of useful information for their innovation processes, and these included: itinerant traders; agricultural research officers; community leaders; agro-dealers; and ABCs .

8.9.5 Roles of Actors in Facilitating Smallholder Rice Farmers' Innovation Processes

A number of roles were identified to have been played by these actors in the facilitation of farmers' innovation processes. Interestingly, most of these roles were played by more than one actor. The key roles identified included: sharing rice farming information among smallholder rice farmers; mentoring and advising farmers; sharing general information on agriculture; facilitation of in-kind exchange services of seed rice; establishment of linkages between farmers and other actors; facilitation of smallholder farmers' access to agricultural inputs and to purchases of rice outputs from smallholder farmers. The key actors involved in these roles included, but were limited to: MAFFS extension workers; colleague farmers inside and outside the community; itinerant traders; NGO Extension workers; radio; lead farmers; and Agricultural Research Officers.

However, MAFFS and NGOs seemed uniquely associated with the provision of rice seed to smallholder farmers, while that of facilitation of farmers' access to pesticides was mainly associated with Agro-dealers and MAFFS extension workers.

With respect to role differentiation at household level, the majority of respondents indicated that men were mainly responsible for making decisions about where to farm, what changes to make to the way they farm (innovate), the time at which they sell their produce and how much they sell. Decisions normally jointly made by men and women included the same responsibilities, but in a different order, i.e., where to farm, changes to the way they farm, and when and how much to sell. Similarly, men were mainly found to do the brushing of farms and the digging/ploughing, puddling, and nursery preparation, along with having control over proceeds/income from household farms and over the use of the produce in the household. Meanwhile, women mainly undertook weeding and chose who to sell to; they were also largely associated with milling/pounding and transportation of rice paddy to market. Children were mostly associated with activities such as milling/pounding of rice paddy and transportation from home to market. Activities that were largely identified to be carried about by men, women, and children jointly included transplanting, harvesting, threshing, transporting rice paddy from farm to home, and uprooting of seedlings from the nursery.

8.9.6 Constraints of the Innovations

The constraints faced by smallholder farmers with respect to the innovations were also categorized into pre-production (IRVs and LRVs), production, and post-harvest innovations. With respect to IRVs, the key constraints identified by respondents included the high cost of IRV seeds, their inaccessibility/scarcity, and the fertiliser requirement for their cultivation. Other constraints with minimal importance included: susceptibility to attack from pests and disease; the high cost of fertiliser required for their cultivation; the scarcity of fertilisers; inability to withstand too much water; rigorous management practices; and the requirement for heavy weeding. On the other hand, the use of local varieties of rice seed was associated with the key constraints which included low quality seed, low yield, scarcity or unavailability of some varieties, scarcity of fertiliser, and the high cost.

Production innovations, such as line sowing, were mainly associated with constraints such as being too technical, time consuming, and labour intensive. The key constraints with puddling of IVS were labour intensiveness, lack of tools for its implementation, and lack of labour. Swamp development was mainly associated with key constraints which included: its high cost of implementation; its labour intensiveness and tedious nature; its high technicality; and the high cost of labour. Similarly, weeding of IVS was mainly associated with constraints such as labour intensiveness and being tedious, lack of labour, irritation of the skin, the fact that it coincides with other farming activities, and the high cost of labour. The use of chemical fertilisers was perceived to be expensive and scarce; while the use of rice mills was constrained by the long waiting time at peak periods, high cost, and unavailability in community. The increased spacing of seedlings was identified with constraints which included encouragement of weed growth and the problem of having to replace seedlings after transplanting as most are lost. The reduction of seedlings per hill (one, two or three seedlings per hill) was mainly associated with constraints including the tendency to lose seedlings, their poor growth, the need for replacement of seedlings and it being time consuming. This includes reduction to one, two, or three seedlings, as per SRI or TP-R recommendations. Threshing by trampling with feet was associated with constraints such as being time consuming, the lack of improved threshing equipment, inflicting pains on the feet, and being labour intensive.

8.9.7 Innovations not tried by Farmers and Reasons for not doing so

The study found that a number of innovations were not used by farmers for a number of reasons. Line sowing has not been tried/used by the majority of smallholder farmers as they perceive it to be time consuming, labour intensive, too technical or difficult to implement, and they lack technical support, training, and labour. Similarly, the planting of a single seedling per hill has not been tried due to fear of loss of seedlings to erosion or pests, the perception that it is too technical or difficult to implement, lack of training, the perceived difficult for seedlings to grow healthily, and the belief that it encourages weed growth, among others. NERICA and other IRVs have not been tried mainly due to their perceived scarcity or inaccessibility in respondents' communities.

Priming was not tried by some farmers mainly due to the perceived difficulty or technicality involved, but also the belief that it is not necessary or is a waste of time, there is a lack of technical support, it is not ideal for large quantities of seeds, the farmers trust their seeds, and they do not see priming practised in the community. Similarly, early transplanting of seedlings has not been tried by some respondents due to the perception that it is too technical or difficult to implement, the thinking that it is not necessary, the difficulty for the seedlings to develop, the use of late varieties which farmers believe do not necessarily need early transplanting, and the lack of labour.

Main reasons given by respondents for not trying a reduction in the number of seedlings per stand were: lack of training; fear of seedlings being eaten by pests or lost to erosion; the belief that it encourages weed growth and is time consuming; and the lack of fertilisers to ensure proper growth of seedlings. Swamp development was not tried due to the high cost involved, being too difficult/technical to implement, lack of labour, and farmers' perception of its tendency to reduce farm size. Further, some farmers had not tried increased spacing between seedlings on their farms because they believe this encourages weed growth, they lack training, they perceive it as being too technical or difficult to implement, and they believe it is difficult for seedlings to develop.

Rice mills have not been tried/used by some farmers for reasons such as unavailability or inaccessibility, being too expensive to use, and being faulty. Consistently, ABCs have not been used by some respondents due to their inaccessibility or unavailability, farmers' unawareness of their existence, and their location being too far away from the farmers' communities.

The use of organic manure promoted through the SRI system had not been tried/used by some respondents due to it being perceived to be labour intensive in its generation, the lack of technical support, and the further perception that it is unnecessary or a waste of time.

8.9.8 Innovations discontinued and Reasons given by Respondents

A number of innovations were identified to have been discontinued by the sampled respondents, and again there were for a number of reasons for this. For example, line sowing was discontinued mainly because it was perceived as time consuming, there was a lack of improved rice varieties, it was too labour intensive and too technical or difficult to implement. Furthermore, the planting of single seedlings per stand was mainly discontinued due to farmers' perceptions of it being time consuming, the general unavailability of improved seeds, the lack of fertilisers to ensure the healthy growth of the seedlings, the belief that it is labour intensive or tedious to undertake, the perceived difficulty of seedlings to develop, and also farmers' risk averseness through avoidance of the need for replacement of seedlings. Similarly, the planting of NERICAs and other IRVs were mostly discontinued by farmers for reasons which included inaccessibility to the seed, its fertiliser requirement, the lack of such fertiliser, and the perception that it is not ideal for their swamps, such as mangrove. Again, priming of seeds before planting was mainly discontinued as a result of farmers' perception of the innovation being time consuming and the belief of some farmers that it is not necessary. The early transplantation of seedlings was discontinued by a few respondents because of the lack of improved rice varieties, its timing coincided with other farm activities, there was a lack of financial resources, and farmers feared the loss of seedlings to pests and erosion. On a similar note, farmers have stopped the planting of just a few seedlings (reduced seedlings/hill) due to: the lack of IRVs; the high cost of labour; the perception that it is labour intensive, tedious, and time consuming; the lack of fertiliser; and fear of the loss of seedlings to pests and erosion.

Further, respondents reported that the control of water in IVS through swamp development was discontinued because: it was too technical or difficult to do; the high labour costs involved; the high cost associated with carrying it out; and the lack of tools and financial resources. The spacing of seedlings was only discontinued by a few respondents who indicated that it encouraged weed growth and that it was too difficult to implement. The use of rice mills was stopped by some respondents mainly due to the perceived high cost and defective equipment at available mills.

8.9.9 Smallholder Farmers' Attitudes towards Innovation

The study found that a large majority of the target farmers had a positive/supportive attitude towards innovation. They tended to agree strongly with most of the statements that demonstrate support for innovation. This implies that if the necessary conditions are available, the majority of smallholder farmers are willing to change to innovative methods or techniques of farming. However, there is also evidence that they are more willing to do so only when they are sure of the outcome. They tend to be risk averse given their low level of agreement to statements that require risk taking in innovation processes. This is consistent with findings in a number of studies such as Sulewski and kloczko-Gajewska (2014) and Binci et al. (2003) who found that farmers are risk averse for a variety of reasons. Finally, although farmers generally manifested supportive attitudes towards innovation, respondents from Koinadugu district demonstrated the least supportive attitude to almost all the statements compared to their counterparts in other districts.

8.9.9 Constraints Limiting the General Innovation Capacity of Smallholder Farmers on Rice

The study identified the key constraints which limit the general ability of smallholders to innovate in their rice farming systems. Some of the general constraints were also identified as specific constraints which limit the farmers' use of certain innovations. However, some are beyond specific innovations. The lack of financial resources was one of the top constraints to innovation which the majority of smallholders identified, followed by the high incidence of pests and disease, and the lack of farmer "friendly" credit facilities for smallholder farmers.

The lack of opportunity for smallholder farmers to share their feedback with research and extension actors on innovations, the high cost of labour for their innovations, and the perceived lack of knowledge held by research and extension professionals about the real problems smallholder farmers face, were the next set of constraints that seemed to largely impede farmers innovation capacities.

Further, the low prices for agricultural produce, the shortage of agricultural inputs and their subsequent high cost, the poor contact between smallholder farmers and extension staff, the lack of information about new agricultural technology/techniques, farmers lack of confidence in innovations from external actors/professionals, and finally, the lack of access to markets were the last set of constraints identified which limit the innovation capacity of smallholder farmers in the target communities/districts.

CHAPTER 9 : DISCUSSIONS, CONCLUSIONS, POLICY IMPLICATIONS, AND RECOMMENDATIONS

9.1: Introduction

This chapter is introduced through two sections, firstly a review of the background information and rationale for the study is provided, and this is followed by a description of the structure of the chapter.

9.1.1 Background/Rationale of the study

The agriculture sector in Sierra Leone comprises a wide array of actors and includes research institutions such as the Sierra Leone Agriculture Research Institute (SLARI), the Ministry of Agriculture, Forestry and Food Security (MAFFS), national and international Non-Governmental Organisations (NGOs), and other private actors. One primary driver for agriculture sector actors is to increase smallholder farmers' productivity through increased access to modern and improved methods and technologies for farming. MAFFS, for instance, is the key arm of the government which primarily manages the development of the agricultural sector in Sierra Leone. SLARI is the technical arm of MAFFS and is primarily responsible for the conduct of research activities in response to the needs of smallholder farmers. NGOs have been very active in the adaptation and dissemination of innovations, by way of complementing the efforts made by MAFFS, to boost the agriculture sector in the country.

At the end of Sierra Leone's civil war in 2002, the country witnessed an upsurge in the number of actors in the agriculture sector, particularly NGOs and other private sector actors. MAFFS and SLARI also saw large increases in donor funding for their activities, seen as a general strategy to boost the agriculture sector, and based on the assumption that this would have a subsequent impact on economic recovery and development as the country emerged from the decade-long war (MAFFS, 2004, 2012). Given the importance of the agriculture sector in Sierra Leone, the vast majority of NGOs working in the country include a component on agriculture, and largely target resource poor smallholder farmers, as this is believed to increase their portfolios.

Thirteen years on from the end of the civil war and the subsequent increase in the promotion of agricultural innovations in the country, this study seeks to understand the agricultural innovation system on rice as one of its three objectives, the other two objectives are discussed below. Rice is the major crop grown and consumed by the majority of Sierra Leoneans and is also closely targeted by most research and extension professionals in the development and promotion of innovations, hence it became a key motivation for targeting rice in this study.

9.1.2 Structure of the Chapter

This chapter presents discussion on the three key objectives of the study, it draws overall conclusions from the findings, outlines policy implications of those findings, and makes recommendations on areas for further research. The discussion section is divided into themes and sub-themes consistent with each research objective and question, respectively. This is to provide the reader with a better understanding of how the research findings have answered the research questions. This structure is also important as it helps identify the specific contributions made and how the findings agree or disagree with the existing literature. The second section contains the conclusion to the overall study, consistent with the study objectives. The final sections describe policy implications which arise from the study, and finally, the chapter offers recommendations for further research which could build on the findings.

9.2 Discussions of the Findings

9.2.1 The Agricultural Innovation System on Rice in Sierra Leone: A Research and Extension Perspective (Objective 1)

In order to provide a thorough description of the innovation system on rice in Sierra Leone from a research and \extension perspective, the study addresses the following research questions:

1) What are the key rice innovations and their perceived benefits promoted by research and extension actors in the past ten years (2005-15)?

2) Who are the key actors involved in the promotion and development of these innovations and what are their roles?

3) What linkages/patterns of interactions exist among the actors of key rice innovations?

4) And what factors constrain the effectiveness of the innovation system on rice in Sierra Leone?

Data for this research objective were generated mainly through qualitative techniques which included the use of FGDs and KIIs. Research and extension professionals from public and private organisations were targeted and sampled using expert and criterion sampling. Organisations were selected only if they had designed and/or implemented programmes on rice within the past ten years (2005-2015). Two workshops and 49 KIIs were conducted nationally.

Findings revealed that there has been a myriad of innovations on rice promoted by research and extension professionals in the country within the target time frame of the study. The motivation for these innovations were based on several assumptions made by research and extension professionals. Key among those assumptions was the ability of the innovations to increase smallholder farmers' productivity. A change in rice variety or in farmers' practices, from traditional to improved, is expected to have an overall positive affect on productivity per unit area, which will have a direct impact on household incomes, their food security, and well-being. While this is a claim widely made in the literature, for example, the ability of improved rice varieties to increase yield (Dontsop-Nguezet et al., 2011; WARDA, 2000, 2002 and 2009), there is not always a direct relationship. This study has largely found that farmers are constrained by many factors which limit their ability to innovate (see Section 9.2.3), and even in cases where these external innovations have been used, they have not uniformly met farmers' expectations, such as increasing yield and/or ameliorating their current constraints. This points to the fact that increasing the innovative capacity of smallholder farmers is a challenging venture that requires a diversity of actors for innovation processes to be effective (Temel et al, 2002).

The innovation system on rice in Sierra Leone is dominated by a few actors, mostly within the agricultural environment, MAFFS, SLARI, NGOs, and the farmers, and it is these actors who have been identified as playing major roles in the four key innovations studied. However, the effectiveness of the innovation system has been constrained by many factors, as the following sections demonstrate. The aforementioned actors revealed strong interactions among themselves, while weak ones existed between them and other actors outside this cohort. The frequency, intensity, and strength of these interactions amongst these four groups of actors was stronger than that between any of them and any actors outside this cohort. This largely confirms findings by Research Into Use (2010), which revealed the existence of weak interactions between a number of innovation actors in the country. These have been primarily involved in the development, adaptation, multiplication, communication, and facilitation of access to the innovations through mentoring and coaching of smallholder farmers. There has been limited participation of private sector actors, such as marketers, agro-dealers, the media, and transporters; where they do exist, there is no evidence of coordination of their activities by research and extension professionals for the benefit of smallholder farmers, for whom these innovations are targeted. Effective linkages of farmers to post-harvest service providers, such as processors, transporters, and marketers, appear to be non-existent. Farmers are left with the onus of establishing these linkages, which poses a major constraint on most smallholder farmers as this leaves them at the mercy of their service providers, who are unreliable and usually unaffordable.

Further, the effectiveness of the innovation system in Sierra Leone is constrained by the prevalence of many structural conditions. Consistent with Schut et al, (2014), these conditions are associated with infrastructure and institutions, collaboration and interaction, capabilities and resources. These have not only constrained the innovative capacity of research and extension professionals, but also that of farmers, and have played a major role in weakening the effectiveness of the innovation system on rice in the country. Implicitly, improvements in the effectiveness of the innovation system should aim to address these constraints at all levels.

A more detailed and specific discussion of the findings under this heading follows.

9.2.1.1 The Key Rice Innovations and their Perceived Benefits Promoted by Research and Extension Professionals

This study found that four main innovations on rice have been promoted by research and extension professionals for several benefits perceived to be useful to smallholder farmers. They are: Improved Rice Varieties (IRVs); the System of Rice Intensification (SRI); Technical Package on Rice (TP-R); and Agricultural Business Centres (ABCs). Other innovations on rice promoted include Plant Health Clinics and Purdue Improved Crop Storage (PICS) Bags.

i) Improved Rice Varieties (IRVs): IRVs constitute mainly NERICAs and the ROK series developed or adpated by SLARI through RARC, the main subsidiary of SLARI responsible for the generation, adaptation, and dissemination of cereals, including IRVs (SLARI, 2011). However, the study found that NERICAs have been the most commonly promoted variety by research and extension professionals within the study period, mainly as a strategy to increase smallholder farmers' productivity due to the perceived advantages of NERICAs over local crop varieties. For instance, NERICAs were recently distributed to farmers across the country as a restocking strategy for seed stocks lost as a result the Ebola virus outbreak in 2014. Certainly, research and extension professionals view IRVs to have key advantages lacking in traditional rice varieties.

Research and extension professionals indicated they have been motivated by a variety of reasons for promoting IRVs among smallholder farmers. Key among their reasons are: the high yield potential of IRVs; the ability to improve farmers' household food security, incomes, and livelihoods; and their ability to enhance farmers' adaptability to climate change and reduce post-harvest losses. These findings are in line with the majority of claims made in the literature, e.g., Bruce et al. (2014) and CGIAR (2013), who found that farmers' use of IRVs can increase their yield significantly. WARDA (2000, 2002, and 2009) and Woperies et al. (2009) similarly noted some of the key advantages of NERICAs over traditional rice varieties and included: early maturity, about 50-70 days earlier than farmers' traditional varieties; resistance to local stresses (blast, stem borers, termites); higher yield advantage (up to 6 tonnes per hectare under favourable conditions); higher protein content (by 25%) and good taste; resistance to drought; and higher tillering qualities. Similarly, Dontsop-Nguezet et al. (2011), in their study conducted in Nigeria, found that IRVs can positively impact farmers' incomes. These claims and beliefs put forward in the literature justify research and extension professionals' development, adaptation, and promotion of IRVs among smallholder farmers. However, perceptions of IRVs held by of smallholder farmers are different, this is discussed in later sections of this chapter. Certainly, several factors affect farmers' ability and willingness to adopt IRVs, despite the perceived benefits held by research and extension actors.

ii) System of Rice Intensification (SRI): Another important rice innovation that was found to have been largely promoted by research and extension actors was the SRI. This is mainly a production-focussed innovation, suited to lowland rice production, especially in Inland Valley Swamps (IVS). It focuses on key agronomic changes that farmers should make in the cultivation of lowland rice in order to reduce their use of inputs, such as seeds, and to enhance the healthy growth of their seedlings. SRI was introduced in Sierra Leone in the early 2000s by an NGO, World Vision (Yamah, 2002), and was replicated by other NGOs and the public sector institutions SLARI and MAFFS. Almost all the key NGOs working in the agriculture sector in the country, such as Concern Worldwide, Catholic Relief Services, World Vision, CARE, MADAM, and others, have participated in promoting SRI as an innovation for rice cultivation. This seemingly general promotion was borne out of the perceived benefits of SRI. The study found that the majority of research and extension professionals have been promoting the system due to the belief that, like some other rice innovations, it can increase farmers' yield per unit area and their incomes, and it uses fewer inputs for maximum production, thereby reducing the cost of production for resource poor smallholder farmers. It is also believed that SRI saves them income (and by extension the environment) by encouraging the use of organic manure, instead of chemical fertilisers. These perceived benefits are, however, somewhat controversial, e.g., Dobermann (2004) and Sheehy et al. (2004). A number of studies have similarly shown substantial improvements in the productivity of the land, and the use of labour and water with the use of SRI methods, e.g., Ceesay et al. (2006) in the Gambia; Sinha and Talati (2007) in India; Sato and Uphoff (2007) in Indonesia; Kabir and Uphoff (2007) in Myanmar; and Namara et al. (2008) in Sri Lanka. Barison and Uphoff (2011) recently found that rice plant cultivation with SRI methods produced average yields more than double those achieved from the standard practice of rice cultivation in Madagascar. Islam et al., (2013) found that SRI has a 209.9% average productivity of rice over conventional methods of rice cultivation, and that SRI could save seeds (97.56%), save water (78.05%), and reduce costs (70.33%) compared to the conventional method of rice cultivation. Similarly, Harding et al., (2012) found that the number of tillers/hill, panicles/hill, spikes/panicle, and yields (t/ha) of SRI plots were 76.3%, 75.0%, 22.1%, and 52.8%, respectively, greater than those of traditional farmer practice plots. These findings largely corroborate respondents' reasons for promoting SRI as an innovation among smallholder farmers in the country.

iii) Technical Package on Rice (TP-R): The TP-R was also found to be one of the key rice innovations currently being promoted by research and extension actors. The TP-R was piloted and introduced to farmers through two consecutive projects implemented in the Kambia District, one of the four districts targeted by the study, by the Japanese International Co-operation Agency (JICA) from 2006-14. The results of the TP-R, according to respondents, were impressive to stakeholders, including MAFFS. This motivated MAFFS to generally adopt the innovation for onward dissemination to farmers in other parts of the country. JICA provided the technical training to MAFFS staff and developed training manuals for use by MAFFS extension staff and, since then, the innovation has been widely promoted across the country. However, this study did not discover any current promotion of the innovation by other NGOs, JICA and MAFFS appear to have been the key promoters of the innovation at the time of the data collection. The TP-R, like the SRI, is mainly suited for IVS rice cultivation. It is similar to SRI in that it also promotes practices of water control, reduced seedlings per hill, early transplanting, timely weeding, increased spacing of seedlings, and preparation of the field before transplanting. However, the key differences are that the TP-R promotes the planting of one to three seedlings per hill, random transplanting of seedlings, the use of chemical/inorganic fertilisers, transplantation of seedlings at 21 days old, and has a training component on post-harvest handling of rice (JICA, 2014), as opposed to the SRI which promotes planting of one seedlings per hill, line sowing, transplantation of seedlings between 8-14 days, use of organic manure, and is mainly focussed on the agronomic component of rice production. Consistent with JICA (2012, 2014), respondents have been motivated to promote the TP-R among smallholder farmers for a number of reasons which they consider beneficial to resource poor smallholders, including its potential to increase yield per unit area, its use of fewer inputs, and its ability to improve the incomes and livelihoods of farmers. This is based on the assumption that if farmers control the water in their inland valley swamps, root development and tillering of seedlings is enhanced. The increased spacing between seedlings reduces competition and enhances better tillering as well as reducing the amount of seeds used. The planting of few seedlings also contributes to reducing the total amount of seeds required to cultivate per unit area. The successful adoption of these practices will then impact on proper growth of seedlings and overall productivity per unit area, while reducing the overall amount of seeds farmer use to cultivate per unit area. In fact, JICA (2014) indicated that TP-R is low-cost and easy to adopt by smallholder farmers. However, given it is an innovation that seems to only have been promoted in Sierra Leone, there is currently a dearth of literature on its efficacy in improving smallholder farmers' productivity, incomes, and livelihoods, and the extent to which the practices are being adopted or used by smallholder farmers. This study contributes to the generation of some of this information and this is discussed in later sections of this chapter.

iv) Agricultural Business Centres (ABCs): The ABCs emerged in this study as the key post-harvest handling innovation, designed and promoted mainly by MAFFS. The Government of Sierra Leone, through MAFFS, and with support from the Global Agriculture and Food Security Facility (GAFSP), have constructed 193 ABCs nationwide (IFAD, 2011) since 2010. At least one ABC was constructed in each Chiefdom out of the 169 Chiefdoms in the country. According to findings, the ABCs are structures equipped with post-harvest processing machinery, including harvesters, rice mills, rice parboiling and storage facilities, power tillers, drying floors, and agricultural inputs. They also serve as market centres where farmers can buy and sell inputs and outputs. In fact, some respondents disclosed ABCs were, at least in theory, intended to have internet facilities and generators for electricity. The ABC model aimed to ameliorate the many constraints smallholder farmers' face in post-harvest processing of their rice by increasing their access to these facilities and markets. Therefore, MAFFS and its partners believed the construction of the ABCs across the country would be a solution which would reduce post-harvest losses, and a strategy that would enhance farmers' ability to add value to their rice products, as well as improving their access to markets for both their farm inputs and outputs. Consistent with the literature, the vast majority of smallholder farmers in Sierra Leone have been found to face huge constraints associated with post-harvest processing and access to markets for their produce. To combat such constraints, CARD (2009), for instance, made a number of recommendations, such as: the construction of farm market centres; daily retail markets; irrigation schemes; post-harvest processing of produce at on-farm and village level, including drying floors and crop storage; rice hulling and milling machines. Similarly, WFP (2011) recommended the provision of improved access to storage facilities and market infrastructure to help stabilise the domestic rice supply, increase profitability for cultivators, and facilitate regional trade opportunities. Such recommendations might have played a role in the establishment of the ABCs nationwide by MAFFS and partners, motivated by their ability to remedy smallholder processing and access to market constraints.

Overall, the findings show the existence of innovations on rice either adapted from other countries (e.g., NERICAs, SRI) or developed and promoted by research and extension actors in-country (e.g., ROK rice varieties, ABCs, TP-R) all of which aim to increase farmers' productivity and income. However, a key observation based on the findings is that the key agronomic innovations – SRI and TP-R – are mainly aimed at IVS rice production. Even the rice varieties developed and disseminated are mainly for lowland cultivation – only a few are for uplands. The focus of rice innovations on lowlands is possibly due to the fact that yields in lowlands are almost double that of uplands (MAFFS, 2004) in Sierra Leone. Also, maintaining soil fertility and productivity in lowlands could dissuade smallholders from engaging in upland rice farming, which is a major source of deforestation and environmental degradation in the country due to the slash-and-burn system of farming.

