Assessment of collaboration among Research – Extension - Farmers for Agricultural Innovation in North West Province, South Africa.

By

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Declaration

I, Thato Marjorie Moagi declare that this dissertation submitted for the completion of MSc in Agricultural Extension at North West University is my own work. It has not been submitted before for any other Degree or examination at this University or any other University. All sources used or quoted have been properly indicated and acknowledged by means of complete references.

Signature _____

Date 11/04/2014

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Dedication

I dedicate my work to my brothers- Thabang and Lennon, and my younger sister Modiegi; not forgetting my niece Omphile and supportive aunts, uncles and cousins. This one goes to all of you and I hope it will inspire the upcoming generations in my entire family.

Abstract

The study examined collaboration among research-extension-and farmers for agricultural innovation in North West Province, South Africa. The study was based on the need for agricultural production to be more responsive to demand through effective collaboration and strengthened linkage activities among researchers, extension officers and farmers. A simple random sampling technique was used to select 50 researchers, 50 extension officers and 50 farmers from the Agricultural Research Council and North West University, Department of Agriculture and Rural Development, National African Farmers' Union and African Farmers Association of South Africa respectively. A structured questionnaire was used to collect data. Data was analyzed with SPSS version 21 using frequency count percentages, mean and standard deviations. The results indicate that there is weak linkage between researchers, extension agents and farmers. Actor linkage is affected by personal characteristics, attitude towards collaboration, knowledge of Agricultural Innovation Systems and institutional constraints among others. To make the value chain more effective, this paper recommends operative linkage among researchers-extension agents and farmers.

List of tables

Table **Page**

List of figures

Figure **Page**

Acronyms

AFASA – African Farmers Association of South Africa

AKIS – Agricultural Knowledge and Information System

ARC – Agricultural Research Council

DARD – Department of Agriculture and Rural Development

NAFU – National African Farmers' Union

NARS – National Agricultural Research Systems

NWU – North West University

Table of Contents

Chapter 1

Introduction

1.1 Background of the study

Agriculture is the largest employer of labour in Africa, accountable for over half of the export earnings and plays a very critical role in the continent's development. It underpins the livelihoods of over two thirds of Africa's poor and is of much more importance in the continent's poorer countries (FARA, 2012). The sector is crucial to rural development in general and, it contributes significantly to any initiative to alleviate poverty.

In South Africa, the sector is diverse and consists of several branches, namely: field crop husbandry, horticulture, animal production, dairy farming and fish farming. The country is one of the major exporters of agricultural produce with its fruits and fruit-derived products such as wine and fruit juice being highly competitive in the global market. The South African agricultural sector also encompasses both primary (resource production) and secondary (primary processing) activities. The contribution of the primary agriculture to gross domestic product (GDP) is about 2.5% and its contribution to formal employment is about 5% while the secondary sector has a higher contribution of about 12% to GDP (AgriSeta, 2010).

DAFF (2012) posited that even though the contribution of agriculture to the GDP is very little and it has not grown as fast as other sectors such as mining, the agricultural sector still remains the most critical sector because it contributes to food supply, the country's trade balance, employment, supply of raw materials and, it is a market for other sectors. Agriculture is basically said to be the main source, if not, the only source of food production hence it can be assumed that life without it would not exist. Thus, the sector is put to the onus to provide access at all times to adequate and quality food for a rapidly growing population, in order to ensure a productive and healthy life (Smith, et al., 2004).

Agriculture therefore needs to be well developed in order to cater for the needs of the growing population and to sustain their well-being, while reserving natural resources for future use. This means that agricultural research must be of priority to the sector and the capacity to innovate and transfer innovation must be dealt with. Hence the National Agricultural Research Systems (NARS) were introduced in the 1980's and it was later revised and led to the introduction of the Agricultural Knowledge and Information system (AKIS). Both of these frameworks were developed with a mind-set of investing in research and delivering its outputs to farmers.

NARS is basically comprised of all entities in a country that are liable for organizing, coordinating or executing research for agricultural development and management of natural resources. Its underlying idea is that agricultural research, if transferred, can lead to technology adoption and growth in productivity and the capacity to realize this goal lies within the agricultural research, training and extension organizations of the public sector. Capacity is therefore developed by investing in scientific infrastructure, equipping human resources with skills, setting research priorities and providing funds to implement those priorities (World Bank, 2006).

AKIS, on the other hand, aims to connect people and institutions to endorse mutual learning and generate, share and utilize agricultural technologies, knowledge and information. AKIS integrates farmers, agricultural educators, researchers and extension staff to exploit information and knowledge from different sources for improved livelihoods. This framework has its origins in the analysis of agricultural extension arrangements and, it focuses on how information and ideas can be effectively communicated between various actors in rural areas and how this knowledge can be harnessed for rural livelihoods (World Bank, 2006).

Unfortunately agricultural production in Africa or South Africa in particular, is said to be increasingly on the decline and this is undesirable because it cripples the country's economic status and will ultimately lead to food shortage if not mitigated (Agwu, et al., 2008). According to Tenywa, et al. (2011), the weak and uncompetitive state of agriculture in most African continents is an attribute of non-adoption of newly improved technologies which are essential to increase productivity and profitability of agricultural systems. Tenywa, et al. (2011) also argues that if African farmers with limited resources had adopted some of the technological innovations generated by research over the past decades, declining food security and increasing poverty would not be a major crisis today.

Reports on agricultural production and food security show that food production in Africa has to increase substantially to meet the food demand of the growing population (Agwu, et al., 2008) hence there is an urgent need to develop sustainable agricultural systems in order to address the highlighted food security and economic crisis (World Economic Forum, 2010). It is imperative that researchers must constantly develop innovations and ensure that they are adopted by the intended end users, which are farmers.

Spielman, et al. (2008) defines agricultural innovation as the ability to introduce new products and processes that are socially and economically relevant to farmers and other actors

in the agricultural sector and, if emphasized, innovation can catalyze growth and development of most African countries (Sandrey & Vink, 2008). Agricultural innovations can be divided into those that are embodied in capital goods or products (e.g. tractors, new seed varieties, new types of fertilizers) and those that are not embodied in any physical item (e.g. a new formula to improve irrigation scheduling). Although research is always attempting to come up with these innovations its impact, especially in African countries, is not adequate because its outputs are sometimes not relevant to the needs of farmers. It is therefore of the essence that an initiative must be taken to address this issue of irrelevant research outputs.

The above scenario can be solved by forming an agricultural innovation system, which is defined as a set of interrelated components (i.e. individuals, organizations, public agencies or institutions) working through collaboration and competition to generate, diffuse and utilize knowledge and technology that have economic value within the agricultural sector (Sumberg, 2005). This innovation system concept focuses not merely on the science suppliers but on the totality and interaction of actors involved in innovation. Innovation systems analysis therefore recognizes that creating an enabling environment to support the use of knowledge is as important as making that knowledge available through research and dissemination mechanisms (World Bank, 2006).

Since agriculture, like any other sector, is evolving in an environment of rapid changes in technology, markets, policies, demography and natural resources; it is important that all actors in and around the agricultural sector must innovate and develop new ways of collaborating to generate knowledge and put it into use at the required pace (Daane, 2010). According to Agbamu (2000), the lack of adoption of improved innovations by farmers is among other factors, a result of weak and/or often non-existent linkages and interaction between research, extension and farmers. Tenywa, et al. (2011) remarked that institutions like Universities and research institutes such as the Agricultural Research Council (ARC) usually innovate in isolation.

Moreover, extension agents' transfer of technologies is also handicapped because they just have to abide by the technologies brought-up by researchers even if they do not suit the local agro-ecological or socio-economic conditions. "They are almost always separated from researchers by wide gaps in educational levels, status, salaries and social class. Researchers often blame them for their failure to transfer innovations which have shown promise under experimental conditions, and for their apparent inability to provide systematic feedback.

Farmers often see them as incapable of providing answers to local problems and needs" (Doamekpor, 2005). Nonetheless, it is crucial that information must continuously flow between research and extension in order to successfully transfer technologies to farmers but, the poor communication and lack of coordination between researchers and extension workers has regrettably constrained the flow of technology to farmers (Doamekpor, 2005).

Researchers, extension agents and farmers should therefore align themselves in deriving project objectives and goals and; they must also establish working relationships and communicate with each other in pursuing these commonly shared objectives and goals. Collaboration of these stakeholders in the agricultural sector can build on the comparative advantage of different actors and institutions to reduce transaction costs, achieve economies of scale and scope, exploit complementarities, and realize synergies in innovation (Spielman, et al., 2008). However, this stakeholder collaboration requires awareness raising, development of trust, a willingness to work together, and creation of a shared vision for the future (Adekunle, et al., 2012}.

Oladele (2008) opined that; farmers, farmers' organizations, research, extension and other agencies must work together in a coordinated manner in ensuring that farmers acquire access to improved innovations developed by research and that they adopt the technologies because the merit of research is highest when it leads to adoption of a derived technology by farmers. Researchers and extension officers depend on one another to deliver improved technologies to farmers hence the failure of one link in the chain diminishes the overall performance of the innovation system. Sadly, extension agents are faced with a challenge in ensuring that technological innovations flow from the researchers to farmers hence the link between researchers-extension-farmers must be strengthened.

Agbamu (2000) describes the concept of linkage as, the communication and working relationship established between two or more organizations pursuing commonly shared objectives in order to have regular contact and improved productivity. Oladele (2008) contends that linkage mechanisms can come in handy in moving information between different groups and coordinating required tasks with the mandate of delivering relevant technologies to farmers.

Strengthening the linkages and interactions between stakeholders can efficiently and effectively raise the level of economic performance of farmers through increased productivity. Sumberg (2005) concludes that greater interaction between stakeholders will

make the agricultural system more dynamic, flexible and, it will give the ability to generate information and respond to change.

Thus, for agricultural innovations to be relevant to farmers' needs - researchers, extension workers and farmers must play important roles in identifying research problems, adapting and making recommendations to local conditions and, providing feedback to researchers about the innovations that have been developed. They should all pull their knowledge, expertise and other resources together in order to deal with the triple scourge of rural poverty, food insecurity and the degradation of natural resources (Smith, et al., 2004).

1.2 Problem statement

Over the past several years, food security and economic crisis have highlighted an urgent need and the potential for developing sustainable agricultural systems. Nearly one billion people – one out of six globally, lack access to adequate food and nutrition. By 2050 the global population will surpass 9 billion people and the demand for agricultural products is expected to double. At the same time, the world's agricultural systems will be increasingly challenged by water scarcity, climate change and volatility, raising the risk of production shortfalls (World Economic Forum, 2010).

Even though agricultural research has generated many technologies with the potential to address agricultural stagnation, their impact on productivity, livelihoods and quality of life has been disappointing (Adekunle, et al., 2012). This can be attributed to lack of information and innovation adoption by farmers. Substantial gains in agricultural productivity can therefore be realized through innovation adoption by farmers. However, realizing these gains will require an exceptional level of collaboration among stakeholders in the agricultural value chain including governments, companies, educational institutions and farmers (World Economic Forum, 2010). Adekunle, et al. (2012) suggested that multiple stakeholders along the agricultural value chain must come together to address challenges and identify opportunities that will facilitate and enhance innovation adoption. DAFF (2009) reported that collaboration between the ARC, University faculties' of Agriculture and the Provincial Departments of Agriculture should be promoted to refocus on strategic priorities, innovation and adaptive research in provinces.

1.3 Research questions

- What are the personal characteristics of researchers, extension agents and farmers?

- What is the attitude of researchers, extension officers and farmers towards collaboration?
- What is the extent of collaboration among researchers, extension officers and farmers?
- What are the researchers, extension agents and farmers' knowledge of agricultural innovation systems?
- What are the constraints hindering collaboration among researchers, extension agents and farmers?

1.4 Research objectives

The main objective of the study is to assess and analyze collaboration among researchers, extension agents and farmers for agricultural innovation.

The specific objectives of the study are to:

- Determine the personal characteristics of researchers, extension agents and farmers.
- Investigate the attitude of researchers, extension personnel and farmers towards collaboration.
- Determine the extent of collaboration among researchers, extension officers and farmers
- Investigate the researchers, extension agents and farmers' knowledge of agricultural innovation systems.
- Identify and analyze constraints hindering collaboration of research, extension and farmers.