9.2.1.2 The Key Actors Involved in the Development and Promotion of Rice Innovations and their Roles

One of the key objectives of the study was to describe the innovation system in Sierra Leone. This included the identification of actors and their roles in the key rice innovations that have been promoted in the country in the ten years (2005-2015) before this study took place. Research and extension professionals from public and private institutions that have been implementing programmes on rice were targeted. Data were generated through FGDs and KIIs. The study identified several key actors and their roles, as has been reported in Section 5.2. The roles played by various stakeholders in the innovation system can be broadly classified as facilitator, communicator, collaborator (Leeuwis, 2004; Klerkx and Gilemacher, 2012), coordinator (Hall et al. 2006), knowledge source and networker (Hellin, 2012), and policy formulator and implementer (Roper et al. 2006).

The actors in some innovation system studies (Bhattacharjee and Saravanan, 2014) are regarded as "stakeholders" who have played a role in the development and or promotion of the innovation. In this study, they have been referred to as actors mainly because they take actions that initiate, contribute to, or facilitate the innovation processes of the innovations studied.

The study identified three areas to which the key actors who have been predominantly involved in the processes of the four innovations studied belonged, they were: public institutions, NGOs, and farmers (and their derivatives, which included the community leaders). Other actors identified included: international donor agencies; marketers/agro-dealers; parastatals; and international research institutions.

MAFFS emerged as one of the major public institution actors to have played a role in all the four of the key innovations studied. MAFFS is viewed as the umbrella actor who does not only oversee the actions of other actors in the agriculture sector, but is also active in the development, multiplication, and dissemination of innovations, e.g., ABCs, IRVs; capacity development support and collaboration and regulation of the actions of other actors, such as NGOs (local and international), through policy formulation. Given that they are representative of the government, MAFFS was identified to have been involved in all the innovations promoted, either directly, through development, multiplication, or dissemination; or indirectly through technical support or oversight. However, in the TP-R, MAFFS collaborated closely with JICA and received technical training from JICA staff for onward dissemination of the innovation. On the other hand, MAFFS initiated the ABCs and collaborated with a number of NGOs in order to augment their effectiveness through the provision of training by NGOs to leadership committees of the ABCs. For SRI, MAFFS has been involved in the conduct of demonstration trials with farmers. At the time of data collection, MAFFS was promoting SRI through the WAAP program. This is consistent with findings in the literature that the Ministries of Agriculture in most countries have been a key player in the development and promotion of innovations (Bhattacharjee and Saravanan, 2014). Also, MAFFS assumes roles which include policy formulation and implementation, as well as that of collaboration and facilitation; while that of the JICA was mainly as an expert or source of knowledge.

SLARI was mainly associated with collaborating with other innovation system actors for the provision of research support in most of the innovations identified, particularly the TP-R and SRI. Its role was, therefore, more that of a collaborator and expert. For IRVs, SLARI was identified to have played a prominent role in that they were largely responsible for the development and adaptation of all IRVs before their official release and certification for dissemination to smallholder farmers. For instance, SLARI, through their subsidiary RARC, has been the major source of all ROK rice varieties disseminated across the country. Similarly, NERICAs, although originally developed by the Africa Rice Centre, were identified to have been adapted by SLARI before dissemination to farmers by MAFFS and other actors. With the TP-R, SLARI was instrumental in conducting soil tests for JICA during the demonstration stage of the technology and was also identified to have been among the first institutions after NGOs to have conducted trials on the SRI innovation approach. However, SLARI's role in the ABCs was not specifically mentioned by respondents, which suggests a lack of, or weak, participation in this innovation. Finally, SLARI was the first public institution to conduct demonstration trials of SRI, primarily in a bid to ascertain yield claims of the innovation before scaling out to farmers.

The Sierra Leone Seed Certification Agency (SLeSCA), as a public institution, has not played a major role in the processes of the innovations studied within the time frame of the study (2005-15). It seems that most of the roles identified by respondents are anticipated to be played by SLeSCA in the near future in that the institution is yet at its nascent stages, established only a few years ago. However, its key role has been associated mainly with IRVs through the certification of seed before it is released to farmers for cultivation.

NGOs (both national and international) are another set of actors identified to have played important roles in the innovation processes of all the key innovations identified/studied. Notably, their involvement in the development, adaptation, and dissemination of these innovations differed among NGOs. Innovations largely promoted by them include IRVs and SRI. Although initiated by an NGO –

JICA – the TP-R was not found to have been well promoted by NGOs at the time of data collection. ABCs had minimal intervention from NGOs, such as COOPI and Catholic Relief Services (CRS), amongst others, in the provision of technical training to the managing committees, and establishing linkages with farmers. This is linked to the fact that funding for the establishment of the ABCs was channelled through MAFFS, who were the primary actors responsible for their functionality. A few years after establishment of the ABCs, other NGOs decided to contribute due to the many constraints associated with their functional utility. INGOs, including World Vision, Concern Worldwide, CRS, COOPI, BRAC, JICA, Engim, amongst others, have been key actors in the promotion of innovations such as IRVs and SRI, as have local NGOs, such as MADAM, GbonFA, ABC-Development, CIFD-SL, and Denbem Federation. The NGOs mainly serve as bridging agents providing mentoring services to smallholder farmers and enhancing the scaling up and out of these innovations. This is largely consistent with the literature, and indeed the proposed conceptual framework of the study that NGOs commonly known as civil society or private sector play an important role in innovation systems (Speilman and Birner, 2008; Mambo, 2014; Temel, 2002). However, Bhattacharjee and Saravanan (2014), in their study of stakeholders in SRI in India, found that the key actors there were the Ministry of Agriculture and farmers; NGOs were not involved, but it was emphasised that these actors were key in the initial phases of the innovation. Possibly, NGOs might have played a role in the latter stages of the innovation, though this was not mentioned in the paper.

Further, farmers, the ultimate target of any innovations, unsurprisingly emerged as another key set of actors identified to have participated in the innovation processes of those studied. Farmers, including community leaders/authorities, were largely associated with trying, modifying, and using the four innovations promoted by research and extension professionals at community level. They were also associated with mobilising colleague farmers at community level, however, differences existed across the four innovations studied. For example, with the IRVs farmers were also associated with the multiplication, preservation, and informal distribution of them (and other seeds) among colleagues, NGOs, and MAFFS, in their communities and beyond. With respect to ABCs, farmers' roles included the contribution of local materials to establish, manage, and ensure the function and sustainability of their operations by acting both as customers and owners. Undoubtedly, farmers are the primary target of all these innovations, therefore, they try, adapt, use, and distribute them accordingly. Farmers, therefore, play the roles of facilitators, communicators, collaborators, and users of knowledge.

International donor agencies including WFP, World Bank, ADB, AGRA, and FAO, amongst others, and international research agencies such as IRRI, IITA, Africa Rice, and Cornell University, were key actors identified by respondents to have also played a role in the innovations studied. As the name implies, donor agencies were identified as the key funders of most of the innovations promoted by research and extension professionals. Undoubtedly, innovations promoted by NGOs are largely, if not totally, donor dependent. For MAFFS, their establishment of ABCs was mainly funded by international donor agencies, including the World Bank, ADB, and FAO. WFP has also been instrumental in supporting the ABCs, and by extension farmers, by buying rice produce from them. This largely confirms the Sierra Leone Government's dependence on donor funding for the implementation of development programmes, and to which MAFFS is no exception. International research institutions, such as the International Rice Research Institute (IRRI), Africa Rice, and the International Institute of Tropical Agriculture, were the key research institutes identified to have played a role, particularly with IRVs. They have been collaborating with SLARI for the provision of capacity development support and, to some extent, funding of SLARI's activities. IRVs were originally developed by the Africa Rice Centre and later adapted by SLARI for onward dissemination across the country. This largely suggests the importance of international agencies in the innovation system of developing countries like Sierra Leone, consistent with Spielman and Birner (2008). Their willingness to fund development activities can affect the innovation capacity of research and extension actors, especially in a developing country like Sierra Leone which is highly donor dependent. Cornell University mainly provided technical support to ENGIM, an INGO based in Port Loko District, on the SRI innovation.

Traders/agro-dealers and other parastatals, such as the Seed Multiplication Project (SMP) and the West Africa Agricultural Productivity Programme (WAAPP), were other actors identified to have participated in the innovations studied, according to research and extension professionals. Traders were mainly associated with facilitating access to markets by smallholder farmers for the sale of their produce and purchase of inputs. Itinerant traders/agro-dealers were identified as key actors in innovations such as IRVs, ABCs, and TP-R as they enhanced farmers' access to inputs and also bought their rice products. However, there was no indication of any organised linkages between them and farmers or other actors in any of the innovations studied. Itinerant traders are value chain actors who can be useful in marketing, adding value, and processing rice in the innovation system, as indicated by Mambo (2014) and Spielman and Birner (2008). The availability of market facilities is an important component of innovation that contributes largely to its effectiveness. For instance, the lack of access to inputs or opportunities for the sale of outputs can serve as a constraining factor to smallholder farmers' innovative capacity.

Parastatals, such as SMP, were identified as important in the multiplication and dissemination of IRVs to farmers. They work in tandem with SLARI and MAFFS since they are partly funded by MAFFS for the implementation of their activities. On the other hand, WAAP has been largely involved in the scaling out of SRI practices to smallholder farmers since the start of their project in the country. They are the current MAFFS pioneered programme promoting SRI in the country, in addition to their other support activities in the sector. This shows the usefulness of parastatals in complementing the state institutions' efforts in development, including in the agricultural sector.

It is evident from the findings that the effectiveness of the innovation system has been largely affected by the thin and uncoordinated presence of some actors and their corresponding roles. The numbers of private sector actors, such as agro-dealers, marketers, processors, and transporters, are believed to be few. Their roles are uncoordinated and, therefore, they offer unreliable and often expensive services to smallholder farmers. Also, the role of universities in the innovation system was not distinctive in any of the innovations studied. This is evidence of a dysfunctional collaboration between agricultural universities in the country, such as Njala University, and the other actors in the agriculture sector.

9.1.2.3 The Linkages/Patterns of Interactions among the Actors of key Rice Innovations

The interactions among innovation actors in a social network were examined to understand the knowledge flows, identify central/key actors, and to see how farmers are connected to other actors in the system (Matsaert et al., 2002; Biggs and Matsaert, 2004; Hall, 2007; World Bank, 2007; Mohammad et al., 2012). Acquisition or transference of knowledge and skills in an innovation system is an interactive process that requires extensive linkages among a wide variety of actors (Hall et al. 2006). Understanding these interactions is, therefore, important in describing the innovation system at a given point in time. Linkages are considered important in the spread of stocks of knowledge (Rasiah, 2011) and they play an important role in establishing partnerships and cooperation with other actors, sourcing external knowledge and information, and securing funding for innovation processes (Ng and K, 2011).

In this study, the patterns, strengths, and purposes of linkages among actors on the four innovations studied were examined and synergized from a research and extension professionals' perspective, as outlined in Chapter 5. The aim was to better understand the interactions among the actors and the possible reasons they occur. Based on findings of this study, interactions appear to be concentrated among a few actors in the innovation system, while there seems to be marginalisation of others. For instance, interactions among public sector actors (e.g., MAFFS), NGOs, and farmers were the strongest. Knowledge flow among these actors seemed more effective compared to that between them and other actors, e.g., SLeSCA, universities, or marketers. Unsurprisingly, interactions and knowledge flow are strongest between public-sector actors e.g., between MAFFS and SLARI, compared to that between SLARI and farmers, for example, as evidenced by the strength and frequency of their interactions, and reported in Chapter 5. MAFFS and farmers emerged to be at the centre of interactions, as every other actor tends to interact with them in some way. Given the role of MAFFS in the innovation system, including agricultural policy formulation and enforcement, and being primarily charged with the responsibility of providing oversight in activities of other actors in the sector, most actors view them as important and may therefore feel obliged to link with them in some way to enhance their innovation processes.

Farmers are the primary target of all innovations promoted by research and extension actors and are, therefore, highly likely to be interacting with a variety of actors in the innovation system. Thus, they were identified to interact or link with research professionals, such as SLARI, traders, extension professionals (including those from MAFFS and NGOs), processors, and district council officials, amongst others, in order to either acquire or share knowledge, information, and skills. The only concern over their interactions with actors such as traders/marketers was the lack of coordination and reliability. Research and extension professionals have done little to strengthen their interactions, or make them more effective. This also brings to the fore the extent to which traders, amongst others, have been marginalised in the innovation process, and hence have contributed to slowing down the innovative capacity of smallholder farmers. Marketing services emerged as key constraints in the innovation system.

Similarly, NGOs emerged to have interacted strongly with diverse actors. NGOs are independent entities which usually strive to increase their visibility through networking and partnerships with other actors beyond the agriculture sector. In some cases, it is even obligatory for them to do so; for instance, all NGOs working or implementing programmes on agriculture are required by policy to not only register with MAFFS and the Sierra Leone Association of NGOs, but also to attend their monthly meetings, either at national or district level accordingly. Also, linking with diverse actors promotes their visibility and credibility to some extent, which in turn sustains their operations and life span through consistent funding opportunities for their interventions. Therefore, they seem to link with other actors whom they believe can provide them advantages to sustain their activities, consistent with findings of Ng and K. (2011), who found that innovation actors in Malaysia established links with other firms in order to increase their technological advancement, or to sustain their existence. For example, in the TP-R innovation process, JICA needed to establish linkages with MAFFS, district councils, farmers, community leaders, and traders (for the purchase of inputs for demonstrations), amongst others. The absence of these links may hamper their innovation processes. In fact, for SRI, NGOs had the highest number of linkages among actors in the innovation system compared to all other actors identified.

Other actors, e.g., SLARI, traders, processors, SLeSCA, generally had fewer linkages, thereby stemming their mandates and areas of interest. SLARI, for example, may have links with processors, traders, or SLeSCA in SRI innovation if there is no formal coordination of innovation activities among these actors. Similarly, traders may not be interacting with MAFFS or SLeSCA if there is no established platform for the promotion of the interaction of numerous actors in the innovation processes.

Further, the study identified the strengths and purposes of linkages which exist among the various innovation actors of the various innovations studied, and these were classified into three categories, strong, medium, or weak, consistent with Gervacio (2012). The higher the frequency and intensity of interactions or linkages between two actors, the stronger the linkage. Therefore, a strong linkage indicates a frequent interaction between those actors, and the reverse is true for a weak linkage. Interestingly, strong linkages were found to exist among the various government institutions identified by respondents across all the innovations studied. MAFFS, for instance, had a strong linkage with institutions such as SLARI, SLeSCA, and WAAPP on IRVs innovation processes, compared to their weak linkages with processors, for example. The strong linkages between MAFFS and other innovation system actors for all the four innovations studied were for various purposes, such as: funding; facilitating access to, and disseminating, innovations (e.g., new rice varieties); collaborating in project activities (e.g., ABCs, TP-R); networking through meetings and workshops; training; engaging in policy formulation; monitoring and coordinating activities, mainly with actors such as SLARI, SLeSCA, Africa Rice, Agro-dealers, NGOs, farmers, WFP, and district councils.

Similarly, SLARI was found to have strong linkages mainly with MAFFS, SLeSCA, and farmers, for purposes which included the researching and release of new rice varieties; convening and attending meetings, workshops and training sessions; facilitating uptake of new rice varieties; providing technical advice; and collaborating in project implementation with actors. The only NGO which had a strong linkage with SLARI was JICA on the TP-R, possibly due to their involvement in the pilot phase of the innovation in Kambia District. SLARI was identified to have taken part only in three of the four innovations studied. Medium linkages exist between SLARI and other NGOs which suggests limited interactions between these two; and weak linkages between SLARI and most other actors such as traders, processors, district councils, WFP, amongst others, across all the innovations studied. This is possibly due to reasons such as the lack of a common point of interest (Klerkx et al., 2012) as traders, for instance, would have no need for research services. SLeSCA consistently had a linkage strength pattern similar to that of SLARI, i.e., its services may be needed mainly by MAFFS and SLARI and maybe a few NGOs, hence weak linkages exist with the majority of actors, apart from those state actors involved in the innovation system.

NGOs, both local and international, had strong linkages with farmers across all the innovations studied. They had a strong linkage with MAFFS in the ABCs, but a medium linkage in the TP-R, SRI, and IRVs. This indicates that, although NGOs may be interacting with MAFSS in the latter innovations, their interactions may not be as frequent compared to those they have with farmers, for example. The innovations they promote are mostly aimed at farmers, and therefore, they have had frequent and intense interactions during the innovation process. In general, NGOs were found to largely have strong to medium linkages with other actors in all the four innovations studied, suggesting the existence of some form of interaction between NGOs and the majority of other actors in innovation processes. Such linkages with other actors were mainly for purposes of information sharing, dissemination, convening, partnering, coaching, reporting, and securing or providing funding, accordingly. Undoubtedly, these activities are essential for NGOs to promote their visibility, their impact on learning, and the sustainability of their interventions. For instance, sharing of information about what they do is vital in informing other relevant actors about their activities; disseminating and coaching helps them increase their impact, especially at farmer level.

Further, farmers were generally found to have strong linkages with most of the actors in the innovation system, including MAFFS, NGOs, and community leaders, amongst others, while weak linkages existed between them and SLeSCA, SLARI (in the TP-R), and donor agencies. Unsurprisingly, farmers seem to have a lot more in common with the two former agencies compared to the two latter. For instance, MAFFS and NGOs mostly targeted farmers directly and interacted more frequently and intensively at community level, compared to the way SLeSCA or donor agencies, like DFID or ADB, interacted with them. Donor agencies, for instance, interacted directly with institutions receiving their funds, and not necessarily with the farmers. Therefore, the strength of their linkages with actors such as NGOs and MAFFS may be stronger than that for other actors. The key purposes for smallholder farmers' linkages with other actors included facilitation of the exchange of information and access to inputs, processing, and marketing services; raised awareness; mobilisation of community members; and participation in meetings and coaching sessions. These purposes offered many of the reasons smallholder farmers interacted with a wide array of actors, particularly with research and extension actors, in their innovation processes.

For the remainder of the actors identified across the innovations studied, such as Cornell University, WFP, marketer/traders, SLeSCA, WAAP, amongst others, they emerged as having medium to weak linkages with other actors in the innovations with which they were associated. Their interactions were associated with a number of purposes, such as coaching/mentoring, facilitating marketing processes, disseminating and certifying seeds, receiving information, collaborating, partnering, and consulting. The reported weak and medium linkages existing among other actors to MAFFS, SLARI, NGOs, and farmers, suggest that the frequency and intensity of their interactions with other actors was low, possibly due to the lack of coordination of activities, or a lack of common interest in the innovation process.

9.1.2.4 Factors which Constrain the Effectiveness of the Innovation System on Rice in Sierra Leone

The effective functioning of an innovation system can be influenced by a number of structural conditions/factors, as presented in Section 5.4 (Schut et al. 2014). In this study, research and extension professionals in the public and private sectors were targeted, and FGDs and KIIs conducted for the generation of information to address the associated research questions. The study found a number of conditions which constrained the effectiveness of the innovation system among research and extension professionals in both the public and private sectors (NGOs). These have been generally classified as factors related to capabilities and resources, infrastructure, interaction and collaboration, institutions (Schut et al., 2014; Turner et al., 2016), and nature.

i) Capabilities and Resources Factors: The key capabilities and resources factors which constrained the effectiveness of the innovation system were human and financial capacity/resources. For innovation to occur, human resources constitute any successful innovation. The study found that research and extension institutions are constrained by the lack of a required human resource base and the capacity to enhance innovation. This is related to the key factors constraining the innovation system in the country, i.e., limited numbers of staff, along with the high numbers of ageing staff, particularly at MAFFS, poor training opportunities for staff, and illiteracy among the vast majority of farmers. The limited and ageing staff constrained the number and frequency of interactions between research and extension staff and farmers, as well as their ability to interact with other actors. This has also increased the ratio of farmers to extension professionals. The lack of training opportunities limits research and extension professionals' capacity to deliver as they lack up-to-date knowledge and the skills required for the effective execution of their roles. On the other hand, the literacy level of farmers was associated with its influence on farmers' capacity to understand and use farming-related ICTs and similar innovations, as well as a willingness to change from traditional methods of farming to improved methods.

Consistently, factors related to financial resources were identified by respondents as constraints to the innovation system in the country. They included the limited funding available for agricultural innovation programmes, and farmers limited access to financial resources. The study found that funding for agricultural innovation programmes is difficult to secure and is highly competitive, particularly for NGOs. Where funding is available, the terms of use are usually dictated by the donors, and therefore cannot be used, for instance, to initiate innovation programmes outside their requirements, even though they may encompass a more effective innovation system approach. This limits the innovative capacity of research and extension professional and the functioning of the innovation system. The same was reported for farmers who severely lacked sources of finance to engage in extensive agricultural activities, and thus possibly take risks and use innovations from external actors. In Sierra Leone, farmers lack insurance and access to formal credit facilities. These issues make it difficult for them to access the financial resources required to either scale up or to try agricultural innovations.

ii) Infrastructural Factors: The key infrastructural factors which constrained the effectiveness of the innovation system in the country, as identified by respondents, have been further classified by the researcher into communication, mobility, marketing facilities/services, tools/materials, and soil conditions, based on how they were reported by respondents.

Communication constraints were identified as contributing to the overall constraint of innovation processes as a system in the country due to the lack of, or limited, ICT networks and the related costs e.g., internet facilities, the lack of appropriate software for the processing of information, such as data analysis software for researchers, and the reported slow response of officials at national level at MAFFS. The lack of internet facilities was considered a key communication factor in that it affected the rate at which information can be shared, e.g., reports and best practices among innovation actors via emails and other internet related media, like Dropbox, are often not possible. This also limits opportunities for networking and the electronic receipt of feedback from field staff to their supervisors at national level, thereby constraining their innovation processes. However, this was mainly reported by staff in public sector offices, including MAFFS and SLARI. Researchers from SLARI also indicated a lack of software to facilitate the analysis of data, thereby inhibiting their research potential.

In the study areas, the vast majority of research and extension actors indicated they were constrained by the lack of mobility caused by the poor road networks, the lack of vehicles, and the non-existent budget for repairs. This was, however, a constraint reported mainly by public sector actors, especially MAFFS. With the lack of vehicles to facilitate movement of research and extension actors, their interaction with farmers and other actors is severely interrupted, and thus their effectiveness is limited. Furthermore, the bad road conditions contribute to frequent wear and tear of the few vehicles at their disposal, as well as constraining other actors, like traders, to access farmers in their communities. Public transporters may also shy away from using these roads, thereby contributing to the weakened innovative capacity of farmers, and all other actors in the country, as a result of immobility and the subsequent lack of frequent and effective interactions.

Market facilities or services were also identified and considered a key infrastructural constraint limiting the effectiveness of the innovation system on rice in Sierra Leone. Markets, for both the sale of outputs and purchase of inputs, are grossly lacking in the country, particularly at community level. The study found that most agro-dealers or traders are based in headquarter towns where smallholder farmers find them difficult to access. The few traders who do venture into farmers' communities charge exorbitant prices for their inputs and buy rice products at very low prices. The ABCs, which were constructed to remedy this problem, are few and far between. Farmers and other actors, therefore, remained constrained in their access to markets, thereby weakening their innovation capacity. However, it can be argued that most traders are profit driven, therefore, given the financial status of most smallholder farmers in Sierra Leone, they normally lack the capacity to buy inputs in large quantities, or even pay cash for inputs. This may have contributed to the limited presence of traders or agro-dealers at community level as they may perceive it would not be cost effective to transport inputs at community level only to find a few farmers who are able to buy with cash.

The tools or materials necessary for increased innovative capacity of smallholder farmers and research and extension actors were found to be constraining the innovation system. The lack of spare parts for agricultural machinery, such as rice mills, and the inadequate, or lack of, post-harvest facilities were identified to be key constraining factors. Post-harvest innovations, such as the ABCs, require the continual replacement of spare parts which were reported to be inaccessible by smallholders at community level. Post-harvest processing facilities were also found to be exceptionally low in their number, making it challenging for smallholder farmers to use innovative methods for the processing of their rice products. Also, respondents indicated the smallholder farmers' high dependence on crude tools, such as cutlasses and hoes, and manual post-harvest processing techniques, such as rice milling and threshing, which constrained their ability to try innovations on rice cultivation. For instance, if farmers lack the appropriate tools for swamp development, they may find it hard to try SRI or TP-R techniques. Also, if machinery in the ABCs are defective due to the lack of spare parts, farmers may find it challenging to try the innovative methods of rice processing that the ABCs offer. Therefore, the lack of the appropriate tools and materials are considered infrastructural factors which constrain the innovation system in the country.

Similarly, the soil conditions in the study areas were found to be important infrastructural factors which affected the innovation of smallholder farmers. Most soils in the country are perceived to be depleted, that is, they lack the fertility level to accommodate the cultivation of rice without dependence on fertilisers. These constraints have led many farmers to carefully select local varieties that seem to do well in such soils; this limits the willingness and ability of the smallholder farmers to try innovations, like new rice varieties, which require the use of fertilisers due to the associated cost and the scarcity of fertilisers in their communities. Further, the lack of developed swamps in the country has been a huge constraint to smallholder farmers trying, or using, innovations such as SRI or TP-R on their farms. The way the innovation system functions in the country means not all the constraints on the farmers can be removed.

iii) Interaction and Collaboration Factors:

The effectiveness of the innovation system is largely determined by the level of collaboration and interaction among the various actors; limitations in this area can play a huge role in hindering its function (Klerkx et al. 2012). The key constraining factors in this regard, discussed in Section 5.4.4, included the difficulties associated with getting farmers to participate in group work, the lack of trust among actors, poor partnerships, poor coordination of the agricultural activities of the various stakeholders, and poor cooperation of farmers in innovation programmes. These are the most important factors identified. If farmers are unwilling to work with others (e.g., not participating in group work), and do not trust other actors, such as research and extension actors, the achievement of a well-functioning innovation system becomes challenging, consistent with Hall et al. (2006). This is simply due to the fact that participation in innovation programmes is limited, which in turn makes it impossible for the farmers to learn new ways of operating or to share their experiences from which others can learn. Similarly, poor partnerships among innovation actors, such as between different research and extension organisations, has the tendency to limit learning and sharing of innovative ideas among actors, hence, this also constrains the effective functioning of the innovation system. Also, in cases where the activities of various actors in the innovation system are poorly coordinated, their interactions are consequently limited, thereby the sharing of useful knowledge, experiences, and best practices among innovation system actors is limited, and this increases the chances of doubling efforts in a few localities and leaving out others. In summary, all the factors identified by respondents in this category can largely hamper the level of interaction and collaboration among innovation actors, and can therefore constrain the effectiveness of the innovation system on rice generally.

iv) Institutional Factors:

Institutions normally determine the “rules of the game” in the innovation system (Klerkx, 2012). The key institutional factors identified included: ineffective policies on decentralisation; salaries; the price of agricultural produce and honorarium; divergent organisational interests/objectives; poor monitoring and evaluation structures; and bureaucracy. These factors were seen to hamper innovation processes, particularly among research and extension actors, and are mostly hinged on policies of the public institutions, particularly those of MAFFS.