1.5 Hypothesis

- There is no significant relationship between socioeconomic characteristics and collaboration activities of researchers.
- There is no significant relationship between socioeconomic characteristics and collaboration activities of extension officers.
- There is no significant relationship between socioeconomic characteristics and collaboration activities of farmers.
- There is no significant difference in the collaboration activities between researchers, extension officers and farmers.

1.6 Significance of the study

This study will reveal the extent of collaboration that exists among researchers, extension agents and farmers for agricultural innovation. Researchers, extension agents and farmers of the North West Province will have an opportunity to express their views and also divulge their attitudes towards stakeholder collaborations. The study will also reflect on how researchers, extension agents and farmers' link with one another in agricultural systems and how these links can be improved to best ensure that innovations are made to be relevant to the end users' needs and that they (the farmers) adopt these innovations. Furthermore, the research will come up with recommendations that can assist the various stakeholders of agricultural innovations to formulate working relationships with each other and how they can all interact to successfully pursue their shared objectives.

Chapter 2

Literature study

2.1 Introduction

This chapter focuses on different perspectives of different authors who have researched about the same or similar topics in the past. It describes the role of research, the role of extension and the role of farmers. Collaboration and linkage among research-extension-and farmers and the conceptual framework are also highlighted in this chapter.

2.2 The role of research

According to World Bank (2006), research is the main driver of innovation, creating new knowledge and technology that can be transferred and adapted to different situations. Its central role is to provide effective solutions or responses to the major constraints of agricultural and rural development, such as those related to policy and institutional issues, those related to technical production, productivity enhancement, resource management or utilization, and those related to the social and economic problems such as access to land, water, and other required inputs (Smith, et al., 2004). This means that through research, the lives of people, especially of the poor in most developing countries, can be improved dismally (Spielman & Grebmer, 2004).

Spielman and Grebmer (2004) further clarified that research also contributes to the augmentation of agricultural productivity, output, and quality, to improvement in sustainable use of natural resources, to lower consumer prices for food, and to the accumulation of physical and human capital among poor or vulnerable agrarian agents and households. Such improvements can certainly improve the income of the poor; have a positive impact on food consumption, better nutrition, and favorable changes in the allocation of individual and household assets.

Agricultural research can thus be summed up as a unit that can address two sets of problems, that is, those related to the competitiveness of agricultural commodities in domestic and global markets and, those related to the quality and maintenance of natural resources. It is an essential tool for a sustainable agricultural development programmes in both developed and developing countries of the world (Oladele, et al., 2006).

Greater emphasis should therefore be put on research as it is essential to maintain the sustainability of agricultural production and economic development (DAFF, 2005). Unfortunately in Africa, research has not impacted much on production hence its priorities

and methods have been widely critiqued and the relevance of its outputs has also been questioned (Sumberg, 2005). Smith, et al. (2004) pinpointed that researchers do not always work in coordination with farmers hence there is lack of technology adoption and the utilization of research in agricultural systems is minimal. This leads to most of the research outputs being literally shelved in mountains while they remain unutilized simply because the large amounts of information ends up being tied up in journal publications targeted to peer-groups or colleagues rather than farmers who rarely have access nor understand such publications.

Another critique of research is that most institutions like universities and research institutes innovate in isolation and even-though research is conducted in so many different organizations nationally and internationally, its coordination is dysfunctional and poorly linked to the production sector (Agwu, et al., 2011). Furthermore, the financial and institutional instability within which agricultural research institutes are located and, in certain contexts, their isolation at the national and sub-regional levels, weaken their ability to mobilise themselves and capitalize on existing knowledge (Coraf, 1999). These institutions should rather work in a coordinated manner and conduct researches for technology development and transfer and not only for journal reviews (DoA, 2005).

Oladele (2008) concludes that it is imperative that research must be intelligently mobilized and its outputs and technologies should be effectively disseminated because the dissemination of research results keeps people thinking about research and, it also allows them to be familiar with the technologies and to easily accept the need for further research work. Hence, research must be given great attention and, wider competencies, linkages, enabling attitudes, practices, governance structures and policies should be wisely developed so as to allow research findings to be put into productive usage (World Bank, 2006).

2.3 The role of extension

Extension can be defined as a systematic process of working with farmers in order to assist them in acquiring relevant and useful agricultural knowledge and skills with the mandate of increasing farm productivity, competitiveness and sustainability (DoA, 2005). Ashraf, et al. (2007) contends that extension poses as a centre of information for both researchers and farmers because it brings farmers' problems to researchers and also provides the research findings back to the farmers. Adisa (2011) remarked that agricultural extension plays a substantial role to agricultural and rural development as it facilitates the diffusion process of

agricultural technologies and innovations among farmers so as to improve their production levels and income. Thus the ultimate objective of extension is to improve the living standards of farmers, farm workers and, their families and, to achieve this objective, extension workers need to know about new things and ways that work for the different people of their area and have solutions to their constraints and new opportunities for more income, more food security and employment (Prolinnova, 2007).

In most countries, agricultural extension involves quite a number of various activities in both the public and private sectors but, information exchange is the most important out of all these extension activities. Public agricultural extension structure consists of professional agricultural experts who are generally government employees. These experts are liable to teach improved methods of farming, demonstrate innovations, and organize farmer meeting and field days on a wide range of topics. Public extension is sometimes also used as a channel to introduce and implement agricultural policies. However, extension activities are also performed by several institutions in the private sector (e.g. Senwes) and non-profit organizations (Schwartz, 1994).

2.4 The role of farmers

According to Smith, et al. (2006), farmers and their organizations, are the main if not the only producers of food required to sustain the ever increasing world population in both urbanized and rural areas. Most of these farmers and farmers' organizations in developed and even in developing countries, are becoming more diverse and are getting actively involved in numerous components of the agribusiness chain by not only being the producers, but also taking part in the processing and marketing of commodities. However, increased productivity is still their greatest concern and it requires adequate access to new and improved technologies obtainable from agricultural research (Oladele, 2008).

Farmers and their organizations are thus the main actors responsible for using and translating research findings into real life production systems and natural resource management practices. It is therefore imperative that they generate and use knowledge acquired on a regular basis and, they must constantly experiment on how they can best manage their risks and improve their operations (Smith, et al., 2004). Thus, World Bank (2006) remarked that "farmers are the heart of the knowledge triangle formed by education, research and extension".

As remarked by Peterson, et al. (2001), farmers are the ultimate users of technology and information, and they contribute to its flow by providing indigenous knowledge and information and, determine which technologies are relevant and useful them. They are expected to identify production problems they incur and define what is needed from research and, to also communicate with research and extension regarding the results of technology use. NAFES and NAFRI (2005) posited that the involvement of farmers can vary from just doing the physical labour in an on-farm research plot in traditional on-farm research, over being a source of information and consultation in farming systems research, and being a partner in the design and implementation of research.

2.5 Collaboration and linkage among research-extension-and farmers

Ashraf, et al. (2007) contends that neither research nor extension alone can fulfil its responsibilities effectively; hence strong interaction and effective collaboration among all the stakeholders are essentially needed to achieve the common objective of increasing agricultural production and uplift the living standards of the farmers. Researchers, extension personnel and farmers should therefore have a relationship with each other in order for them to successfully develop the agricultural sector. Collaboration of researchers, extension agents and farmers, will help them realize strategic alliances and cost-effective partnerships that will assist them to benefit from the economies of scale (Smith, et al., 2004).

The term "linkage" generally refers to an action of linking or in fact, a device that links people or things together. This study, however, conceptualizes linkage as an existing and inter-relation between research, extension and farmers towards the pursuit of commonly shared objectives (Uzuegbunam & Madukwe, 2005). Peterson, et al. (2001) emphasized that in the absence of effective linkages, the significance of research results may be vague and, the concerns and needs of farmers may not be met. Lack of functional linkages leads to difficulties in research when scaling up beneficial innovations for farmers, and it also makes it cumbersome for extension to offer services that address the problems of farmers or enable them to exploit opportunities (Pluss, et al., 2008).

Ashraf, et al. (2007) posited that researchers, extension personnel and farmers are the three primary pillars of agricultural systems which are complementary and independent upon each other and, for them to be highly effective, a strong linkage must exist between them. These linkages are certainly a pre-requisite for agricultural development (Kumar, et al., 2001) as they encourage and facilitate feedback from farmers to researchers through extension officers

who visit and give advice to farmers on a regular basis, thus helping researchers to solve actual production constraints (Rathore, et al., 2008). Coraf (1999) concluded that the achievement of true collaborative linkages depends on national research institutes integrating support to development into their scientific planning process and implementing a policy of incentives which are sufficient to lead to researchers working closely with farmer's organizations.

2.6 Agricultural Innovation Systems

Pound and Essegbey (2008) define an innovation system as a network of organizations, enterprises, and individuals focussed on bringing new products, new processes and new forms of organization into economic use together with the institutions and policies that affect their behaviour and performance. Innovation system encompasses three elements namely: (1) the organization and individuals involved in generating, diffusing, adapting, and using new knowledge; (2) the interactive learning that occurs when organizations engage in these processes and the way this leads to new products and processes; and (3) the formal and informal rules, norms, and conventions that govern how these interactions and processes take place (Anandajayasekeram, 2011). Conventional approaches to agricultural development conceptualize innovations as output of research and have viewed its dissemination as a largely linear process from researchers to extension officers and then farmers.

Agricultural development demands and depends on innovation and innovation systems. Innovation is generally acknowledged as a major source of improved productivity, competitiveness and economic growth throughout advanced and emerging economies. Innovation also plays an important role in creating jobs, generating income, alleviating poverty and driving social development. Agricultural research, extension, education, and training are key components of an Agricultural Innovation System (World Bank, 2012).

According to Anandajayasekeram (2011), Agricultural Innovation System is a collaborative arrangement bringing together several organizations working toward technological, managerial, organizational, and institutional change in agriculture and such a system may include the traditional sources of innovations; the modern actors; private sectors; civil society organizations; and those institutions that affect the process by which innovations are developed and delivered.

Innovation system thinking characterizes a significant change from the conventional linear approach to research and gives analytical framework that explores complex relationships

among heterogeneous agents, social and economic institutions, and endogenously determined technological and institutional opportunities. It demonstrates the importance of studying innovation as a process in which knowledge is accumulated and applied by heterogeneous agents, through complex interactions that are conditioned by social and economic institutions (Agwu, et al., 2006).

2.7 Conceptual framework

Doamekpor (2005) conducted a study on the effectiveness of extension-research linkages in Volta Region of Ghana. The study revealed that most participants in extension and research are males and; the level of education in extension only ranged from a Certificate in Education to Diploma in Agriculture whereas with researchers, majority were disclosed to be having a PhD or at least a Master's Degree in their fields of expertise. The study also made an assessment on research-extension linkage activities in the region and it indicated that attendance of farmers' day celebrations, mini-demonstrations, on-farm trials and the joint diagnosis of farmers' situations were among other activities, ranked highly important by both researchers and extension personnel.

Theoretical evidence of Oladele (2008) on research-extension linkage system on banana and plantain (musa spp.) in Nigeria showed that: researchers are involved in prominent linkage activities such as evaluation meetings and joint problem identification, while extension agents are highly involved in joint problem identification and evaluation reports. Farmers on the other hand, were recorded for highest involvement in joint problem identification and dissemination of knowledge. The number of activities and the degree of involvement showed that there is a wide disproportion in the level of involvement.

Ogunremi and Olaniran (2012) examined the research-extension-fish farmer linkage system in Coastal and Inland States of Nigeria and this study randomly selected researchers, extension agents and fish farmers for sampling with their responses on involvement in linkage activities being elicited through a structured questionnaire. The results showed that there is a significant difference in the involvement of researchers, extension agents and fish farmers in linkage systems and the mean involvement score also revealed that researchers are the ones who are mostly involved in linkage activities followed by extension agents and then fish farmers. Furthermore, researchers were ranked high for their participation in technical committee, trials on the farm and staff rotation while extension agents showed prominence in field visits, training and technical committee and listed all other linkage activities as cardinal

to their linkage with researchers and fish farmers who highly rated training and trials on farm as prominent linkages.