MAFFS’ policies on decentralisation which devolve the disbursement of funds to the local councils at district level has not been as effectively handled by the district councils as expected. This has been associated with undue delays in getting the line ministries of MAFFS access to funds for implementing their programmes, and hence an overall delay in implementing innovative programmes with farmers. The key problem with this is the lateness in securing the necessary inputs, and implementing activities at the right time by taking into consideration the farming calendar. Farming in the country is largely rain-fed, therefore agricultural activities should normally follow a strict calendar in order to realise maximum outputs. The delay in the access to funds by MAFFS officials at district level is considered an institutional factor that has contributed to weaken innovations on rice as it limits their timely interventions at community level for mentoring of farmers, amongst other activities.

Further, the salary structures at MAFFS, compared to other organisations, has been a major reason for the attrition of talented staff in search of better paid jobs, contributing to weakening the institutional innovative capacity of MAFFS, and thereby limiting the effectiveness of the innovation system. On the other hand, the public-sector institutions, including MAFFS and SLARI, policies on honorarium per day has been identified by their counterparts in the private sector as high and demotivating. The perceived high honorarium for engaging public sector staff has contributed to NGOs refusals to collaborate with them in innovation processes as they find it too expensive to do so. This contributes to lessening the frequency of interactions between public and private sector actors, and thus has an overall impact on the effectiveness of the agricultural innovation system in the country.

The lack of pricing policies for agricultural produce means that farmers are at the mercy of traders who arbitrarily determine prices at the farm-gate to their advantage, leaving farmers in constant touch with poverty. This affects their motivation and their ability to try innovations, like NERICA, which requires a reasonable amount of capital for cultivation, hence, affecting the innovation system at macro level.

Also, the weak monitoring and evaluation structures, and the high levels of bureaucracy were identified as important institutional factors which impact the effectiveness of the innovation system on rice. Weak monitoring and evaluation can contribute to poor implementation of innovation programmes and a consequent low quality in their impact on smallholder farmers and/or other actors. Bureaucracy, on the other hand, limits the pace of programme implementation as it tends to centralise decision-making in some way and lengthens the communication process. Innovation decisions which could otherwise be taken at field level, for instance, may need approval from senior management level who are mostly based in cities. This slows innovation processes and could impact the effectiveness of the overall innovation system.

Further, the diverging organisational objectives of research and extension actors makes it difficult to collaborate in innovation programmes as the interest of one actor could be completely different from the other. However, this is somehow obvious as the interests or objectives of a research institution could be different from the objective of a trader or extension organisation. The only problem this may pose could be related to instances where an actor may be completely disinterested in collaborating in an innovation platform due to the lack of interest in the problem it sets out to solve. For instance, a trader may not be willing to participate in an innovation platform geared towards addressing a problem faced by smallholder farmers.

These institutional factors have contributed to the constraints to the innovation system on rice in the country as disclosed by the research findings.

v) Natural Factors: The key natural factors identified to be affecting the functioning of the innovation system in the study areas were largely climatic. They have been classified as natural by the researcher in that they are beyond the control of humans. Key in this regard are: heavy rainfall and natural disasters e.g., floods; inconsistent rainfall; and increases in temperatures. In some cases, heavy rainfall affects farmers' innovation processes in that it disrupts planting activities of rice seedlings, for example, heavy rains are normally accompanied by floods that can erode the newly planted seedlings. In most cases, this can disrupt farming activities of some farmers if the erosion happens to affect large quantities of newly transplanted seedlings, more so if the farmer lacks the financial capacity to buy replacement seeds for those lost. Inconsistency of the start of rainfall and high temperatures were also reported to affect smallholder farmers' innovation processes on rice as they interrupt the start of farming activities e.g., rice cultivation and the subsequent yields. In cases where farmers are trying a new variety of rice, for example, this may blur the potential benefits or usefulness of that rice variety to farmers, and thereby result in farmers who would otherwise use the innovations deciding not to do so. It is on this basis that the researcher has thought it prudent to include natural factors as a category of factors constraining the innovation processes in the country.

9.2.2 Beliefs and Attitudes of Research and Extension Professionals influencing the use of an AIS Approach in Sierra Leone

This chapter discusses the results presented in Chapters 6 and 7. These chapters made use of the TPB model to explore research and extension professionals' attitudes and beliefs which influence the use of an AIS approach in innovation processes, as well as the facilitation of complex and dynamic interactions among diverse stakeholders as a key behaviour of a functioning AIS approach. The TPB predicts people's intentions to perform a behaviour based on their attitudes towards it, their perceived behavioural control (perception of how easy or difficult it is to perform the behaviour), and the subjective norm (social pressure to perform the behaviour).

9.2.2.1 Intentions

As presented in Chapters 6 and 7, the study sought to understand respondents' intentions towards the use of two behaviours, the use of an AIS approach and the facilitation of complex and dynamic interactions. The latter was studied as a component of the former, therefore, much of the discussion here is focussed on the former behaviour – the use of an AIS approach. Three TPB constructs were examined – attitudes, perceived behavioural control (PBC), and subjective norms (SN) – particularly in relation to the respondents' intentions to exhibit these behaviours.

Overall, the majority of respondents had strong positive intentions to use an AIS approach and facilitate complex and dynamic interactions. Out of a range of -2 to +2, the mean intentions of respondents to exhibit both behaviours were 0.83 and 0.73, respectively. These means are both very close to 1, which shows a high degree of intention of respondents to exhibit the behaviours. Also, more than half the respondents claimed they intended to use each of the behaviours; 63.1% agreed or agreed strongly to use an AIS approach, while 70.8% agreed or agreed strongly to facilitate complex and dynamic interactions. These results indicate respondents' favourable beliefs towards the use of an AIS approach. An examination of the relative contributions of the three TPB constructs studied in relation to respondents' intentions show very interesting results. There was a positive and significant association between respondents' attitudes, PBC, and SN with their intention to use an AIS approach. However, regression results showed that respondents PBC had the highest influence on their intention to use an AIS approach, followed by their SN, and then attitude. This is an interesting finding which suggests that despite the very positive attitudes of respondents towards the use of an AIS approach, they still may not use it due to the perceived difficulty of its use, and also that its use is highly contingent on the decisions of people who respondents consider important in their social networks, such as their employers, donors, and supervisors.

9.2.2.2 Attitude

The study found a positive and significant association between respondents' attitudes and their intention to use an AIS approach ($r=0.424$; $p<0.001$), and between their attitude and intention to facilitate complex and dynamic interactions ($r=0.440$, $p<0.001$). Also, the mean attitude of the respondents towards the use of an AIS approach was very high (1.53 out of a range of -2 to +2), and 93.4% of respondents claimed to have a positive attitude towards the use of an AIS approach. This suggests that research and extension professionals are largely in support of participatory approaches (such as AIS) which involve the engagement of diverse actors in innovation processes, and that there is an increased awareness of the importance of the use of AIS approaches in research and extension programmes. A more positive attitude towards its use and the facilitation of complex interactions is necessary to enhance the design and implementation of sustainable agricultural innovations among smallholder farmers (Klerkx et al. 2012; Hall et al., 2007). Further, this suggests that there was some level of acceptance that the success of agricultural innovations is not only a function of research and extension professionals, but rather that a multitude of diverse actors beyond research and extension are involved.

However, although the stated attitude of research and extension professionals towards the use of AIS is positive, signifying a willingness to use AIS approaches, a number of scholars have indicated that research and extension actors still adhere to top-down approaches in innovation processes (Roling, 2006). Findings from this study support this (see Chapter 6). This is consistent with claims in the extant literature that the use participatory approaches has been used cosmetically, even mechanically, due to actors' motivation towards other goals, which significantly differ from increasing the innovative capacity of farmers (Mosse, 2013). They normally use them to meet other requirements (such as job targets and donor requirements) and, to a lesser extent, meeting the local needs of smallholder farmers (Chambers, 2005; W.M. Wilson, 1991; Rivera, 2003).

Further, the study found that the favourable attitudes towards the use of an AIS approach were a result of the beliefs that an AIS approach:

1) increases productivity and profitability of innovations for farmers;
2) increases the attainment of food security among smallholder farmers;
3) enhances the effectiveness and sustainability of innovations on rice;
4) fosters capacity development of stakeholders, including farmers;
5) improves smallholder farmers' access to input and output markets;
6) enhances experience sharing and best practices among different actors;

7) reduces burden on any one actor; and
8) increases the ability of agricultural innovation actors (including farmers) to innovate.

On the other hand, the study found beliefs that could serve as barriers for research and extension professionals to use an AIS approach in innovation processes. These included:
1) difficulty associated with the coordination of activities of the various stakeholders in innovation processes;
2) difficulty associated with the use of an AIS amidst actors with differing interests;
3) the use of an AIS approach being time consuming;
4) AIS being expensive to adopt; and,
5) difficulty of its use when not supported in one's organisational policies.

Similarly, the facilitation of complex and dynamic interactions could be impeded by the following beliefs:
1) difficulty associated with obtaining the commitment of diverse agricultural innovation stakeholders;
2) the perceived differing interests/objectives of diverse innovation stakeholders; and
3) the perceived general difficulty associated with mobilising innovation actors for complex and dynamic interactions.

These beliefs were identified as drivers (or barriers) and present opportunities if they could be strengthened (or dealt with in the case of barriers) among research and extension professionals. According to Garforth et al., (2006), if the driver of a behaviour is strengthened in a particular population, more people will adopt the behaviour. Therefore, these findings suggest that as the government seeks to institutionalize the adoption of an AIS approach in the research and extension programmes in the country, they will need to increase awareness of the advantages of using an AIS approach in research and extension, especially to those in senior management positions who can influence organisational policies and decisions.

9.2.2.3 Subjective Norm

The study found that a positive and significant association exists between respondents mean stated SN with intention to use an AIS approach ($r= 0.438$, $p<0.001$), and facilitation of complex and dynamic interactions among diverse actors ($r=0.546$, $p<0.001$) by research and extension professionals in innovation processes. Also, a positive and significant association exists between respondents' calculated SNs and their intention to use an AIS ($r=0.453$, $p<0.001$), as well as the facilitation of complex and dynamic interactions among diverse actors ($r=0.546$, $P<0.001$). This suggests that social pressure, particularly the opinions of employers, donors, and supervisors, was associated with actors' intentions to use an AIS approach in their innovation processes in the next year, including the facilitation of complex and dynamic interactions. As suggested in the literature (e.g., Garforth et al., 2006; Rehman et al., 2007; Kautonena et al., 2011) the extent to which one is motivated to comply with the different social referents can be used to suggest channels and sources which are likely to have greater impact on them performing the behaviour. This is an implication that these referents, particularly employers, donors, and supervisors, can be targeted as channels for the effective institutionalisation of the use of an AIS approach, and its behaviours, among research and extension professionals in both the public and private sectors. This is so because the activities and behaviours of research and extension actors may be largely influenced by decisions or directives from these referents, meaning field level staff, for example, can only do what has been approved by their donor, employer, or supervisor.

9.2.2.4 Perceived Behavioural Control

Findings from this study showed a significant and positive association ($r=0.440$, $P<0.01$) between research and extension actors PBC and their intention to use an AIS approach in the next year. This suggests that control factors, i.e., those that can encourage or discourage successful performance of a given behaviour, are important in encouraging research and extension professionals to use an AIS approach in their innovation processes. Included are factors such as their confidence, the ease of use of the innovation, and the level of control these professionals have over decisions in the use of an AIS approach in their programmes. This means these factors can positively influence their intention to use an AIS approach, if present. On the other hand, the calculated PBC was mildly negative (-0.156)**,** with a positive but insignificant association ($r=0.141$, $p<0.01$) with research and extension professionals' intention to use an AIS approach in innovation processes. This implies that control factors measured by the calculated PBC are not greatly important in discouraging respondents from using an AIS approach. However, factors such as having adequate financial resources, or the lack of such resources, emerged as having the potential to negatively influence actors use of an AIS approach in research and extension programmes. Meanwhile, factors such as having the knowledge and skills to implement an AIS approach, institutional policies supportive of its use, the cooperation and behaviour of other actors, and the favourable cultural norms of smallholder farmers can all positively influence the intention of research and extension actors to use an AIS approach.

With respect to the facilitation of complex and dynamic interactions, a negative but insignificant association ($r=-0.182$; $p<0.01$) exists between research and extension professionals' intentions and such facilitation among diverse actors. This suggests that the control factors involved are not hugely important in discouraging those professionals' intentions in this regard. On the other hand, the calculated perceived behavioural control was also mildly negative (-2.73), with a negative and significant association (r=-0.419, p<0.01) with respondents' intentions to facilitate complex and dynamic interactions. This implies that the control factors measured by the calculated PBC for this facilitation are important in discouraging these respondents from such interactions. These factors include the lack of capacity to facilitate complex and dynamic interactions, the lack of adequate financial resources, and the lack of cooperation from, and the behaviour of, other actors. These findings are consistent with the literature which has reported factors such as the lack of financial resources, inadequate managerial support, the lack of incentives for research and extension professionals, and the lack of confidence in oneself or others to constrain the functioning of agricultural innovation programmes (Hall et al., 2006; E.K. Davis, 2008).

9.2.3 The Influence of Research and Extension Programmes on Smallholder Rice Farmers' Innovation Processes

This section discusses the findings reported in Chapter 8 with the key objective to assess the influence of research and extension programmes on smallholder rice farmers' innovation processes. The key themes discussed here are: the socio-economic characteristics of smallholder farmers in the target communities; the key innovations farmers have effected in the past ten years (2005-15) in their farming systems; the key drivers for these innovations; the actors involved and their roles; the key constraints farmers face in their innovations; and the key factors which limit farmers' capacity to innovate.

9.2.3.1 Socio-economic Characteristics of Respondents

Consistent with Mahmood (2005) and Kamara (2009) who have conducted studies on rice in Sierra Leone, this study found that the majority of respondents were males within the age bracket (31-40 years) for productive agricultural activities. However, illiteracy is highly prevalent among respondents and this has implications for their ability to use innovations which may require basic numeracy and literacy skills, such as row planting in SRI as it requires basic measurement skills. In fact, this study found farmers' illiteracy to be one of the constraining factors limiting the innovation system in Sierra Leone identified by research and extension actors (see Chapter 5). Married respondents are in the majority; in Sierra Leone farming capacity is usually associated with the household labour force, hence, the reason for most marriages – usually polygamous – is to increase the productive capacity of most farming households. This is also a possible reason for the large household sizes of the target respondents as evidenced in this study. This is largely related to the huge financial constraints faced by most farming households in the country. Their financial inability to hire labour means they largely depend on their family members (Conteh, 2003), who are unpaid for their services.

The targeted households were mainly male-headed, agriculture being the major source of livelihood. This implies that decision making largely rests on the men, which may affect the ability of their female counterparts to make decisions related to agricultural innovations in these households. This is supported by findings reported in Chapter 8, as the majority of respondents indicated that men largely make any innovation-related decisions in the household, e.g., where and what to farm. It is surprising that the majority of farmlands were found to be individually owned, suggesting a shift from communal or familial owned lands, which were highly prevalent in Sierra Leone, to individual ownership. This implies that farmers now use their land for innovation purposes without fear of losing it, as may occur under rented, communal, or forms of ownership which normally restrict the use of land. This serves as a disincentive for innovation, particularly that which may require significant permanent changes to the land e.g., swamp development, as in TP-R and SRI innovation packages.

Respondents use their produce primarily for consumption, denoting the subsistence nature of farming in Sierra Leone. The majority of farmers cannot produce enough surplus for sale, therefore, selling farm produce is only a second option for them. In fact, most farmers participate in both crop production and animal husbandry. Animal rearing is a common practice among the majority of smallholder farmers as they normally revert to animal income in lean periods – usually between June and September when all their produce has been exhausted – for their sustenance. However, food production in Sierra Leone is not regarded as a guarantee of access to sufficient food as only 6% of rice cultivators can rely on their produce to feed their family for the entire year (WFP, 2011).

Rice remains the most dominant crop grown by the majority of farmers in both lowland and upland ecologies, although it is more dominantly grown in lowlands. This finding is consistent with reports (e.g., Bangura, 2006; MAFFS, 2015; Kamara, 2009) that rice is the most dominantly grown crop, followed by cassava, potato, and groundnut. This also justifies research and extension professionals targeting of rice as a key crop that requires innovative production and processing methods.

Household incomes were higher in the dry season ($US47.013) than in the rainy season ($US35.707), with a generally low household income; this implies a potential constraint to the quality of improved farming inputs or innovations for intensive and or extensive rice cultivation, as farmers cannot afford them. Consistently, the study found the lack of financial resources as a key constraint (see Chapter 5) limiting innovation systems on rice.

Certainly, poverty was rife in the target districts. The majority of respondents live below the national poverty line, with the highest incidence in Tonkolili District and the lowest in Port Loko District. Port Loko district on the other hand, reported the highest number of people living above the poverty line, while Tonkolili District had the least. Also, the majority of respondents live above the national food poverty line with Port Loko District having the highest number of respondents in this condition, followed by Kambia, Koinadugu, and Tonkolili respectively. This is consistent with findings of the WFP (2011) that Tonkolili is the least food insecure compared to the other three study districts, but it is only the order of food insecurity among the four districts that differs. Similarly, estimates based on the international poverty line of US$1.25/day showed that the majority of respondents in the four districts live below this line. Tonkolili District had the highest number of respondents in this condition, followed by Koinadugu, Kambia, and Port Loko District. These findings suggest that poverty is rife in the target districts of the study, however, respondents are better-off in terms of access to food than to finance. Also, the incidence of national and international poverty in the four districts studied differs, with Tonkolili being the poorest, followed by Koinadugu, Kambia, and Port Loko. These findings are consistent with reports from the World Bank (2013) and WFP (2011).

In general, many studies in various part of the world have revealed similar findings with regards to the socio-economic characteristics of farmers, including: the predominance of male respondents and male headed households; high illiteracy; the majority being within the most active age bracket (i.e., 31-40); free/individual land ownership; large household sizes; and low household incomes (Mahmood, 2005; Kamara, 2009; Garba et al., 2011; Oluwatusin and Shittu, 2014; Yoganarasimhachari and Vijayalakshmi, 2014; Mooventhan et al., 2015). These have implications for agricultural innovation. The predominance of male-headed households means decision making processes are mostly influenced by males in most farming households. This may limit the innovation capacity of their female counterparts due to their reduced capacity to make decisions in the household.

9.2.3.2 Smallholder Farmers Innovations in the Past Ten Years

The study identified a number of innovations that smallholder farmers have effected in their farming systems over the past ten years (2005-15). These were divided into pre-production, production, and post-harvest innovations. The key pre-production innovations included the use of improved and local rice varieties for cultivation. Among the IRVs cultivated, NERICA emerged as the most popular variety in all the four districts when compared to others, such as the ROK series. Unsurprisingly, NERICA has been one of the major rice innovations promoted by both the public and private sector actors in the country. MAFFS, for example, has been promoting NERICAs through a nationwide programme, begun in the early 2000s, through the Multinational Nerica Rice Dissemination Project (MNRDP), and again recently for the Ebola Virus Disease recovery programme in all districts in the country (MAFFS, 2010; Kane, 2012; KII-KOD-ExtM). The dissemination of NERICAs, in particular, was due to the many advantages advanced in the extant literature (e.g., WARDA, 2002; 2009) that

NERICAs have over traditional rice varieties, such as being high yielding and resistant to drought and disease. Therefore, research and extension actors believe it to be the best variety to remedy smallholder farmers' production problems. However, it is interesting to learn that the majority of smallholder farmers grow local varieties, either in addition to improved ones or exclusively, and, most importantly, these local varieties did not originate from research and extension actors, a point confirmed in Chapter 5 by those research and extension professionals themselves. Local rice varieties were the most popular among respondents in the study area, compared to IRVs promoted by research and extension actors. This implies that research and extension actors should also pay attention to identifying and disseminating the local rice varieties that farmers prefer in their localities, instead of trying to promote those they believe farmers should grow; but more so, they should strengthen local channels for seed distribution through farmer-to-farmer networks as a key mechanism through which seeds can be spread (Jones et al., 2001; Doward et al., 2007).

Further, farmers indicated they used a number of production innovations promoted mainly by research and extension actors in their communities. The top agronomic innovations that revealed the highest rate of acceptance or use among farmers included, in the order of their popularity: puddling; weeding of inland valley swamps (IVS) and land preparation before nursery planting; shallow planting of seedlings; a reduced number seedlings planted per hill; reduced nursery time for seedlings, i.e., early transplanting of seedlings from the nursery to the farm (IVS); increased spacing between seedlings; construction of bunds, water control, and swamp development; the use of chemical and organic fertilisers; priming of seeds before planting; crop rotation; and fencing around farms. Also, the majority of farmers indicated they had reduced the number of days before transplanting their seedlings, with majority doing so after 21,14, or 30 days, respectively; while the majority have also reduced the number of seedlings per hill to two or three; none indicated they planted one seedling per hill.

A number of implications can be deduced from these findings. The first is that farmers can adopt and adapt innovations, stimulated in their communities by external actors, based on their needs and resources (Kiptot et al., 2007). The innovations highlighted are derived from two separate innovation packages promoted by research and extension actors – SRI and TP-R. Farmers indicated that they use most of the techniques promoted by the innovations, but not all. Techniques such as planting of one seedling per stand, the use of weeders, and row planting, amongst others, are some of the techniques promoted by SRI, but which have not been used by farmers. This means they have only used those techniques they find useful, affordable, and/or easy to use in their farming operations. This is consistent with findings in the literature that farmers use or reject technologies based on their complexity, usefulness, affordability, and availability (CIMMYT, 1993; Kiptot et al., 2007; Chi, 2008). Secondly, these findings suggest that techniques promoted by the TP-R have a higher acceptance rate among farmers than those of the SRI innovation package. However, given the close similarity between the two innovation packages, it can be argued that TP-R appears to be a modification of the SRI, except that the former has a post-harvest component, while the latter does not.

Additionally, the key post-harvest innovations used by more than half of respondents in the past ten years included early threshing of their rice paddy after harvest, storing threshed rice in town instead of in the bush, and using rice mills as opposed to manually pounding the rice paddy. Further, the storing of rice paddy in jute bags with wood ash, the use of drying floors, treating the rice paddy with pepper, and storing rice seeds in locally-made baskets were also often mentioned by respondents as post-harvest practices they have effected in their farming system within the last ten years. However, post-harvest innovations relating to ABCs (such as storing rice in an ABC, rice sales through an ABC, and the use of threshers at an ABC) were only minimally mentioned by a few respondents. This implies that post-harvest techniques promoted through the TP-R have been used more by farmers compared to those of the ABCs. This is surprising in that the ABCs were a flagship innovation programme of the government aimed at ameliorating the many processing and marketing constraints smallholder farmers face in the country (SCP Investment Plan, 2010). The only ABC-related innovation that was mentioned to any extent was the use of rice mills. However, before the advent of the ABCs, rice mills were privately owned, or provided to farmers by NGOs, and this would have contributed to their popular use by respondents in the past ten years in the target districts.

9.2.3.3 Drivers of Innovation among Smallholder Farmers

The study elicited a number of drivers stimulating smallholder farmers' willingness to try and use new methods, techniques, and or technologies (innovations) in their farming systems. Consistent with the innovation categorisation, the key drivers were also categorised into pre-production, production, and post-harvest drivers. The drivers basically denoted the reasons for smallholder farmers' use of the innovations they indicated to have used in the past ten years. The key pre-production drivers identified were: better tillering and growth qualities of the seed varieties; the potential to increase household income; the early maturity of the varieties; the potential to improve household food security; yield/productivity; the good taste of the varieties; the opportunity to undertake double cropping and to grow vegetables earlier than usual. Indeed, the key drivers for the farmers' use of production technologies were not markedly different from the pre-production drivers and included, in order of the number of responses: increased yield; the tillering ability of seedlings; improvement in the germination rate of seeds; enhancement of the growth rate of seedlings; minimisation of wastage of farm inputs; reduction of pest infestation; improvement in soil fertility; and enhancement of double cropping. This suggests that most smallholder farmers use new rice varieties and agronomic techniques and methods for the same or similar reasons, and that most of the drivers for smallholder farmers are yield and income related. For instance, farmers believe that if they can undertake double cropping and can reduce wastage, if their seeds grow healthily, pests are eliminated, and soil fertility improved, their productivity levels will increase and subsequently their income, and by extension, their food security status. With respect to post-harvest innovations, the key drivers for farmers' use of these included: the reduction of post-harvest losses and the drudgery associated with manual pounding of rice; improvements in the viability of rice seed; and reductions in the risks posed by pests and thieves. These findings are consistent with findings in the extant literature (e.g., Kiptot et al., 2007; Kamara, 2009; Gabb, 2012; Senthilkumar and Manivannan, 2012; Lalani et al., 2016; Mango et al., 2017). It can also be noted here that these drivers are in line with those highlighted by research and extension actors' promotion of these innovations to smallholder farmers (see Chapter 5).