Ashraf, et al. (2007) conducted a study on the effect of decentralization on linkage among research, extension and farming community. The study revealed that majority of the respondents perceived the linkages between research and extension between average and strong categories. Only few respondents indicated that the existing linkage was very strong and very weak between research and extension. Few respondents regarded the research with extension as weak. Majority of respondents indicated that the extension had strong linkage with farming community. Moreover, only few of the respondents mentioned that extension had very weak and weak linkages with farming community. Only few respondents pointed out that very strong and strong linkage between research and farming community existed.

Oladele, et al. (2006) also examined research-extension-farmer linkage system in South-Western Nigeria. The study used the simple random sampling technique to select researchers, extension agents and farmers, and their responses on involvement in linkage activities were elicited through a questionnaire. Results showed that researchers had high participation in problem identification, visitation of research institutes and evaluation of technologies. However, extension agents cited that all the linkage activities are key mechanisms for strengthening links with researchers and farmers. Farmers were found to be less involved in problem identification, evaluation of technologies and joint field days; and they were not involved at all in joint report writing, staff rotation, priority setting and technical committee. Results also showed that there is a significant difference in the involvement of researchers, extension agents and farmers in linkage activities with extension agents being mostly involved, followed by researchers and then farmers.

Adebisi-Adelani, et al. (2010) conducted a study on research-extension-farmers collaborative linkage on horticultural technologies in South West Nigeria: A case study of NIHORT adopted villages. The study determined the interest of farmers in horticultural technologies and decision for further collaboration. Data were collected using Focus Group Discussion (FGD) and structured interview schedule. Results obtained were analysed using descriptive statistics. Findings revealed that constraints affecting farmers' interest on technologies were in the order of inadequate personnel, knowledge and capital.

2.8 Chapter summary

This chapter explored the perspectives of different authors on: the role of research, the role of extension, the role of farmers, and collaboration and linkage among research-extension-and farmers. It also gave a conceptual framework of the study.

Chapter 3

Methodology

3.1 Introduction

This chapter focuses on research methods used in conducting this research and, the specific research tools. The research design, type of study, study area, sampling frame, sampling size and analysis of data collection will be described.

3.2 Study area

The study was conducted in the North West Province of South Africa which lies in the north of the country on the Botswana border, fringed by the Kalahari Desert in the west, Gauteng Province to the east and the Free State to the south. The province has a total area of 106.512 square kilometres and is the country's fourth smallest province, taking up to 8.7% of South Africa's land area.

North West Province was created during the end of Apartheid in 1994 and includes part of the former Transvaal and Cape Province, as well as most of the former Bantustan of Bophuthatswana. The Province is now made up of four districts namely; Bojanala Platinum district, Ngaka Modiri Molema district, Dr Ruth Segomotsi Mompati district and Dr Kenneth Kaunda district. The province has two Agricultural Research Council (ARC) offices in Rustenburg and Potchefstroom, provincial and district Departments of Agriculture as well as farmers' organizations.

The mainstay of the North West economy is mining which generates more than half of the province's GDP and provides jobs for a quarter of its workforce. However, agriculture is also buzzing in the province as it contributes to the food basket hence the province is sometimes referred to as "Texas of South Africa". The northern and western parts of the province have many sheep farms, cattle and game ranches. The eastern and southern parts are crop-growing regions that produce maize (corn), sunflowers, tobacco, cotton and citrus fruits. These farming enterprises are mostly favoured by the provinces' temperatures which range from 17^0C to 31^0C in summer and, from 30^0C to 21^0C in winter. Annual rainfall totals about 360mm with almost all of it falling during the summer months, between October and April.

Majority of the province's residents are Tswana people. Minority groups include Afrikaans, Sotho and Xhosa speaking people. English is spoken primarily as a second language. According to 2007 community survey 90.8% of the provinces' population was Black (mostly

Tswana speaking), 7.2% was White (mostly Afrikaans speaking), 1.6% was Colored and 0.4% as Asian. The survey showed that the province had a population of just over 3million.

Figure 1: Map showing the North West Province.

3.3 Research design

Quantitative research design was used because it is descriptive and provides hard data on the numbers of people exhibiting certain behaviours and attitudes. It provides information in depth and allows one to sample large numbers of the population. Descriptive survey was also used because it observes the subject without intervening.

3.4 Population of study

The population in the study consisted of researchers, extension officers and farmers from different organizations relevant to the study, that is; researchers from the Agricultural Research Council (ARC) and the North West University (NWU); extension officers from the Department of Agriculture and Rural Development (DARD) and; a group of farmers from National African Farmers' Union (NAFU) and the African Farmers Association of South Africa (AFASA).

3.5 Sampling procedure

A list of researchers, extension agents and farmers was obtained from their respective organizations within the North West Province and the list served as a sampling frame for the

study. The frame for different groups was as follows: researchers in ARC and NWU (159); DARD extension agents (212) and for NAFU and AFASA farmers (193). Simple random sampling technique was used because it gives everyone the opportunity to be selected. A total sample of 150 members was selected from researchers, extension agents and farmers; and the sample size was 50 for each group.

3.6 Data collection

Data was collected through a structured questionnaire that was developed based on the objectives of the study. The questionnaire therefore had six sections namely: demographic characteristics; researchers-extension agents-farmers attitudes; extent of collaboration, linkage activities among researchers-extension agents-farmers, researchers-extension agents-farmers' knowledge of agricultural systems and, constraints hindering collaboration.

Interview schedule was based on the structured questionnaire. The reason for the use of interview schedule is that this method of data collection is relatively easy to arrange and, the opinions and views expressed throughout the interview stem from one source, the interviewee. Another advantage of interview schedule is that it is relatively easy to control as the researcher only has one person's idea to grasp and interrogate, and only one person to guide through the interview agenda.

3.7 Data analysis

Data was sorted, coded and analysed using the SPSS version 21. Frequency count, percentages, mean, and standard deviations were used to measure the personal characteristics, attitude, extent of collaboration, linkage activities, knowledge of agricultural innovation systems and the constraints hindering collaboration among researchers, extension agents and farmers. Tables and graphs were also used in the discussions.

3.8 Regression method

Multiple regression was used to assess the collaboration among researchers-extension-farmers. The purpose of the multiple regressions is to learn more about the relationship between several independent (predictor) variables and a dependent (criterion) variable. The model is helpful in testing how a dependent variable (y) is related to more than one independent variables (e.g. X_1, X_2, X_3). This allows the researcher to ask and hopefully answer the general question "what is the best predictor of...". In this study, multiple regressions procedures estimate a linear equation of the form:

$y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5$

y = existing collaboration among researchers, extension agents and farmers.

b's – regression coefficients

X_1 – personal characteristics of researchers, extension agents and farmers.

X_2 – attitude of researchers, extension agents and farmers towards collaboration.

X_3 – researchers, extension agents and farmers' knowledge of agricultural innovation systems.

X_4 – linkage activities among researchers, extension agents and farmers.

X_5 – constraints hindering collaboration among researchers, extension agents and farmers.

3.9 Chapter summary

The chapter focused on research methods and specific tools used in this research. The design of the research, type of study, study area, sampling frame, sampling size and analysis of data collection were described.

Chapter 4

Results and discussions

4.1 Introduction

The aim of this chapter is to present the results of the study. As explained in Chapter three, the study uses data collected from a sample of researchers, extension officers and 50 farmers. The data collected covered information on demographic characteristics, linkage activities, constraints to collaboration, knowledge of agricultural innovation systems, knowledge of collaboration and attitude towards collaboration.

4.2 Demographic characteristics

4.2.1 Gender of researchers, extension officers and farmers

Figure 1 indicates that farmers in the survey were predominately male (82%) and only 18% of them were female. This portends that farming is still male dominated and this might be due to the nature of the work and how many people perceive agriculture as male dominated. This agrees with the findings of Tekana and Oladele (2011) who found that 92% of farmers were male and only 8% were female, indicating low participation of women in agricultural activities. Furthermore, majority of researchers (64%) and extension officers (52%) were also found to be male and this signifies the gender imbalance still occurring in the work environments irrespective of the initiatives that have been implemented by the government to address gender inequalities. These results can be supported by Mabe and Oladele (2012) who revealed that majority of the extension officers were male (76%).

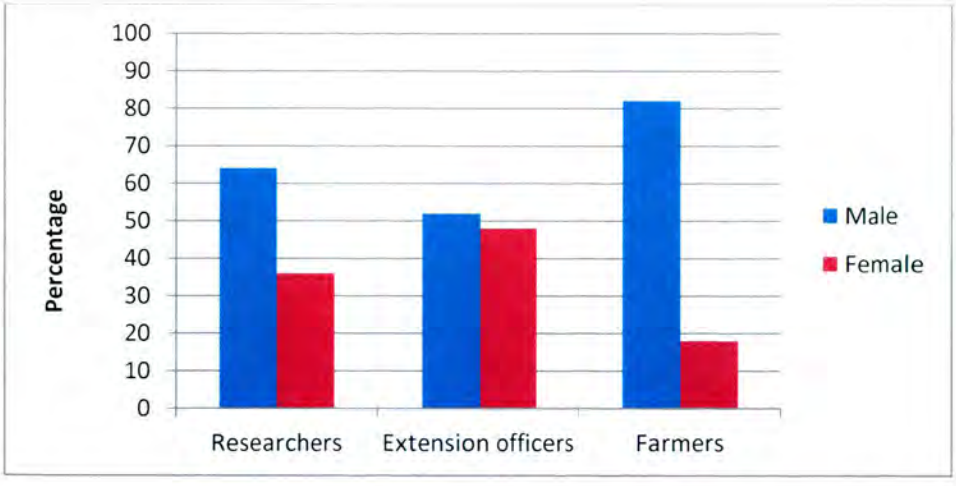

Figure 2: Gender distribution of researchers, extension officers and farmers

4.2.2 Marital status of researchers, extension officers and farmers

Figure 2 depicts respondents' marital status. Over half of researchers and farmers, 56% and 52% respectively, were married while half (50%) of the extension officers were also found to be married. This high level of marriage can be an attribute of the age category of all these actors as most of them are predicted to be adults and often, marital status confers some responsibilities hence researchers, extension agents and farmers strive to better their living standards by generating income from their respective employment so as to provide for their spouses and children. This compares with the survey of Adesoji et al (2006) who reported that majority (84%) of the farmers were married and only 16% were not married.

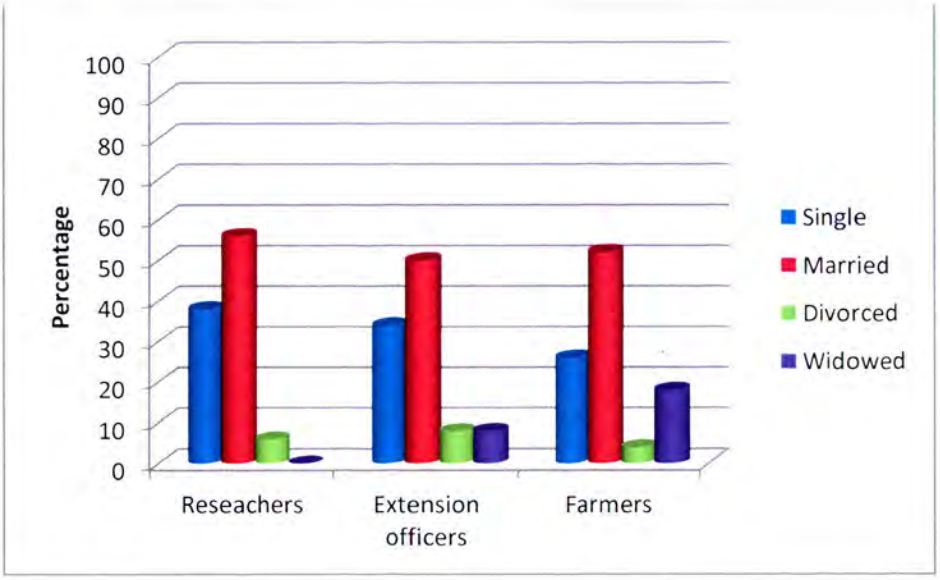

Figure 3: Marital status of researchers, extension officers and farmers

4.2.3 Ethnic group of researchers, extension officers and farmers

The relatively high percentages of black researchers (74%), black extension officers (94%) and black farmers (98%) reflected in Figure 3 can be attributed to the fact that the population group is the most dominating in the country. Stats SA (2011) revealed that Black people make up a greater proportion of the South African population. Furthermore, the Black affirmative action is also a contributing factor to these results as it ensures that qualified people from designated groups have equal opportunities in the workplace and in South Africa, these groups are Black people who were previously under-represented in many key work areas.