9.2.3.4 Actors Influencing Smallholder Farmers Innovation Processes and their Roles

The key actors/facilitators of innovation in the target communities were examined by the extent to which they were helpful, important, or were a source of information for smallholder farmers. The study found that farmers identified a number of key actors as the primary facilitators of innovations in their communities. These included the farmers themselves, NGOs, MAFFS, the media (radio), itinerant traders, agricultural research officers, and district council officials. Farmers were divided into a number of cadres which included lead farmers, i.e., farmers who also double as community authorities in their communities, and farmers from neighbouring communities. Also, a diverse number of NGOs were identified to have played a key role in promoting innovations in smallholders' communities. These can also be broadly categorised into local and international NGOs. However, some actors were more prominently recognised by smallholder farmers than others, primarily due to their actions in the target communities. For instance, actors such as MAFFS, NGOs, and farmers themselves, were key in the innovation processes in all the target communities. Bhattacharjee and Saravanan (2014) similarly found MAFFS and farmers to be key actors in the promotion of SRI innovations in India. MAFFS for example was highly recognised for the ABCs, the TP-R, and IRVs; while NGOs, such as Concern Worldwide, CRS, World Vision, JICA, BRAC Sierra Leone, CARE SL, MADAM, GbonFA, ABC-Dev, ENGIM, were recognized for innovations such as SRI, IRVs, and TP-R. These findings suggest the pluralistic nature of the extension services given the many NGOs participating in the promotion of selected innovations in different parts of the country. In the literature, reports have shown the Ministries of Agriculture, NGOs, private traders, the media (radio), and researchers to be actors in key innovation processes in different parts of the world (World Bank, 2007; Gabb, 2012; Bhattacharjee and Saravanan, 2014). In fact, Gabb (2012) found that newspapers were also mentioned as actors facilitating innovation processes through up-to-date information services to farmers, which is not the case in this study. However, the actors identified in this study were regarded by farmers as being helpful, important, and informative with regard to their innovation processes in their communities. They were seen to perform key roles, including sharing of information, mentoring and advising, enhancing access to seeds and other inputs through in-kind exchange (Dorward et al., 2007), and sharing general information on agriculture.

In a bid to further understand the innovation processes of smallholder farmers, the study identified and analysed the key gender roles played by the various household members. The key findings were that men were mostly responsible for making decisions on where to farm, changes to the way they farm (innovate), and the time to sell their produce, as well as how much of it to sell. Decisions normally made jointly by men and women included where to farm, changes to the way they farm, and again, the best time and amount to sell. Similarly, men were found to mainly do brushing of farms, digging/ploughing, puddling, preparing the nursery, controlling the proceeds/income from household farms, and controlling over-use of produce in household. Meanwhile, women were found to mainly undertake weeding and to make the choice of to whom to sell, they were also largely associated with milling/pounding and transportation of rice paddy to market. Children were mostly associated with activities such as milling/pounding of the rice paddy and its transportation from home to market. Activities that were largely identified to be carried about by men, women, and children jointly included transplanting, harvesting, threshing, transporting the rice paddy from farm to home, and uprooting seedlings from the nursery. These findings are consistent with the extant literature (e.g., Ahmad and Ismail, 1998; Grace, 2004) which claims that men normally perform tasks that are deemed to require technical and operational skills and muscle strength, and that men are mostly in control of resources and decision making in most farmers' households; meanwhile, women undertake repetitive, tedious, and time-consuming tasks. This largely implies that the innovation capacity of women in traditional farming settings in Sierra Leone is limited due to their limited capacity to make decisions and their lack of control of productive resources. Also, these findings suggest that children play a critical role in smallholder farming in rural Sierra Leone, and perhaps in similar developing countries in the world.

9.2.3.5 Constraints Smallholder Farmers Face with their Innovations

Farmers identified a number of constraints they face with the innovations they indicated to have been using in their faming systems. These constraints were classified into pre-production, production, and post-harvest constraints. Pre-production constraints are those related to seeds, both IRVs and LRVs. With respect to IRVs, the major constraints identified by respondents included: the scarcity, and correspondingly high cost, of the seeds; the fertiliser requirement for their cultivation and the related cost; their susceptibility to pests and disease; their inability to withstand too much water compared to some local varieties; rigorous management practices; and the requirement for much weeding. The use of LRVs was mainly associated with constraints which included: low quality seed; low yield; scarcity or unavailability of some varieties; and the scarcity and cost of fertiliser. Differences exist in the constraints farmers face between IRVs and LRVs. The lack of seeds, accompanied by their high cost when they can be accessed, fertiliser requirements for their cultivation, and susceptibility to pests and disease were the key constraints that have affected smallholder farmers use of IRVs in their farming systems. Meanwhile, the use of LRVs was mainly associated with constraints such as low seed quality, low yield, and the scarcity of some varieties . This implies that farmers' use of IRVs could be limited by the high cost and scarcity of the seeds and of fertiliser. This may also be one of the reasons responsible for some farmers' use of local rice varieties as they find it challenging to access the improved ones, such as NERICA, due to the cost associated with their acquisition and cultivation. On the other hand, the low yield and poor quality of seeds of local rice varieties have been a major setback to rice production in the country in as much as the majority of farmers depend on them for cultivation, as the alternative IRVs are scarce and expensive.

Further production related innovations, such as puddling, water control, weeding, the use of chemical fertilisers, increased spacing and reduction of seedlings per hill, were mainly associated with constraints such as being too technical, time consuming, and labour intensive, the lack tools and labour; being expensive, tedious, and scarce; causing irritation to the skin; encouraging weed growth, replacing washed away seedlings, and poor growth due to few seedlings being planted. It can be noted from these findings that farmers are constrained by many factors as they strive to use innovations from external actors in their rice farming systems. This suggests that research and extension professionals promoting these innovations need to pay careful attention to some of these constraints; it is said that one can readily change behaviour if it is easy and cheap to do so (Senthilkumar and Manivannan, 2012). This implies that if farmers think a particular innovation is expensive, technically difficult, or not easily accessible, they may reject or discontinue its use and revert to their traditional ways.

Similarly, the constraints farmers' face that are related to post-harvest innovations, such as rice mills and threshing by trampling with the feet, were associated with constraints such as long waiting times at peak periods of milling, the high cost and unavailability of milling services, and that it is time consuming, labour intensive, and inflicts pain on the feet. This further supports the fact that although rice innovations promoted by research and extension professionals are considered important to farmers and are robust solutions to their farming problems, they also carry constraints that could affect their use by smallholder farmers. This is particularly true in cases where farmers believe that reverting to their old methods or techniques offers advantages that outweigh the disadvantages of the constraints they face with the innovations.

9.2.3.6 Reasons for not Using or for Discontinuing the use of Innovations by Farmers

The study found that a number of innovations were either not used or were discontinued by farmers after they had tried them. The reasons tended to be similar, and are therefore discussed together in this section. Such key innovations, as reported in Section 8.9, included line sowing, planting of a single seedling per hill, IRVs, priming, early transplanting, increased spacing between seedlings, swamp development, rice mills, ABCs, and organic manure. Consistent with findings in the literature, such as those by Kiptot et al., (2007) and Weldegiorges (2014), farmers have the ability to test and then discontinue innovations for a number of reasons. In this study, the key reasons included: labour intensiveness; high cost; inaccessibility/unavailability; lack of financial resources; being time consuming, too technical or difficult to implement; lack of training; encouragement of weed growth; unsuitability of the innovation; being risk averse; perceiving the innovation to be unnecessary; and the loss of seedlings to erosion or pests as a result of planting a single seedling/hill. All of these reasons appear important for smallholder farmers' innovation capacity. If an innovation is perceived to be expensive and labour intensive, for example, resource poor farmers may find it difficult to use due to financial constraints. Also, if smallholder farmers believe an innovation to be too technical or too time consuming compared to their existing practices, this may also serve as a disincentive for them to use that innovation. The key message here is that research and extension professionals should vet agricultural innovations before pushing them to resource poor farmers, and also involve the farmers as much as possible in evaluating them before attempting to scale them up or out. Assumptions that smallholder farmers are willing to accept innovations once they believe they are bound to increase their yield may not be true at all times. As is evident in this study, although research and extension professionals consider the innovations promoted to be beneficial to farmers for the reasons they (research and extension professionals) advance, (see Chapter 5), farmers can decide not to use them at all, or can discontinue them after the trial stage, due to a number of constraints, as highlighted above. A number of studies have made similar findings. For example, Kiptot et al. (2007), in a study of the adoption of tree fallows in Kenya, similarly found reasons for their non-adoption or discontinuation of the innovation to include, lack of market (input/output), lack of labour, lack of knowledge/training, and no noticeable increase in yield (not necessary). Similarly, other studies have found reasons such as the lack of financial resources, the lack of knowledge and skills to use the innovation, risk averseness, dependency on handouts from research and extension professionals, and ineffectiveness of the innovation (Shadi-Talab, 1977; Weldegiorges, 2014; Lalani et al., 2016) to be the key factors constraining the use of agricultural innovations.

9.2.3.6 Constraints Limiting the General Innovation Capacity of Smallholder Farmers on Rice in Sierra Leone

The study identified the key constraints limiting the general ability of smallholders to innovate, and hence, the effectiveness of the innovation system on rice from a farmers' perspective. As highlighted by Schut et al. (2014), and consistent with the conceptual framework of this study, a number of structural conditions, including infrastructure and assets, institutions, interaction and collaboration, capabilities and resources, were identified as being constraining factors which limit smallholder farmers' innovative capacity. These constraints are generally similar to those identified by research and extension professionals as constraining the effectiveness of the innovation system, which further confirms the extent to which these factors inhibit innovation among diverse actors. However, research and extension professionals put forward broader and deeper constraints than farmers, for example they cited underlying institutional factors as constraining their innovation processes, amongst others. The key infrastructural factors identified by smallholder farmers included the difficulty in the availability of agricultural inputs and their consequent high cost, the lack of, or limited, information on agricultural innovations, the lack of access to markets, and the high incidence of pests and disease. The lack of appropriate infrastructural conditions such as these could play an immense role in limiting farmers' abilities to use innovations. For instance, the majority of farmers reported that they have not used NERICAs, or other IRVs, because of either the scarcity of the seeds or their high cost; neither have they used fertilisers due to inaccessibility or affordability; and they have not used ABCs because they are either too far away from their communities or farmers are not adequately informed of the purposes served by them. The lack of access to markets impeded farmers' access to inputs and consequently the intensity of farming operations. Without access to markets farmers were demotivated to engage in extensive production activities, they could see no reason to produce beyond subsistence levels when they lack opportunities to sell any surpluses.

Institutional factors which were found to be the key factors limiting farmers' innovation capacity included: the lack of policies on favourable credit facilities for them; the lack of policies on agricultural prices, and the subsequent low prices paid for agricultural produce; and the social and cultural values held by farmers that influence their confidence in innovations from external actors/professionals. Apparently, the lack of access to 'farmer friendly' credit facilities and low prices of agricultural produce can contribute to lowering resource poor farmers' engagement in robust farming activities, particularly farmers' ability to try innovations that are capital intensive. For instance, agronomic innovations such as swamp development and the use of fertilisers require labour which is capital intensive. The lack of favourable sources of finance, and a low farm income due to low prices of agricultural produce, can hamper farmers' willingness to try innovations.

Interaction and collaboration factors were also identified by farmers to be key in thwarting their abilities to innovate. These included: the lack of opportunity for them to share feedback with research and extension actors on innovations; research and extension professionals' lack of knowledge on the problems smallholder farmers face; and the poor contact between smallholder farmers and research and extension professionals. All of these constraints generally depict limited interactions between research and extension professionals and smallholder farmers. In situations where farmers face difficulties providing feedback to research and extension actors on the workability, or not, of those innovations promoted in their communities, they are not frequently in touch with their mentors or coaches (research and extension professionals). The result is a decreased, or non-use, of innovations from these actors. This is because farmers may face difficulties understanding the technicalities embedded in a given innovation e.g., line sowing, correct spacing of seedlings, swamp development etc., due to limited interactions between them and their mentors. In fact, this study found lack of knowledge or expertise by farmers to be one of the constraints they face with the innovations promoted by research and extension actors.

Factors related to farmers' capabilities and resources included the lack of financial resources, the lack of labour and the related high cost, and the lack of expertise in the use of external innovations. Having the capability and resources to try and/or use innovations is paramount for increasing the innovative capacity of farmers. If they lack financial resources and labour, this may impact on their use of financial and labour-intensive innovations. Buying agricultural inputs, paying for labour and other agricultural services, require finance, therefore, the limited access to finance or financial services can play a huge role in deterring farmers from trying or using innovations, particularly if they are not sure of the outcome. In fact, even if they are sure of the outcome, they may not be able to use them if they are capital intensive.

A number of studies have reported similar factors limiting the use or adoption of a wide variety of agricultural innovations in various parts of the world. Consistently, other scholars (e.g., Mapiye et al., 2016; Ketema et al., 2016; Silva and Broekel, 2016; Shashank et al.,2016; Khan et al., 2016) found the lack of finances/resources, low income, poor interactions of farmers in cooperatives, inadequacies of extension intervention and technical training and information dissemination, poor educational competencies, weak information links, the lack of inputs, non-availability of labour, poor awareness, high cost of labour, and lack of technical guidance to all be key factors limiting farmers innovative capacity on rice and forage crops in Sri Linka, Ethiopia, Zimbabwe and India. Consistent with this, Lowitt et al. (2015), in their study on the factors affecting the innovation potential of smallholder farmers in the Caribbean Community, found the systemic lack of access to finance, markets, and knowledge networks as the key limiting factors of smallholders' innovation potential in the region. These findings show that farmers in the developing world operate under many constraints, to which Sierra Leone is no exception.

9.3 Conclusions

This study sought to critically examine the effectiveness of agricultural innovations on rice in Sierra Leone in view of an Agricultural Innovation System (AIS) perspective. It specifically, aimed to describe the innovation processes and systems; identify and analyse the behaviours, beliefs, and attitudes of research and extension professionals influencing the effectiveness of an AIS approach on rice innovations from a research and extension perspective; as well as identify and analyse the influence of research and extension programmes on smallholder farmers' innovation processes on rice in Sierra Leone from the farmers' perspectives. A number of key questions were explored to adequately generate information that addresses the three key objectives of the study (see chapter 1). The following are the key conclusions made by this study.

1) The innovation system on rice in Sierra Leone is still weak. Despite the fact that a number of innovations have been developed and promoted by research and extension professionals, the approach adopted in doing so still aligns with the traditional 'Transfer of Technology' approach, where farmers are still seen as mere recipients of innovations from research and extension institutions. The dominant actors remain those within the agriculture environment – research scientists, extension personnel and farmers. Current innovations lack conscious attempts to establish useful links that could enhance smallholder farmers' access to services beyond research and extension. Very limited interactions (as shown in the sociograms in chapter 5) exist between public sector actors and those in the private particularly service providers such as traders, financial institutions, processors, and transporters. This is in contrast to pronouncements in national policy documents of the key regulatory bodies in the agriculture sector (MAFFS and SLARI) of a commitment in embracing an AIS approach in their work by establishing useful collaboration with various actors in the sector. The agriculture sector remains hugely challenged by a myriad of structural challenges that have been impeding the effectiveness of the innovation system on rice in the country. The sector is grossly under-

funded by central government (among other constraints) receiving only about 8% of the national budget (MAFFS, 2015). The lack of adequate finances, poor monitoring mechanisms on the use of public funds, and the poor policies have been contributing in limiting the effectiveness of public sector actors and their interactions with other actors.

NGOs equally struggle for funding opportunities; the few options available are highly competitive, in addition to the often constraining 'terms and conditions' that come with them. Research and extension professionals are therefore forced to continue implementing programmes with a traditional lens, as 'modern' approaches such as AIS requires a variety of institutional changes, with implications for a huge financial and human resources base. The innovation system on rice in Sierra Leone is largely in line with Roling (2006), who stated that research and extension actors in the developing world still adhere to top-down approaches in innovation processes despite the advancement of AIS approaches.

2) Despite the low adoption of AIS approaches, most research and extension professionals in Sierra Leone hold favourable attitudes towards the use of AIS approaches. They strongly believe that the use of AIS approaches can be beneficial to smallholder farmers particularly in relation to increasing their incomes and access to services. However, the lack of financial resources and ability to make decisions by many of them remain key disincentives to their ability to adopt AIS approaches (among other factors). Also, their behaviours and activities are also influenced by their social referents particularly their funding agencies, employers and supervisors. Implicitly, the adoption and effectiveness of an AIS approach in research and extension largely rest on directives from these referents. Therefore, to strengthen the use of AIS approaches in the country, robust actions must be taken to revamp the current institutional policies and embrace policies that encourage and support the design and implementation of agricultural innovations that reflect the tenets of effective and functioning AIS approaches. This will not only contribute to sustaining agricultural innovation programmes but can also help actualize the already positive beliefs held by research and extension professionals in both the public and private sectors.

3) Research and extension programmes have not been able to drastically increase the innovative capacities of smallholder farmers. Apart from continuously experiencing poverty, as evident as evident in this study, smallholder farmers are still challenged with access to services that can sustainably increase their innovative capacity. Research and extension programmes have not been able to support the establishment of reliable and useful links for smallholder farmers access to services that they (research and extension professionals) cannot provide, making it difficult to

intensify their productivity, which will in turn increase their incomes. Irrespective of the fact that all key rice innovations promoted in the country within the study period (2005-15) are targeted towards farmers, however, their impact on the innovation processes of smallholder farmers remain low. The 'innovations' tend to be a prescriptive list of activities that farmers need to adopt for increased productivity and incomes, with less consideration to the context and circumstances of the farmers. This has resulted in the low use, and in some cases, to the adaption of these innovations by smallholder farmers. This corroborates findings in the literature that top-down approaches that perceive smallholder farmers as either adopters or rejecters of innovations are unsustainable and cannot ameliorate the many multi-faceted constraints they face (Klerkx et al. 2012). This further emphasizes the need for research and extension professionals to adopt the use of AIS approaches that facilitate the participation of a variety of actors in the design and implementation of innovation programmes, with a [radically?] more prominent role for smallholder farmers.

9.4 Policy Implications

The following section formulates the most important implications of this research for policy development.

a) A key constraint limiting the effectiveness of the innovation processes and system on rice in Sierra Leone is the lack of adequate resources for effective innovation processes by research and extension actors, particularly those in the public sector i.e., MAFFS and SLARI. This implies that their activities and innovation capacities could be augmented if the current funding policies of agricultural activities were reviewed and funds better channelled. This could involve an increase in the national budget for MAFFS particularly that for research and extension programmes, and the institution of a robust monitoring and evaluation mechanism geared towards ensuring that funds are appropriately used to address the many constraints faced by research and extension professionals, particularly those interfacing with smallholder farmers at field level.
b) In the policy documents of the regulating institutions (such as MAFFS and SLARI) there is currently a general approval of the use of an AIS approach in innovation processes by research and extension professionals. However, evidence from this study suggests that its implementation is ineffective, implying that senior management officials have not been doing enough to facilitate its use in their organisations, either by designing favourable innovation programmes or by influencing other junior level staff. Therefore, there is a need for MAFFS to strengthen and facilitate the effective use of an AIS approach by research and extension professionals across all levels in the country. This implies creating an enabling environment for relevant actors beyond

research and extension actors, and particularly those in the public sector, to effectively design and implement agricultural innovation programmes that are widely participatory and inclusive. This might have a deeper impact on the sustainability and functional utility of agricultural innovations for smallholder farmers.

c) The provision of research and extension services in Sierra Leone is largely pluralistic with participation from a myriad of actors from the private sector, including NGOs (both local and international). Therefore, it will be important to establish more, and safer, places for interaction among these actors for effective innovation processes in the country. This will be valuable to the avoidance of any potential duplication of efforts and compliance to regulatory frameworks by research and extension actors. It will also impact the innovative capacity of smallholder farmers in the country.

d) The study found that the majority of smallholder farmers are greatly constrained by the lack of access to financial resources, including friendly credit facilities that meet their needs and their farming production cycle. There is, therefore, the need for research and extension to pay premium attention to the establishment of appropriate links and to support negotiations for the provision of relevant financial services that can be accessed by the neediest of farmers. This may involve engaging the current financial institutions which are already providing credit facilities to non-farmers in the country, and devising credit schemes that could leverage the financial impediments smallholder farmers face. Further, crop insurance schemes for smallholder farmers could be considered, in the long run, as an additional option to improve farmers' confidence, ability and willingness to try, adapt, and use external innovations, as well as improving their innovative capacity.

9.5 Recommendations for Further Research

This research has focussed on research and extension professionals and farmers in assessing the innovation system on rice in the country. It would be interesting if future research would consider a wider diversity of actors and a higher sample size. Also, similar studies could be conducted targeting another popular crop in the country like cassava or groundnut. This will help provide a broader understanding of the innovation system on rice from diverse perspectives. Also, the study has found the existence of marginal interactions between research and extension professionals and private sector actors particularly marketers and processors. It would be interesting to understand the underlying challenges limiting their interactions as well as strategies for addressing these challenges. Further, it will be interesting for future research to examine the key institutional changes required for stimulating an effective innovation system in the country. Although a few recommendations have been made consistent with the findings of this study, however, these are based on the researcher's perception only. Therefore, empirical research on this front would be helpful in devising strategies for strengthening the innovation system on rice in Sierra Leone and beyond.

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APPENDICES

Appendix 1: Tables from Chapters 5 and 6

Appendix 1.1: Improved rice varieties developed/promoted by research and extension actors in Sierra Leone in the last ten years identified by respondents

Source		Improved varieties for different ecologies identified by Respondents					
	Upland NERICA varieties: NERICA 3, 4, 6, 15, 16, and 18	**Upland/IVS** – Rok 3, 34; and Pakiamp;	**IVS** – Nerica L19 and L20;	**IVS –** Rok 24, 35	**IVS/Mangrove** – Rok 36;	**IVS/Boli**: Rok 5,10	**Mangrove** – Rok 37
KII-KOD-ExtM		xxx	xxxx		-	xx	-
KII-KOD-ExtN		xx	xxxx		x	x	-
KII-TOD-ExtN		xx	x	-	-	-	-
WS-RK-Res	x	x	x	x	x	x	x
WS-RK-ExtN	x	x	x	x	-	-	-
WS-FT-ExtM	x	-	x	-	-	-	-
KII-FT-ExtN		-		-	-	-	-
KII-KAD-ExtM	x	x	x	-	-	xx	-
KII-POD-ExtM	x	-	xx	x	-	x	-
WS-FT-ExtN		xx	xxxx	-	-	xx	
KII-FT-RES	xxx	xxx	xxxx	-	x	x	x
KII-KAD-ExtN	x	xx	xx	-	xx		x
KII-POD-ExtN		x	x	x	-	x	-
KII-KAD-Res	xxxxxx	xxxxx	xxxxxx	xx	xx	xxxx	x
KII-TOD-ExtM	x	x	xxx	-	-	x	-
WS-RK-ExtM		x	x	-	-	x	-
KII-FT-ExtM	x	x	xxx	-	-	-	-
WS-FT-Res	x	x	x	x	x	x	x

Source: Field Research, 2016

Appendix 1.2: Perceived benefits of improved rice varieties

Source	Perceived Benefits of Improved Rice Varieties											
	To increase yield of farmers	Short duration varieties enable farmers to crop two or three times a year	Discourage farmers from using low-yielding traditional varieties	Increase income of farmers and other value chain actors	Improve smallholder farmers' livelihood	Improve food security of smallholder farmers	Increase seed bank of improved varieties of smallholder farmers	Increase farmers access to improved and viable seeds	Enhance climate change adaptation such as drought tolerant varieties like NERICAs	Ensure restocking of seeds for Ebola survivors	Reduction of post-harvest losses – low shattering ability of NERICAs	Discourage/ minimize indebtedness of farmers particularly with respect to seeds
KII-KOD-ExtM	xx	-	-	xxxx	-	xxx	-	x	x	-	xx	x
KII-KOD-ExtN	xxxx	-	-	xxx	x	x	-	xx	-	-	x	-
KII-TOD-ExtN	xx	-	-	xx		xxx	-	xx	-	-		x
WS-RK-Res:	x	x		x	x	x	x	x	x	-	x	-
WS-RK-ExtN	x		x	x	x	x	-	x	-	-		-
WS-FT-ExtM	x	x	-	x		x	-	x	x	-	x	x
KII-KAD-ExtM:	xxxx	-	-	xxx	xx	x	-	x	-	-	-	-
KII-POD-ExtM:		-	-	xx	x		-	-	-	-	-	-
KII-KAD-ExtN	xx	x	-	xxx	xx	x	-	-	-	-	-	-
KII-POD-ExtN	x	xxx	-	xx	xx	x	x	-	-	x	-	-
KII-KAD-Res	xxxxxx		x	xxx		xxxx		xxx	x	-	x	
KII-TOD-ExtM	xxx	x	-	x	xxx	x	-	x	-	-		x
WS-FT-Res:	x	x	-	x	x		x	x	x	-	x	x
KII-FT-ExtN	xx	-	-	xx		xxx	-	xx	-	-	xx	-
WS-FT-ExtN	x	-	-	x	x	xx	-	-	-	-	-	-
KII-FT-RES	xxx	-	-	xx		x	-	-	xx	-	-	x

Appendix 1.3: The key features of the SRI identified by research and extension actors

SOURCE	FEATURES							
	Promotes line sowing	Reduced seedlings per hill – 1/hill	Transplanting at 8-14 days	Planting Distance (25*25cm) or (25*40cm).	Use of mechanical Weeders (Rotary)	Swamp development/water control etc.	Preparation of swamp before Nursery	Use of organic manure
KII-KOD-ExtM	xxxx	xxxx	xxx	xxxx	x	xxx	x	x
WS-RK-Res	x	x	x	x	-	x	x	x
WS-RK-ExtM	x	x	x	x	-	x	x	x
KII-POD-ExtM	xxx	xxx	xxx	xx	-	xx	xx	xx
WS-FT-ExtN	-	x	x	-	x	x	x	x
KII-TOD-ExtM	xxx	xxx	xxx	xx	x	xxx	x	x
KII-FT-ExtN	xx	xx	xx	xx	x	x	-	x
KII-KAD-Res	xxx	xxx	xxx	xx	x	xxx	x	xx
KII-KOD-ExtN	xxx	xx	xxxx	xxxx	x	xxxx	xx	xxx

Source: Field Research, 2016

Appendix 1.4: The Perceived benefits of the SRI identified by research and extension actors

	Increases income and livelihood of farmers	Increased productivity	Enhances better water control, reduces weeding-related drudgery due to use of weeder	Facilitate soil aeration	Less costly due to use of organic manure	Increase in tillering of IVS seedlings	Organic crop production	Use less seed inputs and water	Increases yield through better growth and tillering of seedlings
KII-KOD-ExtM	xxxx	xxxx	x	x	xxx	xx	x	xxx	xxx
KII-KOD-ExtM	xxx	xx	-	x		x	x	x	xxx
WS-RK-Res	x	x	-		x		x	x	x
WS-RK-ExtM	x	x	-	x	x	x		x	x
KII-POD-ExtM	x	xxx	-	-	xx	-	x	x	xxx
WS-FT-ExtN	x	x	x	x		x	-	x	x
KII-TOD-ExtM	x	xxx	x	x	xx	x	-	x	xx
KII-FT-ExtN	xxx	xxxx	x	xx	xx	x	xx	xx	x
KII-KAD-Res	xx	xxx	x		xx	x	x	x	xx
KII-KOD-ExtN	xx	xx	x	x	x	-	x	xxx	xxxx

Source: Field Research, 2016/17

Appendix 1.5: Key features of the TP-R identified by research and extension actors

	Use of high yielding varieties	Water control (IVS) – swamp development	Early transplanting (21days)	Timely application of fertilizer	Field preparation before establishment of Nursery	Priming of seeds before nursery	1-3 seedlings per stand	Use of fertilizer treatment to increase yield	Conducting soil test	Training on postharvest handling
KII-KAD-ExtM	x	xx	xxx	xx	xx	xx	xxx	x		xx
KII-KAD-Res	xxx	xxx	xxxxx	xx	xx	xx	xxxxx		x	xx
WS-RK-Res:		x	x		x		x	x	x	-
WS-RK-ExtM:	x	x	x	x	-		x	x	-	-
WS-FT-ExtM	x	-	x	x	x	x		x	-	x
KII-POD-ExtM:	x	x	xxxx	x	x	-	xxx	x	-	x
WS-FT-ExtN	x	x	x	-	-	-	x	x	-	x
KII-TOD-ExtM	x	x	xxx	x	x	-	xx	x	x	x
KII-KOD-ExtM	xx	xxx	xxx	x	x	-	xxx	-	-	x
KII-KAD-ExtN	x	xx	xxx	xx	xx	x	xxx	x	-	xx

Source: Field Research, 2016/17

Appendix 1.6: Perceived benefits of the TP-R identified by respondents

	Enhances possibility for double cropping	Increase smallholder farmers yield per unit area	More income to farmers	Enhancing skills and knowledge of MAFFS extension staff on new techniques	Increase tillering and growth of seedlings	Increase livelihood of farmers	Use of less inputs especially seeds	Discourages upland cultivation due to high IVS yield
KII-KAD-ExtM	x	xxx	xxx		xxx	xx	xxx	x
WS-RK-Res:	x	x	x	x	x	x	x	
WS-RK-ExtM	x	x	x	x	x	x	x	x
WS-FT-ExtM	x	x	x		x		x	
KII-POD-ExtM:	xxx	xxxx	xxx		xxx	xx	x	
WS-FT-ExtN	x	x	x		x		x	
KII-TOD-ExtM	xx	xxx	xx		xx	xx	x	
KII-KOD-ExtM		xx	xx	x			x	
KII-KAD-ExtN	xx	x	xxx		xx	xx	xx	
KII-KAD-Res	x	xxxx	xxx		xxxx	xx	xxxx	

Source: Field Research, 2016/17

Appendix 1.7: Key features and perceived benefits of ABCs/rice processing facilities

	Features				**Perceived Benefits**					
	ABCs are formed by groups of farmers called FBOs	ABCs serve as a source of threshers, parboiling facilities, dry floors, rice mills, generators, and inputs for farmers use	ABCs serve as output markets for farmers produce	Processing facilities constitute grain stores, dry floors and rice mills	Reduce drudgery on rice processing for smallholder farmers	Enhance accessibility of inputs to farmers (seeds, fertilizer etc)	Improve incomes and livelihood of farmers	Help in value addition of paddy rice	Help overcome rice processing and storing constraints	Enhance smallholder farmers skills and knowledge on operation of machinery like mills, threshers etc
KII-KAD-ExtN	x	xxx	x	x	x	xx	xxx	xxx	xxx	-
WS-RK-Res:		x	x	x	x	x	x	x		-
WS-RK-ExtM:	x	x	x			x	x	x	x	-
WS-FT-ExtM	x	x	x	x	x	x	x	x	x	-
KII-POD-ExtM:	xx	xxx	xxx	xx	x	xx	xxx	xx	x	-
WS-RK-ExtN		x	x	x	x	x	x	x	x	x
KII-TOD-ExtM	xxx	xxxx	x		x	xxx	xxxx	-	xx	-
KII-KOD-ExtM	xx	xxx	xx	-	-	x	x	x	x	x
KII-FT-ExtN		xx	x	xx	x	xx	xx	x	xx	xx
KII-TOD-ExtN	x	xx	xx	-	-	xx	xx	x	x	-
KII-KOD-ExtN	x	xxx	xxx	xx	xx	xx	xxx	x	xxx	x

Source: Field Research, 2016

Appendix 1.8: Features and perceived benefits of Plant Health Clinics

Features				
	Initiated by MAFFS in 2008. Diagnose and cure plant diseases	Trained many ABC reps on this Plant Health Clinic and have been provided with kits	Focussed on all crops; training of all plant doctors	Crop protection initiative by MAFFS
WS-FT-ExtM	x		x	x
KII-FT-ExtM	xxx	x	xx	xx
KII-KOD-ExtM	x	xx	xx	xx
KII-KAD-ExtM	xxx		xx	xxx
KII-TOD-ExtM	xx		xxx	xxx
Perceived Benefits				
	Promotion of IPPM	Timely access to crop protection services by farmers	IPM/IVM promotion for smallholder farmers	Helps in plant diseases surveillance and prevention
WS-FT-ExtM	x	x	x	x
KII-FT-ExtM	x	xx	xx	xx
KII-KOD-ExtM	x	xx	xx	
KII-KAD-ExtM	x	xxx	xx	xxx
KII-TOD-ExtM	x	xxx	xx	xx

Source: Field Research, 2016

Appendix 1.9: Features and perceived benefits of PICS Bags

	Features					
	The PICS bags project was implemented in partnership with Purdue University by CRS	About 10,000 bags have been distributed to about 4600 farmers in four districts including Kailahun, Kenema, Kambia and Koinadugu	Some bags were issued to some Agriculture Business Centres in the target districts			Used for storing grains and seeds of rice and other cereals eg maize, sorghum, groundnuts, cowpeas etc
KII-KOD-ExtN	x	x	x			x
WS-FT-ExtM	x	-	x			x
WS-RK-ExtM	x	-	x			x
KII-KOD-ExtM	xx	-	xx			xx
KII-KAD-ExtM	x	-	x			x
	Perceived Benefits					
	Increases shelf life of seed rice	Maintain seed quality	Serves as a safe storage of seeds	Reduce pest infestation	Prevent moisture and rotting of seeds	Reduces post-harvest losses
KII-KOD-ExtN	xx	xx	xx	xx	x	x
WS-FT-ExtM	x	x	x	x		x
WS-RK-ExtM	x	x	x	x		x
KII-KOD-ExtM	**x**	**x**	**x**		**x**	
KII-KAD-ExtM	**x**	**x**	**x**	**x**		**x**

Source: Field Research, 2016.

Appendix 1.10: Factors limiting the effectiveness of the Innovation System on rice in Sierra Leone

Source	Human Capacity /Resources	Financial Capacity /Resources	Infrastructural	Interactions and Collaboration	Institutional	Natural
	Illiteracy: low level of illiteracy among farmers, high dependency of farmers on government/NGOs, difficulty using some innovations; Training/Mentoring: Poor training/capacity building opportunities for R&E staff (esp. MAFFS), long probation period; Staffing: Limited and ageing number of extension workers in the MAFFS; Labour: scarcity of labour in rural communities, labour intensiveness of some innovations.	Credit facilities: Few credit institutions for farmers, poor access to credit, high interest rates on credit for farmers; Cost: high cost of certified/improved seeds, fertilizers, machinery and transportation Funding: Limited funding for agriculture programs, limited funding sources for NGOs Late disbursement of funds by the District Council to MAFFS; late disbursement of funds from donors.	Communication: poor ICT network, internet facilities costly and unaffordable; lack of software for data analysis Markets: lack of markets for improved seeds, agro-chemicals, fertilizers; lack of market information for farmers, few private sector dealers of agro-inputs; lack of market for farm output Mobility: Lack of mobility for field staff especially MAFFS, weak services to farmers, Poor feeder road network Soil conditions: poor soil fertility, poor soil management, rapid depletion of soils, lack of developed IVS Tools/Materials: Lack of machinery, over dependence on manual labour, lack of spare parts for machinery.	Lack of trust among members; Unwillingness of farmers to work as a group; Unwillingness of INGOs to partner with local NGOs; High honorarium for MAFFS/SLARI staff; Poor coordination of agricultural activities of the various stakeholders; Poor cooperation of agric. partners; Elite capture at community level	Decentralization policy: Devolving funds to the District Councils slows the implementation of activities in the MAFFS district offices; High level of bureaucracy; Land tenure system: poor access to land by farmers especially women; Lack of information on climate change (Agro-met stations) Salaries/Wages: Poor remuneration for R&E staff esp. MAFFS staff; High honorarium for MAFFS/SLARI staff is unfavourable for NGOs; Poor/weak M&E structures at MAFFS; Long probation period of staff at MAFFS – 2years- no promotion within this period; Market: lack of pricing policies for rice; Farming Calendar: Poor following of mfarming calendar in program delivery.	Change in climate/weather conditions (early/late rains); Increase in temperatures; Heavy rainfall – washes away seedlings; Disasters (flood, fire) etc, Swamps dry up in the dry season making it difficult for double cropping of rice; Inconsistency of the start and end of the rainy season
WS-FT-Res:	x	x	x	x		

WS-FT-ExtM	x	x	x	x	x	
WS-FT-ExtN	x	x	x		x	
WS-RK-Res:		x	x		x	
WS-RK-ExtM	x	x	x	x	x	x
WS-RK-ExtN		x	x	x	x	
KII-FT-RES	x	xxx	xxxx		xx	
KII-FT-ExtM:	xxx	x	xxx	xx	xx	x
KII-KAD-ExtM	xx	xxx	xxxx	xx	x	
KII-KAD-RES	xx	xxxx	xxxxx	xx	xxx	x
KII-KOD-ExtM	xx	xxx	xxxx	xx	xx	
KII-POD-ExtM:	xxx	xxxx	xxxx	x	xxx	
KII-TOD-ExtM	x	x	xxx	x	x	
KII-KAD-ExtN		xx	xxx	xx	xx	
KII-FT-ExtN		xx	xx	xx	x	x
KII-POD-ExtN	x	x	x	xx	xx	xx
KII-KOD-ExtN	x	x	xxx	xxxx	x	
KII-TOD-ExtN	x	x	xxx	xx	xx	x

Appendix 1.11: Socio-economic characteristics of respondents disaggregated by organisation

Soico-economic Characteristics	Category	MAFFS (n=45)		NGOs (n=42)		SLARI (n=35)		TOTAL (n=122)	
		Frequency (F)	Percentage (%)	F	%	F	%	F	%
Sex									
	Male	35	77.8	37	88.1	33	94.3	105	**86.1**
	Female	10	22.2	5	11.9	2	5.7	17	**13.9**
Age									
	18-30yrs	7	15.6	6	14.3	5	14.3	18	**14.8**
	31-40yrs	19	42.2	17	40.4	10	28.6	46	**37.7**
	41-50yrs	14	31.1	6	14.3	7	20.0	27	**22.1**
	Above 50yrs	5	11.1	13	31.0	13	37.1	31	**25.4**
Education									
	College Certificate	6	13.3	9	21.4	2	5.7	17	**13.9**
	College Diploma	11	24.4	5	11.9	7	20.0	23	**18.9**
	Bachelor's Degree	22	48.9	20	47.6	9	25.7	51	**41.8**
	Master's degree	5	11.1	8	19.0	15	42.9	28	**23.0**
	PhD	1	2.2	0	0.0	2	5.7	3	**2.5**
Other sources of income in addition to job									
	Yes	14	31.1	25	59.5	8	22.9	47	**38.5**
	No	31	68.9	17	40.5	27	77.1	75	**61.5**
Participation in Inter-agency meetings									
	Yes	36	80.0	42	100.0	15	42.9	93	**76.2**
	No	9	20.0	0	0.0	18	51.4	27	**22.1**
	Not available	0	0.0	0	0.0	2	5.7	2	**1.6**
Attended training related to role in last 12 Months									
	Yes	39	86.7	40	95.2	21	60.0	100	**82.0**
	No	6	13.3	2	4.8	14	40.0	22	**18.0**
Membership in professional networks									
	Yes	10	22.2	31	73.8	8	22.9	49	**40.2**
	No	35	77.8	11	26.2	27	77.1	73	**59.8**
Experience in research and extension									
	1-10yrs	31	68.9	29	69.0	18	51.4	78	**63.9**
	11-20yrs	8	17.8	10	23.8	7	20.0	25	**20.5**
	21-30yrs	4	8.9	0	0.0	4	11.4	8	**6.6**
	31-40yrs	2	4.4	3	7.1	6	17.1	11	**9.0**
Length of service in current organisation									
	1-10yrs	31	68.9	42	100.0	22	62.9	95	**77.9**
	11-20yrs	7	15.6	0	0.0	2	5.7	9	**7.4**
	21-30yrs	2	4.4	0	0.0	5	14.3	7	**5.7**
	31-40yrs	5	11.1	0	0.0	6	17.1	11	**9.0**
Speak Community Language									
	Yes	31	68.9	38	90.5	23	65.7	92	**75.4**
	No	14	31.1	4	9.5	12	34.3	30	**24.6**
Have a farming background									
	Yes	37	82.2	42	100.0	34	97.1	113	**92.6**
	No	8	17.8	0	0.0	1	2.9	9	**7.4**

Source: Field Survey, 2016/17

Appendix 1.12: Constraints faced by research and extension professionals in the execution of their functions

Faced constraints (n=122)	F	%
Yes	99	81.1
No	23	18.9

Name of constraints (n=99)	F	%
Financial/budget constraints	30	**24.6**
Limited/Ageing/Unqualified staff	11	**9.0**
Poor remuneration	34	**27.9**
Language barrier	5	**4.1**
Bad road conditions	30	**24.6**
Limited logistics eg computers, vehicles, software, internet, electricity	68	**55.7**
Delay in disbursement of funds	9	**7.4**
Too much workload	3	**2.5**
Lack of training opportunities	20	**16.4**
Poor laboratories	1	**0.8**
Poor transmission of information	2	**1.6**
Poor commitment to monitoring of activities by supervisors	1	**0.8**
Lack of implementing partners with capacity to pre-finance projects	1	**0.8**
Poor Extension-Research relationship	6	**4.9**
Slow response from MAFFS Authorities in Freetown	1	**0.8**
Discrimination	3	**2.5**
Too much workload	2	**2.5**
Poor amenities eg water, electricity, housing for staff	2	**1.6**
Delay in supply of inputs from headquarters	1	**0.8**
Poor commitment to adopting and harmonising extension approach	1	**0.8**
High political interference	2	**1.6**
Lack of cooperation from colleague staff	3	**2.5**
Poor amenities eg water, electricity, housing for staff	2	**1.6**
Lack of office space	1	**0.8**
Cultural practices of clients	6	**4.9**
High illiteracy rate of target farmers	2	**1.6**
Sticking to old policy guidance by the MAFFS	2	**1.6**
High/Unreasonable expectations of farmers from Extension staff	1	**0.8**
Sticking to old policy guidance by MAFFS	2	**1.6**

Top constraints disaggregated by organisation (n=99)	**MAFFS (n=45)**		**SLARI (n=35)**		**NGO (n=42)**	
	F	**%**	**F**	**%**	**F**	**%**
Financial/budget constraints	7	**5.7**	15	**12.3**	8	**6.6**
Limited/Ageing/Unqualified staff	11	**9.0**	0	**0.0**	0	**0.0**
Poor remuneration	16	**13.1**	14	**11.5**	4	**3.3**
Bad road conditions	16	**13.1**	4	**3.3**	10	**8.2**
Limited logistics eg computers, vehicles, software, internet, electricity	29	**23.8**	13	**10.7**	26	**21.3**
Lack of training opportunities	8	**6.6**	6	**4.9**	6	**4.9**

Source: Field Survey, 2016/17

Appendix 1.13: Respondents' beliefs on their roles in working with smallholder farmers

Statement	Strongly disagree		Disagree		Neutral		Agree		Strongly agree	
	F	%	F	%	F	%	F	%	F	%
1. To help farmers adopt new technologies/techniques from research and extension	2	1.6	-	-	1	0.8	23	18.9	96	78.7
2. To constantly provide farmers with new technologies and ideas on how to farm	1	0.8	1	0.8	5	4.1	55	45.1	60	49.2
3. To stimulate farmers' thinking about generating new technologies or ways of doing things in their farm enterprises	2	1.6	6	4.9	23	18.9	59	48.4	32	26.2
4. To help farmers be more confident to interact with other people who can help them solve their farming problems.	-	-	6	4.9	16	13.1	63	51.6	37	30.3
5. To help farmers access the knowledge and information relevant to their farming enterprise	1	0.8	-	-	6	4.9	48	39.3	67	54.9
6. To provide farmers with free technologies/inputs to increase their production	4	3.3	17	13.9	24	19.7	35	28.7	42	34.4
7. To promote farmers' independence in identifying and coming up with solutions to their problems	3	2.5	11	9.0	12	9.8	49	40.2	47	38.5

Source: Field survey, 2016/17

Appendix 1.14: Respondents' beliefs on their roles in working with smallholder farmers disaggregated by organisation (percentages in parenthesis)

Statement	**MAFFS Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	**SLARI Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	**NGO Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
1. To help farmers adopt new technologies/techniques from research and extension	1 (2.2)	-	0 (0.0)	10 (22.2)	34 (75.6)	0 (0.0)	-	1 (2.9)	4 (11.4)	30 (85.7)	1 (2.4)	-	0 (0.0)	9 (21.4)	32 (76.2)
2. To constantly provide farmers with new technologies and ideas on how to farm	0 (0.0)	1 (2.2)	1 (2.2)	18 (40.0)	25 (55.6)	0 (0.0)	0 (0.0)	1 (2.9)	11 (31.4)	23 (65.7)	1 (2.4)	0 (0.0)	3 (7.1)	26 (61.9)	12 (28.6)
3. To stimulate farmers' thinking about generating new technologies or ways of doing things in their farm enterprises	0 (0.0)	1 (2.2)	5 (11.1)	24 (53.3)	15 (33.3)	1 (2.9)	5 (14.3)	8 (22.9)	16 (45.7)	5 (14.3)	1 (2.4)	0 (0.0)	10 (23.8)	19 (45.2)	12 (28.6)
4. To help farmers be more confident to interact with other people who can help them solve their farming problems.	-	2 (4.4)	8 (17.8)	19 (42.2)	16 (35.6)	-	2 (5.7)	5 (14.3)	19 (54.3)	9 (25.7)	-	2 (4.8)	3 (7.1)	25 (59.5)	12 (28.6)
5. To help farmers access the knowledge and information relevant to their farming enterprise	0 (0.0)	-	3 (6.7)	23 (51.1)	19 (42.2)	0 (0.0)		3 (8.6)	17 (48.6)	15 (42.9)	1 (2.4)	-	0 (0.0)	8 (19.0)	33 (78.6)
6. To provide farmers with free technologies/inputs to increase their production	0 (0.0)	2 (4.4)	7 (15.6)	18 (40.0)	18 (40.0)	3 (8.6)	10 (28.6)	12 (34.3)	2 (5.7)	8 (22.9)	1 (2.4)	5 (11.9)	5 (11.9)	15 (35.7)	16 (38.1)

Appendix 1.15: Respondents' beliefs on the role of farmers in agricultural innovation processes

Statement (n=122)	Strongly disagree		Disagree		I don't know		Agree		Strongly agree	
	F	%	F	%	F	%	F	%	F	%
1. Farmers are either adopters or rejecters of new technologies/techniques from research and extension	5	4.1	10	8.2	21	17.2	53	43.4	33	27.0
2. Farmers are only a source of information useful for research and extension actors	1	0.8	-	-	5	4.1	64	52.5	52	42.6
3. Farmers are experimenters of technologies/techniques from research and extension	4	3.3	16	13.1	14	11.5	55	45.1	33	27.0
4. Farmers are one of many partners working with research and extension in agricultural innovation processes	1	0.8	6	4.9	6	4.9	57	46.7	52	42.6
5. Farmers are innovators that can come up with solutions to their problems.	4	3.3	53	43.4	26	21.3	26	21.3	13	10.7
6. Farmers are innovators that exert demand for research and extension services	3	2.5	31	25.4	21	17.2	50	41.0	17	13.9
7. Farmers are innovators that can learn from one another and come up with solutions to their problems	1	0.8	21	17.2	9	7.4	79	64.8	12	9.8
8. Farmers must always depend on research and extension actors for sustainable solutions to their problems	3	2.5	31	25.4	13	10.7	40	32.8	28.7	35

Source: Field survey 2016/17

Appendix 1.16: Respondents' beliefs on the role of farmers in agricultural innovation processes disaggregated by organisation

Statement	MAFFS					SLARI					NGO				
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
1. Farmers are either adopters or rejecters of new technologies/techniques from research and extension	4 (8.9)	2 (4.4)	8 (17.8)	18 (40.0)	13 (28.9)	0 (0.0)	2 (5.7)	3 (8.6)	16 (45.7)	14 (40.0)	1 (2.4)	6 (14.3)	10 (23.8)	19 (45.2)	6 (14.3)
2. Farmers are only a source of information useful for research and extension actors	0 (0.0)	-	1 (2.2)	24 (53.3)	20 (44.4)	0 (0.0)	-	4 (11.2)	14 (40.0)	17 (48.6)	1 (2.4)	-	0 (0.0)	26 (61.9)	15 (35.7)
3. Farmers are experimenters of technologies/techniques from research and extension	3 (6.7)	10 (22.2)	2 (4.4)	16 (35.6)	14 (31.1)	0 (0.0)	0 (0.0)	8 (22.9)	13 (37.1)	14 (40.0)	1 (2.4)	6 (14.3)	4 (9.5)	26 (61.9)	5 (11.9)
4. Farmers are one of many partners working with research and extension in agricultural innovation processes	0 (0.0)	1 (2.2)	4 (8.9)	26 (57.8)	14 (31.1)	0 (0.0)	0 (0.0)	2 (5.7)	15 (42.9)	18 (51.4)	1 (2.4)	5 (11.9)	0 (0.0)	16 (38.1)	20 (47.6)
5. Farmers are innovators that can come up with solutions to their problems.	0 (0.0)	24 (53.3)	10 (22.2)	4 (8.9)	7 (15.6)	3 (8.6)	14 (40.0)	9 (25.7)	5 (14.3)	4 (11.4)	1 (2.4)	15 (35.7)	7 (16.7)	17 (40.5)	2 (4.8)
6. Farmers are innovators that exert demand for research and extension services	0 (0.0)	6 (13.3)	9 (20.0)	24 (53.3)	6 (15.6)	2 (5.7)	9 (25.7)	9 (7.4)	10 (28.6)	5 (8.6)	1 (2.4)	16 (38.1)	3 (7.1)	16 (38.1)	6 (14.3)
7. Farmers are innovators that can learn from one another and come up with solutions to their problems	0 (0.0)	9 (20.0)	1 (2.2)	28 (62.2)	7 (5.7)	0 (0.0)	6 (17.1)	4 (11.4)	22 (62.9)	3 (2.5)	1 (2.4)	6 (14.3)	4 (9.5)	29 (69.0)	2 (1.6)
8. Farmers must always depend on research and extension actors for sustainable solutions to their problems	0 (0.0)	9 (20.0)	4 (8.9)	19 (42.2)	13 (28.9)	3 (8.6)	2 (5.7)	4 (11.4)	10 (28.6)	16 (45.7)	0 (0.0)	20 (47.6)	5 (11.9)	11 (26.2)	6 (14.3)

Appendix 1.17: Respondents beliefs on AIS behaviours and their exhibition in the last 12 months

Behaviour	This is an AIS behaviour:										Exhibited Behaviour?	
	Strongly disagree		Disagree		Neutral		Agree		Strongly agree		YES	
	F	%	F	%	F	%	F	%	F	%	F	%
1. Using innovation platforms in research and extension projects	2	1.6	1	0.8	4	3.3	33	27.0	82	67.2	86	70.5
2. Use of participatory research methods	1	0.8	4	3.3	1	0.8	23	18.9	93	76.2	98	80.3
3. Strengthening smallholder farmers capabilities to independently solve their farming problems	6	4.9	9	7.4	7	5.7	49	40.2	51	41.8	88	72.1
4. Promoting learning within and between organisations for innovation	2	1.6	2	1.6	5	4.1	48	39.3	65	53.3	81	66.4
6. Formulation of policies favourable for collaboration and partnership	10	8.2	4	3.3	5	4.1	45	36.9	58	47.5	59	48.4
7. Decentralizing management of innovation processes	2	1.6	7	5.7	16	13.1	31	25.4	66	54.1	58	47.5
8. Strengthening individual/collective capabilities to innovate	2	1.6	12	9.8	12	9.8	45	36.9	51	41.8	82	67.2
10. Facilitating complex and dynamic interactions for smallholder farmers' access to knowledge sources, input and markets	9	7.4	8	6.6	14	11.5	43	35.2	48	39.3	79	64.8
11. Promoting network-based knowledge dissemination among various actors		-	3	2.5	11	9.0	37	30.3	71	58.2	73	59.8
12. Having confidence of all stakeholders in the innovation process	2	1.6	3	2.5	20	16.4	31	25.4	66	54.1	77	63.1

Source: Field Survey, 2016/17

Appendix 2: Structured Questionnaires for Research and Extension Professionals

Information Sheet for Research and Extension Personnel

Reference:

<u>Information Sheet</u>

Assessment of Rice Innovation Processes and System in Sierra Leone

Dear Sir/Madam,

I am delighted to inform you that you have been selected as one of the respondents of this research, conducted by Mr Lamin Ibrahim Kamara, a PhD student from University of Reading, UK. You have been selected to participate in this study because you are considered as a key stakeholder in the agriculture sector, particularly, rice innovation processes in Sierra Leone.