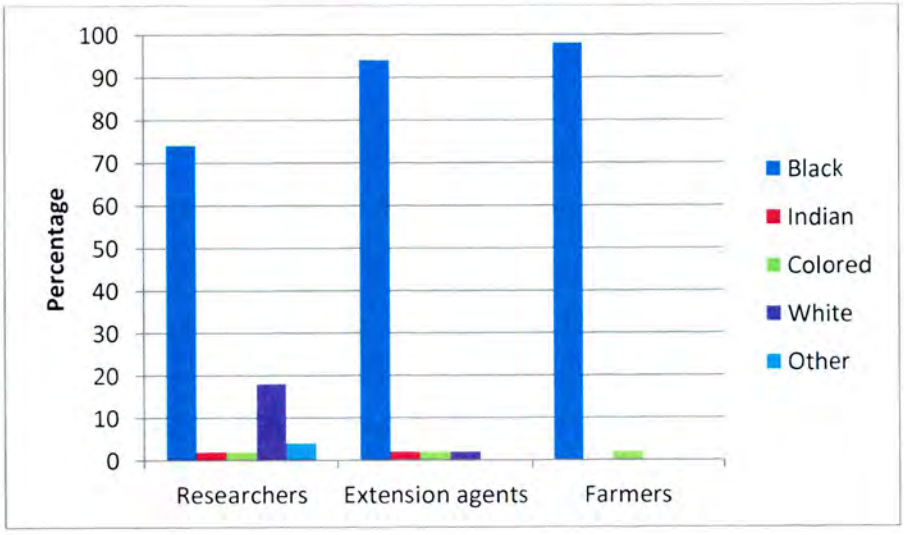

Figure 4: Ethnic group of researchers, extension officers and farmers

4.2.4 Distribution of researchers, extension officers and farmers based on religion

Figure 4 portrays the religion of respondents. Majority of researchers and farmers were Christians, 96% and 94% respectively, while all (100%) of the extension agents also indicated that they were of Christian denominations. This high level of Christianity can be owed to the ethnicity of respondents, which is Black, and this population group is mostly characterised as being Christians as it is rare to find Black people being affiliates of Hinduism or Muslim.

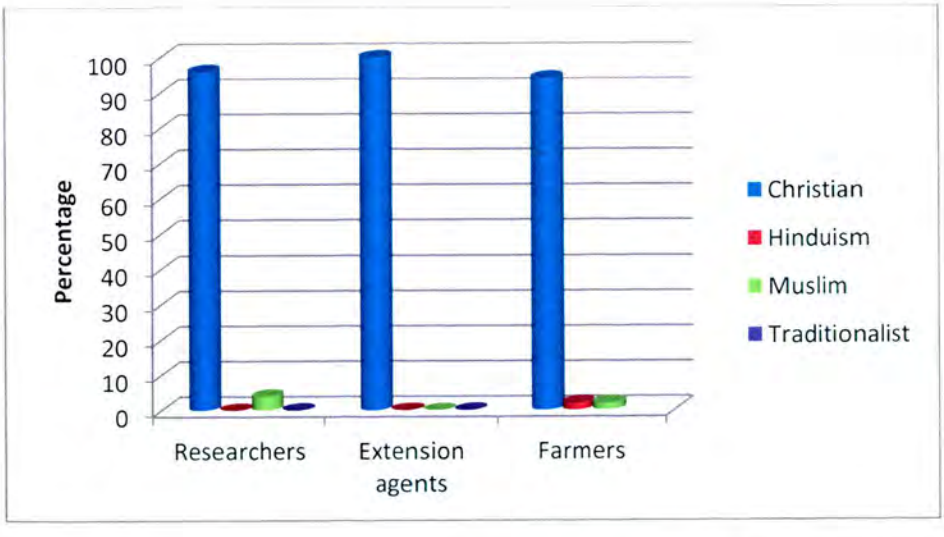

Figure 5: Religion of researchers, extension officers and farmers

4.2.5 Age distribution of researchers, extension agents and farmers

About 34% and 38% of researchers and extension agents, respectively, fall in the age bracket of 36 to 47 years. This signifies active labour age bracket as this middle-aged group are often enthusiastic as opposed to their older counterparts who are bound for retirement. However, the age bracket of farmers is contrary to those of researchers and extension agents as a greater proportion (36%) of them are 60 years and older (Figure 5). Contrary to these findings, Sekoto and Oladele (2012) revealed that majority (58%) of farmers were between the age of 36-60 years. The reason for this skewed age participation in farming might be that older people are likely to have interest in farming than those who are in their middle-ages because they are often content to reside in rural areas whereas the middle-aged are likely attracted and have a desire to live in urban areas. This can instead be justified by the opinion of Moloi (2008) that farming is mostly considered as an alternative job for people who are retiring from their lucrative jobs and, the educated, young and active people migrate to the urban areas to seek better employment and they do not consider farming as a potential business.