The goal of this study is to examine rice innovation system in Sierra Leone from 2005-15, in particular, the processes research and extension actors are engaged in the development/promotion of rice innovations and how these processes have influenced smallholder farmers' innovative capacity.

The survey takes approximately 30 mins to complete. The data generated from the study will be used for my doctoral thesis at Reading University and writing up papers for publication in peer-reviewed journals.

Further, please note that your participation in this study is entirely voluntary, and you are free to withdraw at any time without any consequences of any sort. You are free not to respond to any question during the interview, or request for your information to be removed from the research at any time within the first three months after the survey. If you wish your information to be removed from the study within this timeframe, you can contact me (details below) quoting your reference at the top of this page. However, in as much as I would want this study to reflect the views of research and extension actors in Sierra Leone, I therefore, hope that you will feel able to participate.

Please note that the reference code will only be used by the primary investigator to identify you for in case you intend to withdraw your information from the survey but not to disclose your identity or the information you provided to a third party. A list of all research respondents with their respective reference codes will be kept separately by the researcher for this purpose.

If you volunteer to participate in this study, I would take that as an acknowledgement that you have had the terms of your participation clearly explained and that you agreed to them.

Yours sincerely,

………………………………….

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QUESTIONNAIRE ON RESEARCH AND EXTENSION ACTORS BEHAVIOURS, BELIEFS AND ATTITUDES IN RELATION TO AGRICULTURAL INNOVATION SYSTEM (AIS)

Serial No.__________ District_____________________ Organisation___________________

Department/Unit/Division__________________ Respondent's Ref # _________________

SECTION A: SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS

This section is about your social and economic characteristics including your educational level, sources and use of income, household composition etc. The information you provide in this section will help me understand the rest of the information in the subsequent sections.

1. Sex [ ] [Male (1) Female (2)]
2. Age [ ] [18-30 (1); 31-40 (2); 41 – 50 (3); Above 50 years (4)]
3. My **highest** educational level is [ ] [Secondary School Certificate (1); College Certificate (2); College Diploma (3) Bachelor's degree (4); Master's degree (5); PhD (6); Other (specify________________)
4. What is your disciplinary background? [ ]

Agricultural Economics (1)	Agriculture General (6)
Agricultural Extension (2)	Farm Management (7)
Crop Science (3)	Agricultural Engineering (8)
Animal Science (4)	Agronomy (9)
Agricultural Education (5)	Other (Specify______________________)

5. I am involved in: [ ] [A Research work (1); Extension work (2)]
6. Do you speak the local language of the community you are currently working? [ ] [Yes (1); No (2); Not Applicable (3)]
7. How many years have you been working in research and extension? [ ]
8. What is your current designation/job title? ……………………………………………………………………
9. How long have you worked in this capacity (in years)? (refer to q9 above)? [ ]
10. How long have you worked in this organisation (in years) (if different from above)? [ ]
11. Have you attended any training related to your role in the last 12months? [ ] [Yes (1); No (2)]
12. Do you currently own a farm or have a farming background or have participated in farming even when you were a child? Yes (1) No (2) [ ]
13. Are you a member of any professional networks? (see examples in q14) [Yes (1); No (2)]
14. If "Yes", which (select as many as applicable)?
    a. Sierra Leone Forum for Agricultural Advisory Services (SLeFAAS)
    b. NGO Livelihoods Group
    c. African Forum for Agricultural Advisory Services (AFAAS)
    d. West African Farming Systems Research Network
    e. Forum for Agricultural Research in Africa
    f. Other (specify)…………………………………………………………………………………
    g. ……………………………………………………………………………………………………….
15. Do you participate in any inter-agency meetings related to your field of work? [Yes (1); No (2); Not Available (3)] [ ]
16. If yes, how many times per year? [ ]
17. Are there any constraints you currently face that are limiting your ability to execute your duties effectively? [Yes (1); No (2)] [ ]

18. If "yes" to q16 above, name them in decreasing order of importance to you?

1.
2.
3.
4.
5.
6.
7.
8.

19. In addition to this job, do you have any other sources of income? [ ] [Yes (1); No (2)]

20. If yes to q19, what are they? ....

SECTION B: AGRICULTURAL INNOVATIONS PROMOTED BY RESEARCH AND EXTENSION ACTORS

This section is about the services research and extension provide to smallholder farmers and their interaction with other actors. It specifically focuses on the innovations research and extension actors have promoted in the past ten years, the perceived benefits of these innovations and the constraints limiting the effectiveness of the innovation system on rice.

21. Which of the following innovations on rice have you participated in developing/promoting in the last ten (10) years?

Name of innovation/package	**In the last 10 years (tick as applicable)**	**In the last 2 years (tick as applicable)**
Improved rice seed varieties		
System of Rice Intensification		
Technical Package on Rice		
Agriculture Business Centers		
Swamp development		
Plant Clinics		
Purdue Improved Crop Storage (PICS) Bags		

22. Which of the following do you think are your likely motivation for promoting/developing the innovations/packages you mentioned in q21 above? Please score them.

Perceived Benefits/motivation (<u>Select</u> as many as applicable**)**	**Score each benefit relative to the extent to which it is important to you (**1=No extent, 2= Little Extent, 3= Some Extent, 4=Great Extent, 5= Very Great Extent**) – You can choose a score for more than one selection as you deem appropriate**				
a. Increase farmers access to improved and viable seeds	1	2	3	4	5
b. To increase seed bank of improved varieties of smallholder farmers	1	2	3	4	5
c. To increase yield by smallholder farmers	1	2	3	4	5
d. To enhance climate change adaptation by smallholder farmers	1	2	3	4	5
e. To improve food security of smallholder farmers	1	2	3	4	5
f. To improve smallholder farmers' livelihood	1	2	3	4	5
g. To increase income of farmers and other value chain actors	1	2	3	4	5
h. To reduce cost of production for smallholder farmers	1	2	3	4	5
i. To reduce drudgery associated with manual processing of rice e.g. milling, parboiling, etc by smallholder farmers	1	2	3	4	5
j. To increase access to markets by smallholder rice farmers	1	2	3	4	5
k. To enhance the innovative capacity of smallholder farmers	1	2	3	4	5
l. Other (specify)	1	2	3	4	5
m.	1	2	3	4	5
n.	1	2	3	4	5

23. To what extent do you agree or disagree with the following as roles of research and extension in working with smallholder farmers?

Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1. To help them adopt new technologies/techniques from research and extension					
2. To constantly provide them with new technologies and ideas on how to farm					
3. To stimulate their thinking about generating new technologies or ways of doing things in their farm enterprises					
4 To help them be more confident to interact with other people who can help them solve their farming problems.					
5. To help them access the knowledge and information relevant to their farming enterprise					
6. To provide them with free technologies/inputs to increase their production					
7. To promote farmers' independence in identifying and coming up with solutions to their problems					

24. To what extent do you agree or disagree with the following regarding farmers in research and extension programmes.

Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1. Farmers are either adopters or rejecters of new technologies/techniques from research and extension					
2. Farmers are a source of information useful for research and extension actors					
3. Farmers are experimenters of technologies/techniques from research and extension					
4. Farmers are one of many partners working with research and extension in agricultural innovation processes?					
5. Farmers are innovators that can come up with solutions to their problems.					
6. Farmers are innovators that exert demand for research and extension services					
7. Farmers are innovators that can learn from one another and come up with solutions to their problems					
8. Farmers must always depend on research and extension actors for sustainable solutions to their problems					

25. Which of the following factors do you see as key constraints limiting the effectiveness of the innovation system on rice in Sierra Leone and to what extent? (See further explanation below)

NOTE: An Agricultural Innovation System (AIS) involves the engagement and interaction of diverse actors/stakeholders beyond research and extension, all working towards increasing smallholder farmers' capacity to solve their farming problems. This may consist of Government, Non-Government and private institutions. For e.g. an agricultural innovation project may include research scientists, extensionists, private input suppliers, farmers, transporters, processors etc for the provision products and services aimed at increasing smallholder farmers capacity to solve the complex farming problems they face. AIS also involves putting mechanisms in place by the various actors to help farmers take up innovations and innovate themselves as well as helping each other to help farmers take up innovations.

The Agricultural Innovation System is effective if various actors/stakeholders are consciously and continuously interacting for the sharing of ideas, information, experiences, products and services without competition among themselves, for increasing the innovative capacity of the actors including smallholder farmers ability to come up with solutions to their farming problems.

Which factors? (Circle as applicable)	To what extent? (tick as applicable) (1=No extent, 2= Little Extent, 3= Some Extent, 4=Great Extent, 5= Very Great Extent)				
	1	**2**	**3**	**4**	**5**
1. Difficulty in cooperation of agric. partners eg INGOs and LNGOs					
2. Conflict among actors					
3. Poor cooperation of farmers in external innovation programmes					
4. Unwillingness/Difficulty of farmers to work in groups					
5. High honorarium for Government officials eg MAFFS and SLARI to do field work					
6. Poor partnership between INGOs and local NGOs					
7. Political interference in the operations of government programmes/innovations					
8. Bureaucracy in research and extension institutions					
9. Poor marketing policies for rice					
10.Lack of trust among members/actors					
11. Poor coordination of agricultural activities of the various stakeholders					
12. Differences in mode of operation of various organisations					
13. Differences in organisational interests					
14. Poor capacity building of staff					
15. Poor remuneration of staff					
16. Encouragement of farmers' dependency on external actors					
17. Continued use of top-down approaches (eg ToT)					
18. Lack of linkages to markets for smallholder farmers					
19. The feeling that farmers are incapable of solving problems and unable to innovate					
20. Low level of collaboration and partnerships among various actors					
Other (specify)…………………………………...…………………………………					

SECTION C: KNOWLEDGE OF AGRICULTURAL INNOVATION SYSTEM (AIS)[20] PERSPECTIVE IN AGRICULTURAL RESEARCH AND EXTENSION

26. Please rate your level of understanding of the Agricultural Innovation System (AIS) as a current perspective in the provision of agricultural research and extension services? (Where (-2) represents "very low understanding" and (+2) represents "very high understanding")

Very low understanding	(-2)	(-1)	(0)	(1)	(2)	Very high understanding

27. 2) How important do you think the use of AIS approach is in facilitating innovation processes with smallholder farmers and other actors?

Not important at all	(-2)	(-1)	(0)	(1)	(2)	Extremely important

28. Please rate your level of experience in the use of AIS approach in Research and Extension programmes?

Extremely low	(-2)	(-1)	(0)	(1)	(2)	Extremely high

29. Have you undergone any training on AIS approach? Yes (1) No (2)

30. If "Yes" to q29 above, please fill in the table below.

Length of training (In Days)?	Provider?	How long ago?
	1. Employer (SLARI, MAFFS) 2. Educational institution 3. Consultant	1. In the last 1 year 2. In the last 2-3 years 3. In the last 4-5 years

[20] Refer to question 25 above for an explanation on what this means in the context of this research.

	4. Other (specify)………………..	4. 6 years or more
1.		
2.		
3.		

Perception of Agricultural Innovation System approach

31. Do you think the use of AIS approach in agricultural research and extension a complex process?

Extremely complex	(-2)	(-1)	(0)	(+1)	(+2)	Extremely simple

32. AIS is an expensive approach

Extremely expensive	(-2)	(-1)	(0)	(+1)	(+2)	Extremely cheap

33. The use of AIS is time consuming

Strongly disagree	(-2)	(-1)	(0)	(+1)	(+2)	Strongly agree

34. The following are what other research and extension personnel say are **key behaviours of Research Scientists and Extensionists** for a functioning innovation system on rice in Sierra Leone. **Do you agree**? (**Tick one in each row**)

Behaviours	**Strongly disagree**				**Strongly Agree**
1. Using innovation platforms approach in research and extension projects	(-2)	(-1)	(0)	(+1)	(+2)
2. Use of participatory research methods	(-2)	(-1)	(0)	(+1)	(+2)
3. Strengthening smallholder farmers capabilities to independently solve their farming problems	(-2)	(-1)	(0)	(+1)	(+2)
4. Promoting learning within and between organisations for innovation	(-2)	(-1)	(0)	(+1)	(+2)
6. Formulation of policies favourable for collaboration and partnership	(-2)	(-1)	(0)	(+1)	(+2)
7. Decentralizing management of innovation processes	(-2)	(-1)	(0)	(+1)	(+2)
8. Strengthening individual/collective capabilities to innovate	(-2)	(-1)	(0)	(+1)	(+2)
10. Facilitating complex and dynamic interactions for smallholder farmers' access to knowledge sources, input and markets	(-2)	(-1)	(0)	(+1)	(+2)
11. Promoting network-based knowledge dissemination among various actors	(-2)	(-1)	(0)	(+1)	(+2)
12. Having confidence of all stakeholders in the innovation process	(-2)	(-1)	(0)	(+1)	(+2)

SECTION D: THEORY OF PLANNED BEHAVIOUR VARIABLES

35. Have you in the last one year exhibited any of these behaviours?

Behaviours	**YES (1) NO (2)**
1. Using innovation platforms approach in research and extension projects	
2. Use of participatory research methods	
3. Strengthening smallholder farmers capabilities to independently solve their farming problems	
4. Promoting learning within and between organisations for innovation	
6. Formulation of policies favourable for collaboration and partnership	
7. Decentralizing management of innovation processes	
8. Strengthening individual/collective capabilities to innovate	
10. Facilitating complex and dynamic interactions for smallholder farmers' access to knowledge sources, input and markets	
11. Promoting network-based knowledge dissemination among various actors	
12. Having confidence of all stakeholders in the innovation process	

A. Intention

Instructions: Please indicate the extent to which you agree or disagree with the following statements? Select responses ranging from 1 to 5. Select one response per question.

36. I expect to use AIS approach in the next 12 months.

Strongly disagree	1	2	3	4	5	Strongly agree

37. I want to use AIS approach in the next 12 months

Strongly disagree	1	2	3	4	5	Strongly agree

38. I intend to use AIS approach in next 12 months

Strongly disagree	1	2	3	4	5	Strongly agree

B. Beliefs and Values

37. I think the use of an AIS approach in my work would be: (tick one each row)

Extremely unpleasant for me	1	2	3	4	5	Extremely pleasant for me

Very useful	1	2	3	4	5	Very worthless

Extremely good	1	2	3	4	5	Extremely bad

Extremely unsustainable	(1)	(2)	(3)	4)	(5)	Extremely sustainable

The following statements are what other agricultural research and extension professionals say about a functioning innovation system.

C. Behavioural Belief Strength

38. In your opinion, to what extent do you agree or disagree with the following statements?

B1a. The use of an AIS approach in research and extension increases productivity and profitability of innovations for farmers.

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Increasing productivity and profitability of rice innovations is …..

Extremely unimportant	unimportant	No opinion	important	Very important
(-2)	(-1)	(0)	(+1)	(+2)

B2a. An effective AIS in research and extension can increase the attainment of food security among smallholder farmers…….

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Increasing the ability of smallholder farmers to attain food security is ……….

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B3a. In order to enhance the effectiveness and sustainability of innovations on rice, it is good to adopt an AIS approach

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Enhancing the effectiveness and sustainability of innovations on rice is …………

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B4a. Adopting an AIS approach in research and extension fosters capacity development of stakeholders including farmers

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Fostering capacity development of smallholders and other stakeholders in research and extension programmes is ………………

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B5a. A functioning AIS improves smallholder farmers' access to input and output markets.

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Improving smallholder farmers' access to input and output markets is…………………………………….

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B6a. An effective AIS enhances experience sharing and best practices among different actors

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Sharing of experiences and best practices among different actors is…………………………………….

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B7a. The adoption of an AIS approach in research and extension, will help reduce burden on any one actor.

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Reducing the burden on agricultural innovation actors is…………

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B8a. An effective AIS increases agricultural innovation actors (including farmers) ability to innovate

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Increasing the innovative capacity of smallholder farmers and other actors is …………

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B9a. Using an AIS approach in research and extension, make coordinating activities of the various stakeholders difficult

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Difficulty in coordinating the activities of various stakeholders is……………………………………………….

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B10a. AIS approach in research and extension is difficult to implement due to the diversity of interests of various actors.

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Diversity of interests of agricultural innovation actors is……………..

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B11a. AIS approach is a time consuming approach in research and extension.

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. A time consuming approach in research and extension is …………

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B12a. If I adopt an AIS approach in research and extension, it will be more expensive.

Strongly disagree	disagree	I don't know	Agree	Strongly agree

1	2	3	4	5

b. An expensive approach in research and extension is …………

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B13a. An AIS approach is difficult to adopt if the policies in my organisation do not support an AIS perspective.

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. The lack of favourable policies for AIS in research and extension is ………

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

D. Perceived Behavioural Control

Instruction: Select answers from 1 to 5 in each question**.**

39. I am confident that I can employ an AIS approach if I wanted to.

Strongly disagree	1	2	3	4	5	Strongly agree

40. For me to use an AIS approach in research and extension is easy.

Strongly disagree	1	2	3	4	5	Strongly agree

41. The decision to use an AIS approach is beyond my control.

Strongly disagree	1	2	3	4	5	Strongly agree

42. Whether or not I use an AIS approach is entirely up to me.

Strongly disagree	1	2	3	4	5	Strongly agree

43. For me, I have enough knowledge and skills on AIS.

Strongly disagree	1	2	3	4	5	Strongly agree

44. Knowledge and skills on AIS approach makes it………….

Much more difficult	(-2)	(-1)	(0)	(+1)	(+2)	Much easier

…………….to adopt an AIS approach in research and extension.

45. I have adequate financial resources (eg from donors) to adopt an AIS approach

Strongly disagree	1	2	3	4	5	Strongly agree

46. Financial resources make AIS approach……………………

Much more difficult	(-2)	(-1)	(0)	(+1)	(+2)	Much easier

………………to adopt an AIS approach in research and extension.

47. I expect that institutional policies of my organizations will discourage me from adopting an AIS approach in research and extension.

Strongly disagree	1	2	3	4	5	Strongly agree

48. Institutional policies will make it…………..

Much more difficult	(-2)	(-1)	(0)	(+1)	(+2)	Much easier

………………to adopt an AIS approach in research and extension.

49. I expect that the cooperation and behaviour of other actors (farmers, extensionists, researchers, Agro-dealers as applicable) will discourage me from adopting an AIS approach in research and Extension

Strongly disagree	1	2	3	4	5	Strongly agree

50. For me, the cooperation and behaviour of other actors make it…………

Much more difficult	(-2)	(-1)	(0)	(+1)	(+2)	Much easier

……………to adopt an AIS approach in research and extension.

51. I expect that the cultural norms of smallholder farmers will discourage me from adopting an AIS approach

Strongly disagree	1	2	3	4	5	Strongly agree

52. For me, cultural norms of farmers make it ………………………..

Much more difficult	(-2)	(-1)	(0)	(+1)	(+2)	Much easier

…………………………..to adopt an AIS approach in research and extension

53. I expect that the lack of incentives from my organisation will discourage me from adopting an AIS approach in research and extension.

Strongly disagree	1	2	3	4	5	Strongly agree

54. Incentives for staff will make it…………..

Much more difficult	(-2)	(-1)	(0)	(+1)	(+2)	Much easier

………………to adopt an AIS approach in research and extension

E. Subjective Norm

55. Most people who are important to me think that I should adopt an AIS approach in research.

Strongly disagree	1	2	3	4	5	Strongly agree

56. It is expected of me that I adopt an AIS approach.

Strongly disagree	1	2	3	4	5	Strongly agree

57. I feel under social pressure to adopt an AIS approach.

Strongly disagree	1	2	3	4	5	Strongly agree

58. People who are important to me want me to adopt an AIS approach.

Strongly disagree	1	2	3	4	5	Strongly agree

59. How likely is that the following people would want you to adopt an AIS approach in agricultural research and extension in the next 12 months?

Motivators	Very Unlikely	Unlikely	Undecided	Likely	Very Likely
a. Employer (MAFFS, SLARI, NGO etc)	(1)	(2)	(3)	(4)	5)
b. Supervisors	(1)	(2)	(3)	(4)	5)
c. Professional colleagues	(1)	(2)	(3)	(4)	5)
d. Donors	(1)	(2)	(3)	(4)	5)
e. Farmers	(1)	(2)	(3)	(4)	5)
f. Community leaders	(1)	(2)	(3)	(4)	5)
g. Family	(1)	(2)	(3)	(4)	5)

F. Motivation to Comply

60. How motivated would you be to follow the advice of the following regarding the adoption of an AIS approach in research and extension

Motivators	Very weak	Weak	Undecided	Strongly	Very Strongly
a. Employer (MAFFS, SLARI, NGO etc)	(1)	(2)	(3)	(4)	5)
b. Supervisors	(1)	(2)	(3)	(4)	5)
c. Professional colleagues	(1)	(2)	(3)	(4)	5)
d. Donors	(1)	(2)	(3)	(4)	5)
e. Farmers	(1)	(2)	(3)	(4)	5)
f. Community leaders	(1)	(2)	(3)	(4)	5)
g. Family	(1)	(2)	(3)	(4)	5)

SECTION E

AIS BEHAVIOUR: (For Senior Management Staff ONLY)

The Use of Innovation Platforms in Research and Extension

NOTE: This behaviour is about facilitating interactions of stakeholders with different backgrounds and interests including farmers, traders, food processors, researchers, government officials etc. This involves bringing them together to diagnose problems, identify opportunities and find ways to achieve goals geared towards increasing smallholder farmers' sustainable production and income. This may involve the design and implementation of activities as a platform or the coordination of individual activities.

A. Intention

Instructions: Please select responses ranging from (1) to (5). Select one response per question.

62. I expect to use innovation platforms in the next 12 months.

Strongly disagree	1	2	3	4	5	Strongly agree

63. I want to use innovation platforms in the next 12 months

Strongly disagree	1	2	3	4	5	Strongly agree

38. I intend to innovation platforms in next 12 months

Strongly disagree	1	2	3	4	5	Strongly agree

B. Beliefs and Values

64. I think the use innovation platforms in my work would be: (tick one each row).

Extremely unpleasant for me	1	2	3	4	5	Extremely pleasant for me

Extremely worthless	1	2	3	4	5	Extremely useful

Extremely bad	1	2	3	4	5	Extremely good

Extremely unsustainable	1	2	3	4	5	Extremely sustainable

The following statements are what other agricultural research and extension professionals say about the use of innovation platforms in research and extension.

C. Behavioural Belief Strength

65. In your opinion, to what extent do you agree or disagree with the following statements?

B1a. Innovation platforms create a common vision and mutual trust among stakeholders.

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Creating a common vision and mutual trust among stakeholders is…..

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B2a Innovation Platforms enable partners to identify the bottlenecks hindering innovation and develop solutions beyond what individual actors can achieve alone.

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Partnering for the identification of bottlenecks hindering innovation and developing solutions is ….……….

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B3a. Innovation Platforms empower communities to demand and negotiate for services from the government and support organisations.

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Empowering communities to demand and negotiate for services is …………

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B4a. Innovation platforms enable joint learning and co-operation among diverse actors to solve problems and reduce uncertainties.

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Enabling joint learning and co-operation among diverse actors to solve problems is ………………

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B5a. Innovation Platforms contribute to capacity development of the diverse actors.

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Developing the capacity of diverse actors is…………

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B6a. Innovation Platforms create opportunities for research to be demand-driven and to find critical issues for investigation, and to disseminate research outputs.

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Creating opportunities for demand-driven research is……………………………………………….

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B7a. Innovation Platforms enable farmers to improve their agricultural productivity and profitability and improve how they manage natural resources.

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Improving farmers' agricultural productivity and profitability and management of natural resources is …………

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B8a. Innovation Platforms can be difficult and costly to implement.

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Approaches that are difficult and costly to implement are………

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B9a. Engaging diverse actors and developing relationships in Innovation Platforms takes time.

Strongly disagree	disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. An approach that takes time in research and extension is ………………

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

D. Perceived Behavioural Control

66. I am confident that I can use innovation platforms in my organisation if I wanted to.

Strongly disagree	1	2	3	4	5	Strongly agree

67. For me, to use innovation platforms in my organisation is easy.

Strongly disagree	1	2	3	4	5	Strongly agree

68. The decision to use innovation platforms in my organisation is beyond my control.

Strongly disagree	1	2	3	4	5	Strongly agree

69. Whether or not I use innovation platforms in my organisation is entirely up to me.

Strongly disagree	1	2	3	4	5	Strongly agree

70. I expect that the lack of adequate financial resources (eg from donors) will discourage me from using innovation platforms in research and extension.

Strongly disagree	1	2	3	4	5	Strongly agree

71. Lack of adequate financial resources make it……………………

Much more difficult	(-2)	(-1)	(0)	(+1)	(+2)	Much easier

………………to use innovation platforms in research and extension.

72. I expect that the institutional policies of my organizations will discourage me from using innovation platforms in research and extension.

Strongly disagree	1	2	3	4	5	Strongly agree

73. Institutional policies will make it…………..

Much more difficult	(-2)	(-1)	(0)	(+1)	(+2)	Much easier

………………to use innovation platforms in research and extension.

74. I expect that the cooperation and interest of partners will discourage me from using innovation platforms in research and extension.

Strongly disagree	1	2	3	4	5	Strongly agree

75. Partners cooperation and interest will make it………………

Much more difficult	(-2)	(-1)	(0)	(+1)	(+2)	Much easier

………..to use innovation platforms in research and extension.

E. Subjective Norm

76. Most people who are important to me think that I should use innovation platforms.

Strongly disagree	1	2	3	4	5	Strongly agree

77. It is expected of me that I use innovation platforms.

Strongly disagree	1	2	3	4	5	Strongly agree

78. I feel under social pressure to use innovation platforms.

Strongly disagree	1	2	3	4	5	Strongly agree

79. People who are important to me want me to use innovation platforms.

Strongly disagree	1	2	3	4	5	Strongly agree

80. How likely is that the following people would want you to use innovation platforms in research and extension in the next 12 months?

Motivators	Very Unlikely	Unlikely	Undecided	Likely	Very Likely
a. Employer (MAFFS, SLARI, NGO etc)	(1)	(2)	(3)	(4)	5)
b. Supervisors	(1)	(2)	(3)	(4)	5)
c. Professional colleagues	(1)	(2)	(3)	(4)	5)
d. Donors	(1)	(2)	(3)	(4)	5)
e. Farmers	(1)	(2)	(3)	(4)	5)
f. Community leaders	(1)	(2)	(3)	(4)	5)

g. Family	(1)	(2)	(3)	(4)	5)

F. Motivation to Comply

81. How motivated would you be to follow the advice of the following regarding the use of innovation platforms in research and extension.

Motivators	Very weak	Weak	Undecided	Strongly	Very Strongly
a. Employer (MAFFS, SLARI, NGO etc)	(1)	(2)	(3)	(4)	5)
b. Supervisors	(1)	(2)	(3)	(4)	5)
c. Professional colleagues	(1)	(2)	(3)	(4)	5)
d. Donors	(1)	(2)	(3)	(4)	5)
e. Farmers	(1)	(2)	(3)	(4)	5)
f. Community leaders	(1)	(2)	(3)	(4)	5)
g. Family	(1)	(2)	(3)	(4)	5)

SECTION E
(For Middle and Frontline Staff ONLY)

AIS Behaviour:

Facilitating complex and dynamic interactions among various stakeholders

NOTE: This behaviour is about facilitating interactions of all stakeholders including farmers, private traders, transporters, researchers, extension staff, processors etc in the innovation process in your area of operation. Interactions among these stakeholders aim to ensure their mutual contributions in identifying and solving farmers' problems and opportunities in a timely, sustainable and profitable manner.

Instructions: Please select responses ranging from (1) to (5). Select one response per question.

64. I expect to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders in the next 12 months.

Strongly disagree	1	2	3	4	5	Strongly agree

65. I want to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders in the next 12 months

Strongly disagree	1	2	3	4	5	Strongly agree

66. I intend to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders in the next 12 months.

Strongly disagree	1	2	3	4	5	Strongly agree

B. <u>Beliefs and Values</u>

67. I think facilitating complex and dynamic interactions of diverse agricultural innovation stakeholders in my work would be: (tick one each row)

Extremely unpleasant for me	1	2	3	4	5	Extremely pleasant for me

Very useful	1	2	3	4	5	worthless

Extremely good	1	2	3	4	5	Extremely bad

Extremely difficult	1	2	3	4	5	Extremely easy

The following statements are what other agricultural research and extension professionals say about facilitation of complex and dynamic interactions of diverse agricultural innovation stakeholders including farmers.

<u>C. Behavioural Belief Strength</u>

68. In your opinion, do you agree or disagree with the following statements?

B1a. The facilitation of complex and dynamic interactions of diverse agricultural innovation stakeholders enhances access to knowledge sources, information and markets by smallholder farmers.

Strongly disagree	Disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Enhancing access to knowledge sources, information and markets by smallholder farmers is …….

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B2a. In order to enhance the effectiveness and sustainability of innovations on rice, it is good to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders.

Strongly disagree	Disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Enhancing the effectiveness and sustainability of innovations on rice is ………….

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B3a. Facilitation of complex and dynamic interactions of diverse agricultural innovation stakeholders in research and extension fosters the development of their innovative capacities

Strongly disagree	Disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Fostering capacity development of innovation actors in research and extension is ……………………….

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B4a. If I try to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders in research and extension, I will find it difficult to obtain their commitment.

Strongly disagree	Disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. For me, the difficulty in obtaining the commitment of diverse stakeholders is……………………………………………….

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B5a. I find it difficult to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders with differing interests/objectives

Strongly disagree	Disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. For me, differing interests/objectives of diverse agricultural innovation stakeholders is……………..

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B6a. The facilitation of complex and dynamic interactions of diverse agricultural innovation stakeholders in research and extension is time consuming

Strongly disagree	Disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. A time-consuming approach in research and extension is …………

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

B7a. It is difficult to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders in research and extension.

Strongly disagree	Disagree	I don't know	Agree	Strongly agree
1	2	3	4	5

b. Something that is difficult to do in research and extension is …………

Extremely bad	Bad	No opinion	Good	Extremely Good
(-2)	(-1)	(0)	(+1)	(+2)

D. Perceived Behavioural Control

Instruction: Select one answer from 1 to 5 in each question to show the extent to which you agree or disagree with a given statement**.**

69**.** I am confident that I can facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders if I wanted to.

Strongly disagree	1	2	3	4	5	Strongly agree

70. For me to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders in research and extension is easy.

Strongly disagree	1	2	3	4	5	Strongly agree

71. The decision to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders is beyond my control.

Strongly disagree	1	2	3	4	5	Strongly agree

72. Whether or not I facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders is entirely up to me.

Strongly disagree	1	2	3	4	5	Strongly agree

73. For me, the lack of capacity to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders could discourage me from doing so in research and extension.

Strongly disagree	1	2	3	4	5	Strongly Agree

61. The lack of capacity makes it………….

Much more difficult	(-2)	(-1)	(0)	(+1)	(+2)	Much easier

…………….to execute tasks in research and extension.

74. I expect that the lack of adequate financial resources (eg from donors) will discourage me from facilitating complex and dynamic interactions of diverse agricultural innovation stakeholders.

Strongly disagree	1	2	3	4	5	Strongly Agree

75. Lack of adequate financial resources make it……………………

Much more difficult	(-2)	(-1)	(0)	(+1)	(+2)	Much easier

………………to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders

76. I expect that the cooperation and behaviour of agricultural innovation stakeholders will discourage me from facilitating complex and dynamic interactions in research and Extension

Strongly disagree	1	2	3	4	5	Strongly Agree

77. For me, the cooperation and behaviour of agricultural innovation stakeholders make it………….

Much more difficult	(-2)	(-1)	(0)	(+1)	(+2)	Much easier

……………to facilitate complex and dynamic interactions in research and extension.

E. Subjective Norm

78. Most people who are important to me think that I should facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders

Strongly disagree	1	2	3	4	5	Strongly agree

79. It is expected of me that I facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders.

Strongly disagree	1	2	3	4	5	Strongly agree

80. I feel under social pressure to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders.

Strongly disagree	1	2	3	4	5	Strongly agree

81. People who are important to me want me to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders.

Strongly disagree	1	2	3	4	5	Strongly agree

82. How likely is it that the following people would want you to facilitate complex and dynamic interactions of diverse agricultural innovation stakeholders in research and extension in the next 12 months?

Motivators	Very Unlikely	Unlikely	Undecided	Likely	Very Likely
a. Employer (MAFFS, SLARI, NGO etc)	(1)	(2)	(3)	(4)	(5)
b. Supervisors	(1)	(2)	(3)	(4)	(5)
c. Professional colleagues	(1)	(2)	(3)	(4)	(5)

d. Donors	(1)	(2)	(3)	(4)	(5)
e. Farmers	(1)	(2)	(3)	(4)	(5)
f. Community leaders	(1)	(2)	(3)	(4)	(5)
h. Family	(1)	(2)	(3)	(4)	(5)

F. Motivation to Comply

83. How motivated would you be to follow the advice of the following regarding the facilitation of complex and dynamic interactions of diverse agricultural innovation stakeholders in research and extension.

Motivators	Very weak	Weak	Undecided	Strongly	Very Strongly
a. Employer (MAFFS, SLARI, NGO etc)	(1)	(2)	(3)	(4)	(5)
b. Supervisors	(1)	(2)	(3)	(4)	(5)
c. Professional colleagues	(1)	(2)	(3)	(4)	(5)
d. Donors	(1)	(2)	(3)	(4)	(5)
e. Farmers	(1)	(2)	(3)	(4)	(5)
f. Community leaders	(1)	(2)	(3)	(4)	(5)
g. Family					

Thank you for your time!!

Appendix 3: Structured Questionnaire for Smallholder Farmers

Information Sheet for Rice Farmers

Reference	

Assessment of Rice Innovation Processes and System in Sierra Leone

Dear Participants,

I am a doctoral student from the University of Reading conducting research on R**ice Innovation System in Sierra Leone from 2005-15**. The main aim of the study is to examine the rice innovation system in Sierra Leone from perspectives of research and extension actors as well as smallholder rice farmers. You have been selected as one of the respondents of the study because you are a rice farmer and have participated in research and extension programmes in your community in the past ten years. The interview will take approximately 40 minutes to complete.

Further, please note that your participation in this study is entirely voluntary, and you are free to withdraw at any time without any consequences of any sort. You are free not to respond to any question during the interview, or request for your information to be removed from the research at any time within the first three months after the survey. If you wish your information to be removed from the study within this timeframe, you can contact me (details below) quoting your reference at the top of this page. However, in as much as I want this study to be as representative as possible of the views of smallholder rice farmers in Sierra Leone, I do hope that you will feel able to take part. Please note that the reference code will only be used by the primary investigator to identify you in case you intend to withdraw your information from the survey but not to disclose your identity or the information you provided to a third party. A list of all research respondents with their respective reference codes will be kept separately by the researcher for this purpose.

The data that will be generated from this study will be used for my doctoral thesis at Reading University, writing up papers for publication in peer-reviewed journals.

If you do agree to participate in this research, I will take that as an acknowledgement that you have had the terms of your participation adequately explained and that you have given your consent.

If at any stage you wish to receive further information about the research activities or project please do not hesitate to contact Mr. Lamin Ibrahim Kamara (contact details below). In addition, you can also contact my supervisor, Dr Peter Dorward, at the Graduate Institute of International Development and Applied Economics, Agriculture Building, University of Reading, PO Box 237, Reading RG6 6AR.

Yours sincerely,

…………………………………

Mr. Lamin Ibrahim Kamara

PhD Researcher, University of Reading

l.i.kamara@pgr.reading.ac.uk

+232[redacted] (Sierra Leone)

+44[redacted] (UK)

HOUSEHOLD QUESTIONNAIRE ON RICE FARMERS

District: _____ Community________________ House #_____Left/Right Respondent S.No_______

Enumerator ____________Respondent's Ref:#________________Date______________

Instructions to Enumerators: Please ensure that you have had the terms of participation of the respondent as outlined in the information sheet clearly explained before proceeding with the interview.

SECTION I: SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS

This section is about your social and economic characteristics including your educational level, sources and use of income, household composition etc. [Enumerator]- Please explain how this information will help us understand the rest of the information they will be giving in the subsequent sections.

1. Sex [ ] [Male (1) Female (2)]
2. Age [ ] [18-30 (1) 31-40 (2) 41 – 50 (3) Above 50 years (4)]
3. Marital status [ ] [Married (1); Single (2); Separated (3); Widow/widower (4);
4. Your position in the household [ ] Head (2) Spouse of HH head (3) Son/Daughter of HH head (delete as appropriate) (4) Other (Please specify)___________________
5. Gender of HH head [ ] [Male (1) Female (2)]
6. My educational level is [ ] [None (1); Primary (2); Secondary (3); Vocational college(4); University (5); Arabic (6); Other (specify_____________)]
7. How far is the nearest school to your house (in Kilometres)? [In community (1); 1-5 Km (2); 6-10 Km (3); above 10 km (4)] [ ]

   Hint: 1 Mile =1.6KM
8. How far is the nearest office of the MAFFS from your community? [ ] [In community (1); 1-5 km (2); 6-10Km (3); above 10 km (4)]
9. How many people are in your household? [ ]

   8b. How many are a) Adult Male [ ] b) Adult Female [ ] c) Children aged 0-17yrs [ ]
10. What are your major sources of income?

Primary Source		[Agricultural activities (1); Non-agricultural activities (2)]
Secondary Source		[Agricultural activities (1); Non-agricultural activities (2)]

11. Which of the following best describes your type of land tenure: [ ] [Own land (1); Rented land (2); Leased land (3); Owned by family (4) Communal (5) Other (4) (specify)____________]
12. What is the size of your farmland (irrespective of the tenure type)? [Hint: 1 football field = 100m*50m, 2 football fields = 1 hectare]

	Who owns it?	**Size**	**Unit (i.e. acre, hectare etc)**
Own	Household		
	Husband		
	Wife		
Rent	Household		
	Husband		
	Wife		
Borrow	Household		
	Husband		
	Wife		
Shared Crop	Household		
	Husband		
	Wife		
Communal	Household		
	Husband		
	Wife		

13. What are the main crops you grow on the following ecologies?

Upland	**Lowland**
Main Crop___________________________	Main Crop___________________________
Other Crops_________________________	Other Crops_________________________
____________________________________	____________________________________

14. Which of the following best applies to the way you use your main crop after harvesting? [ ]
[Sell all (1); Eat and sell some (2); Eat, sell and keep some as seeds (3); Eat and keep some as seeds (4); Eat all (5) Other specify (5)____]

15. Rank the 3 most important crops for **household income**?

Crop	**Rank**	
Cassava		[Most important (1); Second most important (2); Third most important (3)]
Potato		
Rice		
Groundnut		
Other____________		
Other____________		

16. Rank the 3 most important crops your household depend on for **food**?

Crop	**Rank**	
Cassava		[Most important (1); Second most important (2); Third most important (3)]
Potato		
Rice		
Groundnut		
Other____________		
Other____________		

17. If you sell all or part of your produce, how far is the nearest market to your community? [ ] [In community (1); 1-5 Km (2); 6-10 Km (3); above 10 Km (4)]

18. What is the average monthly income between:

    a. November to April Le______________?

    b. May to October Le________________?

19. What are the 3 most important things you spend your household income on?

    a. _______________b. _________________ c.____________________

20. Do you rear animals? [ ] Yes (1); No (2)]

21. If "yes" to q20 above, which? [ ] [Poultry (1); Goats (2); Sheep (3); Cattle (4); Pig (5)]

22. How many members does the household have? [ ] [Ten or more (1); Seven, eight, or nine (2); Six (3); Five (4); Four (5); One, two or three (6)]

23. Are all household members' ages 6 to 13 in school now? [ ] [Yes, or no one aged 6 to 13 (1); No (2)]

24. What was the activity of the female head/spouse in her main occupation in the past 12 months? [ ] [No female head/spouse (1); Agriculture, forestry, mining, or quarrying (2); Other, or does not work (3)]

25. How many rooms does the household occupy (exclude bathrooms, toilets, kitchen, pantry, hall, and storage)? [ ] [One (1); Two (2); Three or more (3)]

26. What is the main flooring material? {Enumerator: Observe} [ ] [Earth/mud, stone/brick, or other (1); Wood, or cement/concrete (2)]

27. What is the main construction material of the outside walls? [ ] [Stone/burnt bricks, or other (1); Mud/mud bricks, or wood (2); Cement/sandcrete, or corrugated iron sheets (3)

28. What type of toilet is used by the household? [ ] [Bush/river, none, or other (1); Bucket, common pit, or VIP (2); Private pit, common flush, or flush toilet (3)

29. What is the main source of lighting for the dwelling? [ ] Generator, kerosene, gas lamp, candles /torch light, or other (1); Electricity (mains) (2)]

30. What is the main fuel used by the household for cooking? [ ] [Wood, or other (1); Charcoal (2); Gas, kerosene, or electricity (3)

31. How many radios, radio cassettes, record players, or 3-in-1 radio cassettes do members of the household own? [ ] [None (1); One (2); Two or more (3)

SECTION 2: FARMERS INNOVATIONS IN THE LAST 10 YEARS; DRIVERS, ACTORS AND CONSTRAINTS ASSOCIATED WITH THESE INNOVATIONS

This sections seeks to elicit information on changes you (farmer) have effected on your rice farms in the last 10 years. This could be changes out of your own initiative or those resulting from technologies or techniques promoted by organisations working in the agriculture sector in your community. These changes could range from use of new or improved varieties, trying new agronomic practices, changes in rice processing and marketing strategies etc. The drivers and sources or facilitators of these changes, and the constraints (if any) limiting your ability to make changes in your rice farming system will also be elicited in this section.

32. What do you think are the most important changes you have effected in your rice farming system in the last 10 years? (NOTE**: For each innovation mentioned, please ask respondent to identify the reasons for making the change (q33) and select the appropriate responses in question q33below concurrently**)

Changes/innovations in:	New technology/practice (Innovation)	Name the **top 5 changes/innovations (**if applicable) in **order of decreasing importance** to you:
a) Pre-Production	1. Improved varieties (name top 5 varieties)	1.................................. 2………………………………… 3………………………………… 4……………………………….. 5…………………………………
	2.Local varieties (name top 5 varieties)	1 ………………………………… 2…………………………………. 3…………………………………. 4…………………………………. 5…………………………………..
b) Production/Agronomic	1. Land preparation before nursery 2. Shallow planting of seedling during transplanting 3. Reduced nursery time of seedling (state # of days………………..) 4. Weeding of Inland Valley Swamps 5. Priming of seeds before nursery 6. Reduced seedlings per hill (state # per hill…………) 7. Construction of bunds in lowlands (Swamp development) 8. Puddling 9. Increased spacing between stands of seedlings 10. Use of organic manure 11. Use of chemical fertilizers 12. Crop rotation Other (specify) ………………………………................................. …………………………………………………………………	1 ……………………………….. 2………………………………… 3 ………………………………… 4 ………………………………… 5 ………………………………….

c) Post-harvest Innovations	1. Treatment of stored rice with pepper 2. Early threshing: 1 or 2 days after harvesting as opposed to months after harvesting 3. Threshing by trampling with feet rather than flailing with sticks 4. Storing of rice seed in community store 5. Use of rice mill as opposed to manual pounding 6. Rice sales in ABC located in nearby community 7. Storing rice in town after threshing as opposed to storing in the bush/farm 8. Using drying floor as opposed to drying on the bare ground 9. Use of threshers 10. Storing rice in ABC 11. Use of jute bag plus wood ash 12. Use of plastic containers 11. Other (specify) ………………………………………………………………… …………………………………………………………………	1 ……………………………….. 2 ………………………………… 3 ………………………………… 4 ………………………………… 5………………………………….

33. What are the key reasons for making each of the changes mentioned above on your rice farming system? (**Don't prompt**!)

New Rice Varieties	**Write the serial number (s) of the innovation (s) for which this is a reason (refer to q32 above)**	**Score the reasons in relation to how they are important to you [No importance (1); Very little importance (2); Medium importance (3), Great importance (4) Very Great Importance (5)**				
1. Early maturity of NERICA or other short duration varieties		**1**	**2**	**3**	**4**	**5**
2. Better tillering and growth of seedlings		**1**	**2**	**3**	**4**	**5**
3. Opportunity to grow vegetables or other crops earlier than normal due to early maturity of the variety		**1**	**2**	**3**	**4**	**5**
4. Improve household food security throughout the year		**1**	**2**	**3**	**4**	**5**
5. Good taste		**1**	**2**	**3**	**4**	**5**
6. Enhance opportunity for double cropping		**1**	**2**	**3**	**4**	**5**
7. To increase yield/productivity		**1**	**2**	**3**	**4**	**5**
8. To increase household income		**1**	**2**	**3**	**4**	**5**
9. Reduce indebtedness of farm family		**1**	**2**	**3**	**4**	**5**
10. To ascertain the yield capacity of new local variety being planted by other farmers		**1**	**2**	**3**	**4**	**5**
11. Lack of/limited alternatives		**1**	**2**	**3**	**4**	**5**
12. To improve viability of seeds		**1**	**2**	**3**	**4**	**5**
Other (specify)……………………………………………………………… ……….		**1**	**2**	**3**	**4**	**5**
Other (specify)……………………………………………………………… ……..		**1**	**2**	**3**	**4**	**5**

Production/Agronomic (Reasons)						
1. Improves germination rate		1	2	3	4	5
2. Increases the tillering ability of seedlings		1	2	3	4	5
3. Increases yield		1	2	3	4	5
4. Eases land preparation and reduces weed infestation		1	2	3	4	5
5. Enhances the growth rate of seedlings		1	2	3	4	5
6. Enhances fertilizer application		1	2	3	4	5
7. To repel pests eg cutting grass……………………….		1	2	3	4	5
8. Enhance double cropping		1	2	3	4	5
9. Minimize wastage of inputs		1	2	3	4	5

Other (specify)		1	2	3	4	5
Other (specify)		1	2	3	4	5
Post-harvest						
1. Reduces drudgery associated with manual pounding of rice by women and children		1	2	3	4	5
2. Improves quality of rice by using dry floor – no impurities		1	2	3	4	5
3. Reduces postharvest losses		1	2	3	4	5
4. Improves viability of seeds		1	2	3	4	5
5. Minimizes the risk of consuming seeds when stored in community store		1	2	3	4	5
6. Improves tillering and growth of seedlings		1	2	3	4	5
7. Reduces risk of pests and thieves when stored in community store		1	2	3	4	5
Other (specify)		1	2	3	4	5
Other (specify)						

34. If you have planted improved rice varieties in the past 10 years, what do you consider as the major differences between local and improved rice varieties?

Local varieties	**Improved varieties**
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.

35. Which variety did you grow this season?

a. Improved variety (1) Local variety (2) Both (3)	
b. How many years ago when you started growing this/these variety/ies?	
c. Name of variety (ies)?	
i.	
ii.	
iii.	

36. Have you come up with innovations (apart those from external actors) to solve problems related to your rice farming system in the past 10 years? Yes (1) No (2)

37. If yes, what are they? Are you or other farmers still using them? If no, why not?

Innovation (s) by me	I am still using them? Yes (1) No (2)	Other farmers are still using them? Yes (1) No (2)	If you or other farmers are not using it (or them), why not?
1.			
2.			
3.			
4.			
5.			

38. Have you in a group (with other farmers you know) come up with innovations to solve problems related to your rice farming system in the past 10 years? Yes (1) No (2)

39. If Yes, what are they? Are you or other farmers still using them? If no, why not?

Innovation (s) **we** have come up with	I am still using them? Yes (1) No (2)	Other farmers are still using them? Yes (1) No (2)	If you or other farmers are not using them, why not?
1.			
2.			
3.			
4.			
5.			

40. What do you think helped you make each of these changes on your rice farming system in q32 above? [Not helpful (1); No opinion (2); A little helpful (3) Helpful (4) Very helpful (5)]

Change **(refer to q32 above and number them in that order)**	Information/ ideas from MAFFS Extension Officers **Yes (1); No (2)**	Information/ ideas from NGO Extension Officer **Yes (1); No (2)**	Seeds from MAFFS Extension Officer **Yes (1); No (2)**	Seeds from NGO Extension Officer **Yes (1); No (2)**	Seeds by colleague farmer **Yes (1); No (2)**	Information/ideas from colleague farmer **Yes (1); No (2)**	Own Initiative **Yes (1); No (2)**	Agro-dealers/ Itinerant agricultural traders **Yes (1); No (2)**	Agricultural research Officer **Yes (1); No (2)**	Information/ ideas from the radio **Yes (1); No (2)**	Information/ideas from community leaders (Town chief, etc) **Yes (1); No (2)**	Other (Specify)….
	Helpfulness (1, 2, 3,4 or 5)	Helpfulness (1, 2, 3,4 or 5)	Helpfulness (1, 2, 3,4 or 5)	Helpfulness (1, 2, 3,4 or 5)	Helpfulness (1, 2, 3,4 or 5)	Helpfulness (1, 2, 3,4 or 5)	Helpfulness (1, 2, 3,4 or 5)	Helpfulness (1, 2, 3,4 or 5)	Helpfulness (1, 2, 3,4 or 5)	Helpfulness (1, 2, 3,4 or 5)	Helpfulness (1, 2, 3,4 or 5)	Helpfulness (1, 2, 3,4 or 5)
a.												
b.												
c.												
d.												
e.												
f.												
g.												
h.												
i.												
j.												

41. What activities do the following actors do in your community and how important are these activities to your farming system?

Actor [(Pre-production, Production, postharvest etc)]	Importance **[No importance (1); Very little importance (2); Medium importance (3), Great importance (4) Very Great Importance (5)**]	**Specific activity of Actor** [Selling agricultural inputs (1); Buying rice produce (2); Sharing rice farming information/ideas (3); Providing processing facilities (4); Providing advice (5); Providing pesticides (6); Connecting us with traders/other actors (7) In-kind exchange services of rice seeds (8) Sharing general information on agriculture (9) None (99) Other (specify) ………………………………]
1. MAFFS Extension Workers		
2. NGO Extension Workers		
3. Agro-dealers		
4. Itinerant agricultural traders		
5. ABC[21]s		
6. Colleague farmers from the community		
7. Colleague farmers outside the community		
8. Agricultural research Officer		
9. Lead Farmers in or outside community		
10. Community Leaders/Authorities		
11. District Council officials		
10. Radio station		
Other (specify)……………………..		

42. For each of the innovations you have mentioned above (question 32), did you face any challenges in trying to make these changes? ☐ [Yes (1); No (2)]

43. If "Yes" to q42 above, what were the challenges?

Change/Innovation	**Challenges**
1.	
2.	
3.	
4.	
5.	

44. Apart from challenges you face in **<u>making the changes in your rice farming system</u>** mentioned above, do you generally have any constraints that are limiting your ability to make changes to the way you farm? ☐ Yes (1) No (2)

[21] Agricultural Business Centres constructed by MAFFS nationwide to serve as input and output markets and processing centres etc

45. If “yes” to q44 above, what are the major constraints (**Prompt**)?

	Not constraining (1)	Minor constraint (2)	Constraint (3)	Major constraint (4)
Lack of contact with extension staff				
Cost of inputs				
Unavailability of inputs				
Cost of labour				
Unavailability of labour				
Lack of opportunity to share ideas with other farmers				
Lack of financial resources				
Lack of “farmer friendly” credit facilities/loans				
Lack of information on new agricultural technology/techniques				
Lack of processing facilities				
Lack of access to markets				
Low prices of agricultural produce				
Lack of opportunity to feedback to extension / research about innovations				
Research and extension don’t know the real production problems we face				
I don’t have confidence that the new activities will work				
Fear of the risk associated with trying new things or techniques				
High cost of new technologies (seeds, tools, fertilizers etc)				
Lack of influence on household decision-making				
Pest and diseases				

46. What innovations from “external sources” have you not tried and why? Which have you tried and dropped?

Innovations not tried (circle as many as applicable)	**Why? (give reasons here)**	**Innovations tried and dropped (name them)**	**Why? (give reasons here)**
1. Line sowing		1.	
2. Use of ABCs		2.	
3. Planting of single seedling per stand		3.	
4. Growing NERICAs		4.	
5. Growing other improved varieties		5.	
6. Water control – swamp development		6.	
7. Use of fertilizer		7.	
8. Nursery duration		8.	
9. Priming – soaking of seed before nursing		9.	
10. Use of public store in community		10.	
11. Planting of 2 or 3 seedlings per stand		11.	
12. Increased spacing between stands of seedlings		15.	
13. Use of rice mills		16.	
14. Use of organic manure		17.	
Other (specify …………………………………….)		18.	

Other (specify ………………………………………)		19.	

47. In your household, who is responsible for what in carrying out your rice farming operations (**Prompt)**?

Activity	**Responsible Category**					
	Majorly Men	Majorly Women	Men and women jointly	Majorly Children	Women and Children jointly	All (men, women and children)
1. Making decision on where to farm						
2. Making decision on changes to the way you farm						
3. Brushing						
4. Digging/ ploughing						
5. Puddling						
6. Nursery Preparation						
7. Transplanting						
8. Weeding						
9. Harvesting						
10. Threshing						
11. Transportation from farm to house						
12.Transportation from home to market						
13. Milling/pounding						
14. Control of proceeds/income from farm produce						
15. Control over use of produce in the household						
16. Choice of who to sell to?						
17. Making decision on when and quantity to sell?						
16. Uprooting of seedlings from nursery						
17. Other …………………………….						

48. What are the **major sources of information** for helping you make changes in your **rice farming** system? How useful is this information?

	Source of information?	What information?	How useful?
	Yes (1) No (2)		Not useful (1); No opinion (2) A little useful (3) Useful (4) Very Useful (5)]
1. MAFFS Extension Workers			
2. NGO Extension Workers			
3. Agro-dealers			
4. Itinerant agricultural traders			
5. ABCs			
6. Colleague farmers from the community			
7. Colleague farmers outside the community			
8. Agricultural researcher			
9. Community leaders			
10. Radio station			

11. Lead farmer in community			
12. District Council Officials			
Other (specify)…………………….			

49. Please indicate how strongly you agree or disagree with the following behaviours?

(1=low degree of I, 5= high degree of I)	**Strongly Disagree** **1**	**Disagree** **2**	**Neutral** **3**	**Agree** **4**	**Strongly Agree** **5**
Questions I am constantly looking for ways to improve my rice cultivation methods, techniques/ products/ services.	1	2	3	4	5
I like to frequently experiment with new farming ideas/techniques.	1	2	3	4	5
I typically generate unique ideas for solutions to my farming problems.	1	2	3	4	5
I will try new things only if they are guaranteed to work	1	2	3	4	5
I always try new activities/ methods/ practices regardless of whether I am guaranteed about results or outcomes.	1	2	3	4	5
I like working in a group with other farmers to improve the way I farm	1	2	3	4	5
In group activities, I will only work if everyone else is working	1	2	3	4	5
I actively pursue ways to improve my skills and/or knowledge. (i.e. trainings).	1	2	3	4	5
I make great effort to improve upon existing ways of doing things.	1	2	3	4	5
I am interested in trying new things to improve myself or my farming enterprise, regardless of costs	1	2	3	4	5
If something cannot be done, I find a way	1	2	3	4	5
I see no reason to improve something if it is working.	1	2	3	4	5
I will only try new techniques or technology if it is easy to do so	1	2	3	4	5

50. Do you have any Farmer Groups in your community? ☐ (1); No (2)

51. If yes, are you a member of any of them? ☐ (1); No (2) If "No" go to question 56.

52. If yes, to q52 above, who organised you into groups? ☐ FFS Extension workers (1); NGO Extension workers (2); Colleague farmers (3); Other (specify………………………….)]

53. If you belong to a Farmer Group:

S/No.	Top 5 activities of the group	How frequent do you participate in them? Always (1) Sometimes (2) Rarely (3) Never (4)
1.		
2.		
3.		
4.		
5.		

54. If you **do not 'Always'** participate in group activities, what are some of the key reasons responsible for this?

    a. ………..

    b. ………..

    c. ………..

    d. ………..

55. If you **do not belong** to a Farmer Group, why not? ....

    ....
    ……

<u>Thank you for your time!!</u>

Appendix 4: KIIs Interview Guide for Research and Extension Professionals

Interview Guide (Objective 1)

Key Informant Interviews - Research and Extension Personnel

A. Rice Innovations and Perceived Benefits

- **a.** What are the key rice innovations you/your organisation has participated in developing/adapting/promoting in the past ten years? Please state the timeline for each. What is your organisation's role in this?
- **b.** Who were the target beneficiaries and their locations (consider gender, age group, economic status, farm size etc)? Why were they targeted?
- **c.** Where these innovations originally developed by you/your organisation? If yes, why?
- **d.** What were the intended benefits of each of the innovations?
- **e.** Were there any cost implications for the intended beneficiaries? How did this compare with existing alternative innovations at the time?
- **f.** Which innovations had the highest adaptation/adoption by the intended beneficiaries? Why? How did you know?

B. Actors, Roles, Interactions

- **a.** What is your organisation's role in the development/promotion/adaptation of these innovations?
- **b.** Who are the other key actors involved in the development/adaptation/promotion of each of these key innovations?
- **c.** What were their contributions in the process? Were there any differences in their contributions? Why or why not?
- **d.** How effective were these actors in the dispensing their functions? If not, why?
- **e.** How and why were these actors selected?
- **f.** Were there any other actors you wanted to be involved but didn't? Why did you want them to involve? Why didn't they involve?
- **g.** What were the key type of interactions that existed among the actors including you eg meetings, seminars, informal or formal advice, lobbying, publishing reports or papers, input sales, demos, field-days, project implementation etc
- **h.** Were there any bottlenecks to these interactions? If yes, please elucidate.

C. Constraints to rice innovation processes

- **a.** What are the key constraints you faced in the development/adaptation/promotion of these innovations?
- **b.** Did you overcome these constraints? If yes, how? If no, why not?
- **c.** Did the following elements enhance or constrain your interactions/innovation process? How?
  - **i.** Institutions – Organisational mandate, agricultural policies, socio-cultural norms and values, Market access, M&E structures etc
  - **ii.** Infrastructure – physical, financial, communication, knowledge etc
  - **iii.** Capabilities and resources – human resource (quality and quantity), literacy rates, agricultural entrepreneurship, financial resources etc
  - **iv.** Collaboration – Networking, sharing of knowledge and info, PPPs, etc

Appendix 6: FGDs Discussion Guide for Research and Extension Professionals

Discussion Guide (Objective 2):

Focus Group Discussions- Research and Extension Personnel

A. Behaviours of Research and Extension personnel influencing rice innovation system

Participants will be asked to explain what they understand by an Agriculture Innovation System? Their definitions/points will then be reinforced by the conventional definition to be presented by the researcher and then will be asked to identify behaviours that reflect this. The following will be asked.

a. Which behaviours of Researchers and Extension Personnel do you think will be necessary to achieve a functioning/effective rice innovation system? (Identify common as well as separate behaviours as necessary between researchers and extension personnel)

b. Which behaviours of Researchers and Extension Personnel do you think can constrain or prevent achieving a functioning/effective rice innovation system?

B. Outcome Beliefs (behavioural) of Research and Extension Personnel for a functioning rice innovation system

a. What do you see as the advantages of each of the behaviours (in "Aa" above) you have identified/mentioned? Why?

b. What do you see as the disadvantages/challenges associated with executing each of these behaviours (in "Aa" above)? Why?

C. Social Referents of Researchers and Extensionists in relation to behaviours of a functioning rice innovation system

a. Who (individuals/groups / organisations) do you think can approve/encourage you to execute each of these behaviours? Why?

b. Who (individuals/groups / organisations) do you think can disapprove or discourage you to execute these behaviours? Why?

c. In cases, where you are unsure of what to do in executing your routine rice research or extension functions, please identify the individuals or groups you turn to for advice or consultation?

D. **Control beliefs of Researchers and Extension Personnel in relation to behaviours of a functioning RIS**

a. What factors or circumstances would enable your ability to execute each of these behaviours?

b. What are those factors that would make it difficult for you to execute these behaviours?

c. How do (agricultural) policies of: a) your organisation; and b) MAFFS; influence whether you execute these behaviours and the way you execute them?

d. Are a) gender and b) cultural issues (e.g. of organisations, beneficiaries) influencing your ability to execute these behaviours? How?

Appendix 7: KIIs Interview Guide for Smallholder Farmers

Interview Guide (Objective 3):

Key Informant Interviews – Smallholder Rice Farmers

A. Farmers' innovations, their drivers and constraints

a. What key most important changes have you made to your rice farming system in the past ten years (2005-15) (in production, processing, marketing etc)? State the timeline for each of these changes?
b. Which of these changes are from external actors? Which are from colleague farmers? And which are from your own initiative?
c. For changes from sources other than you, did you adapt (modify before use) or adopt them? Why and how?
d. Are there any other changes/innovations promoted by external actors/colleague farmers that you didn't try in the past ten years? If yes, why not?
e. Are there innovations (external or otherwise) that you used/tried but stopped using? If so, why?
f. What were the most important reasons for making these changes you made on your farm?
g. Which of the changes you have made in the way you do your rice farming do you consider most important? Why? Did the changes meet your expectations? If no, why not?
h. Did you face any challenges in trying to make changes to the way you do your rice farming?
i. If yes, what are the major challenges you faced?

B. Actors and their roles

The researcher will select **up to five most important innovations** farmers mentioned and ask the following questions.

a. What or who do you think helped you make each of these changes on your rice farming system (from production to marketing)?
b. How did it help you?
c. What or who are the most important actors involved in the promotion of these innovations and what do they do? Have you been involved in their activities? If yes, how and why? What do you think are their advantages and disadvantages?
d. What do you think of innovations from research and extension actors compared to innovations from colleague farmers in your or nearby community? NB: Think in terms of cost, complexity, improving agricultural production, categories of beneficiaries, gender of beneficiaries etc.
e. What are the major sources of information for helping you make changes in your rice farming? How useful is this information? How reliable is the information?
f. Are there any differences in access to agricultural information between male and female farmers? If yes, please explain.
g. In the past 12 months, have you received any information regarding rice innovations from any sources? If so, what information? Did you use it to make changes to your farm? Why?

C. Factors influencing farmers ability to innovate

a. Are there changes (innovations) you wish to make in your farming system but could not make? (These may include changes from production through marketing).
b. If so, what are these changes?
c. What are key problems preventing you from making these changes?

d. How are the following elements influencing (enhancing or constraining) your ability/capacity to make changes in the way you farm?

i. Market access (input and output)
ii. Socio-cultural norms and values
iii. Physical and communication infrastructure
iv. Financial resources
v. Human resources/labour
vi. Your literacy rate
vii. Lack of information

e. What suggestions would you make to enhance the innovative capacity of rice farmers in your community?

Appendix 8: Sample Information sheets for participants in FGDs and KIIs

<u>Information Sheet for FGDs</u>

Assessment of Rice Innovation System in Sierra Leone

Dear Participants,

I am a doctoral student from the University of Reading conducting research on **rice innovation system in Sierra Leone**. The main aim of the study is to examine the rice innovation system in Sierra Leone from perspectives of research and extension actors as well as smallholder rice farmers. The study will be conducted through workshops, focus group discussions, semi-structured interviews/Key Informant Interviews, and a questionnaire. You will be asked to participate in this study through participating in a focus group discussion.

Your participation in the research is entirely voluntary; and you are free to withdraw at any time and will not be required to specify a reason. However, in as much as I want this study to be as representative as possible of the views of researchers, extensionists and smallholder farmers in Sierra Leone, I do hope that you will feel able to take part. Please be assured that your identity will not be revealed to anyone nor will your names be mentioned in the final report.

The data that will be generated from this study will be used for my doctoral thesis at Reading University, writing up papers for publication in peer-reviewed journals.

If you do agree to participate in this research, I will take that as an acknowledgement that you have had the terms of your participation adequately explained and that you have given your consent.

If at any stage you wish to receive further information about the research activities or project please do not hesitate to contact Mr. Lamin Ibrahim Kamara (contact details below). In addition, you can also contact my supervisor, Dr Peter Dorward, email p.t.dorward@reading.ac.uk or by mail at the Graduate Institute of International Development and Applied Economics, Agriculture Building, University of Reading, PO Box 237, Reading RG6 6AR.

Yours sincerely,

…………………………………

Mr. Lamin Ibrahim Kamara

PhD Researcher, University of Reading

l.i.kamara@pgr.reading.ac.uk

+2327[redacted] (Sierra Leone)

+4477[redacted] (UK)

Information Sheet for Key Informant Interviews with Individual Farmers, Research and Extension Actors

Reference:		

<u>Information Sheet</u>

Rice Innovation System in Sierra Leone

Dear Respondent,

I am delighted to inform you that you have been selected as one of the respondents of this research, conducted by Mr Lamin Ibrahim Kamara, a PhD student from University of Reading, UK. You have been selected to participate in this study because you are considered as a key stakeholder in the agriculture sector, particularly, rice innovation processes in Sierra Leone.

The goal of this study is to examine rice innovation system in Sierra Leone, in particular, the processes research and extension actors are engaged in the development/promotion of rice innovations and how these processes have influenced smallholder farmers' innovative capacity.

The data that will be generated from this study will be used for my doctoral thesis at Reading University and writing up papers for publication in peer-reviewed journals.

Further, please note that your participation in this study is entirely voluntary, and you are free to withdraw at any time without any consequences of any sort. You are free not to respond to any question during the interview, or request for your information to be removed from the research at any time. If you wish your information to be removed from the study at any time within the next three months, you can contact me (details below) quoting your reference at the top of this page. Also, note that the reference will only be used by the primary investigator to identify you for this purpose but not to disclose your identity or the information you provided to a third party. A list of all research participants with their respective codes will be kept separately by the researcher for reference purposes particularly in cases where a participant wishes his/her information to be withdrawn from the research.

If you volunteer to participate in this study, I would take that as an acknowledgement that you have had the terms of your participation clearly explained and that you agreed to them.

Yours sincerely,

…………………………………….

Mr. Lamin Ibrahim Kamara

School of Agriculture, Policy and Development

University of Reading

RG6 6AR

Email: l.i.kamara@pgr.reading.ac.uk

Phone: +232[redacted] (SL); +44[redacted] (UK)

Appendix 9: Sample Invitation Letter to NGOs for the Workshops sent by the NGO Desk Officer, MAFFS

SIERRA LEONE GOVERNMENT
MINISTRY OF AGRICULTURE, FORESTRY & FOOD SECURITY
YOUYI BUILDING, FREETOWN

January 15, 2016

…………………………………………………….

…………………………………………………….

…………………………………………………….

Dear Sir/Madam,

RE: INVITATION TO WORKSHOP ON AGRICULTURAL INNOVATION SYSTEM IN SIERRA LEONE

I am pleased to invite you (or your organisation) to a workshop on Agricultural Innovation Systems on rice in Sierra Leone that will be held on February 3, 2016; starting at 10:00am prompt. This will be **held at the Conference Room of the Ministry of Agriculture, Forestry and Food Security (MAFFS), Youyi Building, Freetown**. The workshop seeks to understand the innovation processes and system on rice as promoted by research and extension actors in the country. You have been invited to this workshop **due to the role of your organisation in the development of the agriculture sector in Sierra Leone**; thus, your attendance would undoubtedly add value to the outcomes of the workshop.

The workshop will be conducted by a Doctoral Student from the University of Reading, United Kingdom in collaboration with the Ministry of Agriculture, Forestry and Food Security. Given the importance of the topic of the workshop, it is highly recommended that a member of your organisation who is aufait with the key rice innovations/projects implemented by your organisation/institution within the last ten years attend. Additionally, it is important that staff in the agriculture department/unit attend given the nature of the topic.

Tea and Lunch will be provided as well as **refunds for transportation cost for participants.** In order to inform the planning of the workshop, please **confirm your attendance** latest two days before the scheduled date by email to pamelakonneh@yahoo.com **with copy to** klamin2007@gmail.com or by phone at **078-**[redacted] **or 077** [redacted]**.**

I count on your usual corporation as the Ministry places a very high priority on this event and looks forward to welcoming you.

Best regards,

………………………..

Pamela Konneh (on behalf of Lamin Kamara)

NGO Desk Officer, MAFFS

AGENDA

1. Welcome Statement: Director of Extension, MAFFS
2. House Keeping: NGO Desk Officer, MAFFS
3. Presentation: Doctoral Student, University of Reading, UK
    a. Aims and objectives of the workshop
    b. Agricultural Innovation System: Meaning and differences with preceding perspectives/models
4. Workshop Activities: Groups of four or five participants.
    a. Session 1:
        i. Identify the key rice innovations that have been developed/adapted/disseminated by your organisation in the last ten years? State the timeline of each innovation, why developed or promoted and how promoted?
        ii. Who are the key actors involved and what were/are their roles?
    b. Session 2:
        i. Indicate the linkages among the actors identified. State the purposes of these linkages and the strengths and weaknesses of these linkages? Using coloured cards provided, classify the strength of their linkages (strong, medium or weak).
        ii. What constraints did you face in the development/adaptation/dissemination/promotion of the innovations you have identified in session 1? What do you think are the general factors constraining rice innovations from a research or extension perspective?

Appendix 10: List of some of the NGOs invited for the Workshops (highlighted)

NON GOVERNMENTAL ORGANIZATIONS
REPORTING TO THE MINISTRY OF AGRICULTURE, FORESTRY AND FOOD SECURITY - 2015

No	NGO Name	Donor	Operational Area	Start Date	Closing Date
1.	Action Aid SL	Action Aid Sierra Leone Program	Kambia, Moyamba, Bombali, Bo, Kono, Tonkolili, Western Area.	2013	2017
2	Action Contre La Faim	Irish Aid	Western Area	2013	2015
3.	ABC Development	ICCO Sunday Foundation	Kambia	2014	2015
4.	BRAC	DFID	Port Loko, Kambia, Bo, Koinadugu, Western Area, Bombali	2012	2015
5.	CARE	EC	Bombali Tonkolili	2013	2016
		USAID	Bombali	2012	2015
6.	Catholic Agency for Overseas Development (CAFOD)	EC	Bombali and Kenema	2013	2016
		CAFOD	Bo	2014	2015
7.	Catholic Relief Services (CRS)	Food Resource Bank	Koinadugu	2013	2016
		CRS/CORD AID	Koinadugu, Kambia, Kenema, Kailahun	2015	2015
8.	Christian Extension Services	World Renew North America	Koinadugu Tonkolili	2013	2015
9.	Collective Initiative for Development Sierra Leone (CIFD-SL)	Fund Raising	Port Loko	2013	2015
10.	Community Action for the Welfare of Children (CAWeC)	Christian Aid, UNICEF, WFP	Kambia	2015	2016
11.	Concern Worldwide	EU through Natural Resources Institute	Tonkolili	2014	2016
		Irish Aid	Tonkolili	2013	2015
		Irish Aid	Tonkolili	2014	2015
		EU	Tonkolili	2014	2015
12.	COOPERMONDO	Italian Episcopal Conference (CEI)	Port Loko	2013	2016
13.	COOPI	EU/COOPI	Port Loko, Kambia, Bombali	2013	2015
14.	Cotton Tree Foundation	World Bank/GoSL	Kambia	2013	2015
		London Mining	Port Loko	2013	2015
		GIZ	Port Loko	2013	2015
		WFP	Port Loko	2014	2015
		Cord Aid-Netherlands	Bombali, Tonkolili	2014	2015
15.	ENGIM	ENGIM	Port Loko	2015	2015
		ENGIM	Port Loko	2015	2015
		ENGIM	Port Loko	2015	2015
16.	Environmental Foundation for Africa (EFA)	EU, EFA,FAO	Kenema, Kailahun, Kono & Pujehun	2011-	2015
17.	Enviro One	Enviro One	Port Loko, Tonkolili	2012	2015

18.	Faith Healing Development Organization	Self Funding Local	Bombali	2015	2015	[redacted]
19.	Finn Church Aid	Finn Church Aid	Kenema, Bo, Moyamba	2015	2015	[redacted]
			Bonthe	2015	2015	[redacted]
20.	Future in Our Hands	BFTW GAFSP	Koinadugu, Kambia	2013	2016	[redacted]
21.	Green Scenery	Finn Church Aid	Bonthe	2015	2016	[redacted]
22.	Inter Aide SL	EU	Bombali	2011	2015	[redacted]
23.	Kambia District Development and Rehabilitation Organization	Trocaire -Ireland	Kambia	2015	2016	[redacted]
24.	Oxfam	Disaster Emergency Committee (DEC)	Koinadugu	2015	2016	[redacted]
		DFO through Oxfam Germany	Port Loko	2014	2015	[redacted]
25.	Plan International Sierra Leone	EU/Plan Ireland	Moyamba	2011	2015	[redacted]
26.	Pujehun Youths for Development (PYD)	BMZ, KNSL and PYD	Pujehun and Bonthe	2013	2016	[redacted]
27.	Reptile and Amphibian Program-Sierra Leone	U.S. Fish and Wildlife Services	Coastal areas of Bonthe and Western Area	2014	2015	[redacted]
28.	Save the Children	USAID	Kailahun	2015	2016	[redacted]
29.	Sierra Grass Root Agency	Embassy of Japan-Ghana	Tonkolili	2015	2015	[redacted]
30.	Sierra Leone animal Welfare Society (SLAWS)	World Animal Protection (WAP), Humane Society International (HSI).	Western Area	2015	2015	[redacted]
31.	Sustainable Agriculture and Nutrition Program (SNAP)/ACDI/VOCA	USAID-FFP	Koinadugu, Bombali, Tonkolili, Kailahun	2010	2015	[redacted]
32.	Social Enterprise Development (SEND) Foundation	Cord Aid	Kailahun	2015	2015	[redacted]
33.	Trocaire	Trocaire Internal Resources (Global Gift)	Kambia, Port Loko, Bombali	2014	2015	[redacted]
34.	Welthungerhilfe	EC	Kenema, Kailahun, Kono	2013	2016	[redacted]
		EC	Kenema, Kailahun, Kono	2013	2016	[redacted]
		Irish Aid	Kenema	2013	2015	[redacted]
		BMZ	Bo, Pujehun, Kenema Kailahun	2014	2016	[redacted]
35.	West Africa Venture Fund	World Bank	Bo, Western Area	2014	2015	[redacted]
36.	World Hope International	Food Resource Bank, USA,GIZ,W&D	Bombali, Tonkolili, Western Area	2013	2016	[redacted]
37.	World Vision	DFATD- Canada	Pujehun	2012	2017	[redacted]
		Hong Kong	Bo	2014	2016	[redacted]
		World Vision Germany	Bonthe	2015	2016	[redacted]

Appendix 11: Approved Ethical Clearance Form by University of Reading

School of Agriculture, Policy and Development

ETHICAL CLEARANCE GRANTED

University of Reading

Form 2. MSc PhD Staff Ethical Clearance Submission Form

PLEASE allow a minimum of 3 weeks for this process.
You must not begin your research until you have obtained consent as evidenced by this form returned from the APD student Office signed and dated. Ethical Clearance cannot be granted retrospectively.

This form can only be used if the application :
- Does not involve participants who are patients or clients of the health or social services
- Does not involve participants whose capacity to give free and informed consent may be impaired within the meaning of the Mental Capacity Act 2005
- Does not involve patients who are 'vulnerable'
- Does not involve any element of risk to the researchers or participants
- Does not involve any participants who have a special relationship to the researchers/investigators

If any of the above apply, please refer to the APD Ethics Chair to decide whether an application can be made through the APD review process or whether the application needs to be referred to the full University Committee.

It is the applicant's responsibility to check for any particular requirements of a funder regarding ethical review. Some funders may require that the application is reviewed by full University Committee and not the devolved School committee.

Full details of the University Research Ethics procedures are available at http://www.reading.ac.uk/internal/res/ResearchEthics/reas-REethicshomepage.aspx and you are encouraged to access these pages for a fuller understanding. Some helpful advice is available on this link http://www.reading.ac.uk/internal/res/ResearchEthics/reas-REwhatdoIneedtodo.aspx and the FAQs are particularly relevant.

ALL QUESTIONS MUST BE COMPLETED.

APD Ethical Clearance Application Reference Number : Click here to enter text.

1. **APPLICANT DETAILS:**

Main applicant name:	Lamin Ibrahim Kamara
Name of academic supervisor/project investigator:	Dr Peter Dorward
Email Address (decision will be emailed here):	l.i.kamara@pgr.reading.ac.uk
MSc Student	☐
PhD Student	☒
Staff Member	☐
Other (please specify)	Click here to enter text.

Ethical_Clearance_Form_041016-Lamin.docx_Approved.pdf