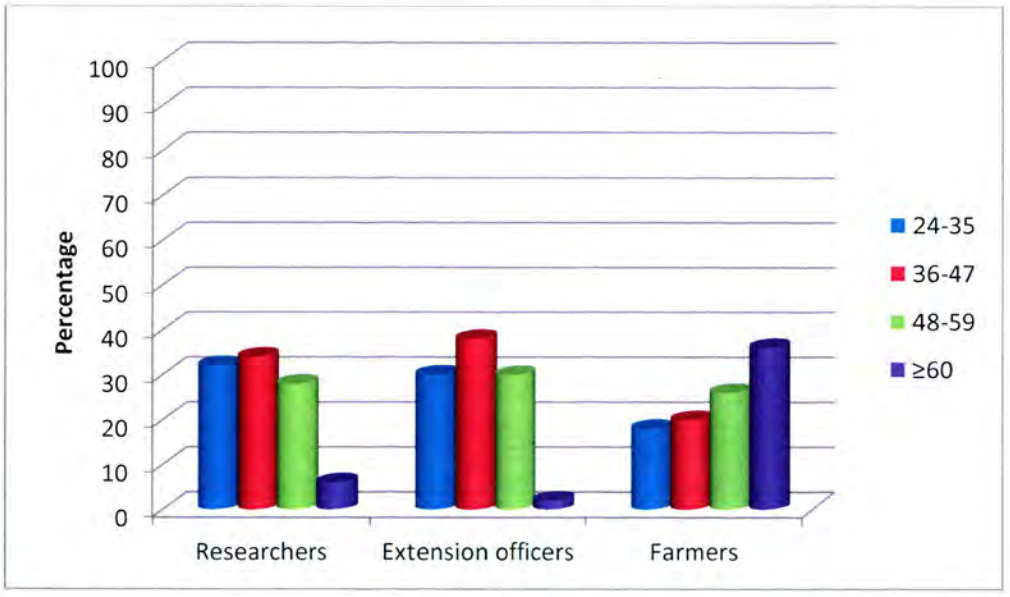

Figure 6: Age distribution of researchers, extension agents and farmers

4.2.6 Household size of researchers, extension officers and farmers

Table 1 presents the household size of respondents. About 48% of researchers, 50% of extension officers and 54% of farmers revealed that their household size falls within the bracket of 4 to 6 persons in counting. This indicates that in these modern times, people no longer have large families like in the olden days and this can be as a result of an informed population, with regard to birth-control mechanisms, because in these recent decades such information has been made available to the public and it is no longer a taboo like it used to be in the past. Another reason can be that the cost of living has become too much and people often prefer to have less mouths to feed. This opposes the findings of Daudu et al (2009) who reported that most (77.5%) of the respondents had a household size of 16 and above persons.

Table 1: Household size of researchers, extension officers and farmers

Household size	Researchers	Extension	Farmers
1-3	20 (40)	18 (36)	6 (12)
4-6	24 (48)	25 (50)	27 (54)
7-9	5 (10)	6 (12)	14 (28)
10-12	1 (2)	1 (2)	3 (6)

* Figures in parentheses are percentages

4.2.6 Monthly income among researchers, extension officers and farmers

It is evident in Table 2 that majority of researchers (70%) have a monthly income generation of more than R15 000, and most (38%) extension officers fall within the income bracket of R10001-R15000 while almost half (46%) of the farmers' income generation falls in the bracket of R1000-R5000. This skewed income earnings can be an attribute of the qualifications that these three actors hold. Farmers often have the least qualifications hence the majority of them are in the second least income bracket earning and this bracket can be justified by the social grants that most of these farmers emphasized to be their primary source of income. However, researchers and extension agents are classified as skilled labourers in a sense that they often have qualifications in their respective fields and this has a positive impact on their earnings.

Table 2: Monthly income of researchers, extension officers and farmers

Income	Researchers	Extension	Farmers
<1000	0	0	2 (4)
1000-5000	2 (4)	0	23 (46)
5001-10000	5 (11)	14 (28)	13 (26)
10001-15000	7 (15)	19 (38)	7 (14)
>15000	33 (70)	17 (34)	5 (10)

* Figures in parenthesis are percentages

4.2.7 Educational level of researchers, extension officers and farmers

Results of the analysis in the Table 3 show that 36% of researchers have Doctorates and 34% of extension officers have Bachelors' Degrees whereas, only a least number (14%) of farmers have any tertiary qualifications. Tekana and Oladele (2011) indicated that only three percent of farmers had tertiary education. However, Al-Subaiee (2005) revealed that over half (54%) of the extension agents have a Diploma as their highest education level and just over one-third of extension agents had a Bachelor's Degree.

Table 3: Educational level of researchers, extension officers and farmers

Educational level	Farmers	Educational level	Researchers	Extension
No formal education	8 (16)	Certificate	0	1 (2)
Primary school	10 (20)	Diploma	1 (2)	15 (30)
Secondary school	12 (24)	Degree	7 (12)	17 (34)
High school	13 (26)	Honors	10 (20)	14 (28)
Tertiary	7 (14)	Masters	15 (30)	3 (6)
		PhD	17 (36)	0

*Figures in parenthesis are percentages

4.2.8 Researchers and extension agents studying for higher degree

It is evident in Figure 6 that majority of researchers (76%) and extension officers (60%) are not furthering their studies and this can either be as a result of the higher qualifications they already have or that they have reached a certain age that makes it a bit of a challenge for them to proceed with their studies as most of them emphasized that they head families and have plenty of responsibilities thereof, which makes it difficult for them to find balance between work, studies and family responsibilities.

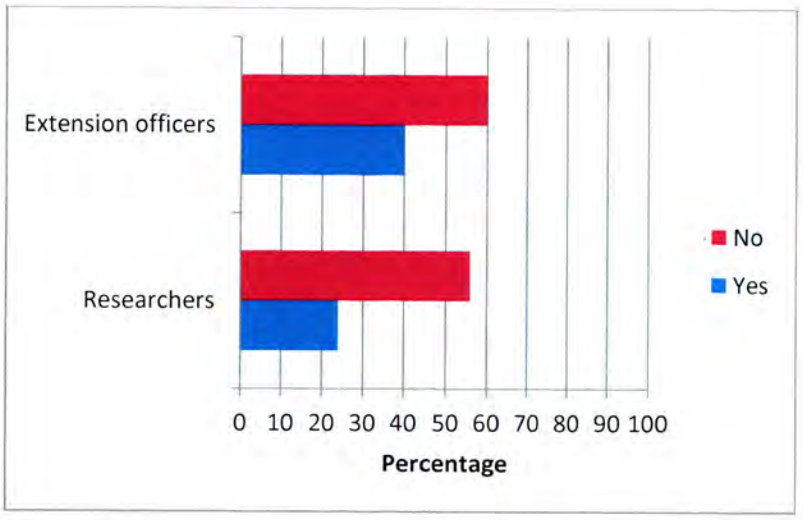

Figure 7: Researchers and extension agents studying for higher degree

4.2.9 Working experience among researchers, extension agents and farmers

Findings in Table 4 reveal that 26% of researchers and 30% of extension agents have working experience of 1 to 5 years. This can be as a result of opportunities that these new entrants (researchers and extension officers) have in terms of education as they can easily access tertiary education given the funding mechanisms that have been put in place to cater for their financial crisis. After obtaining their qualifications, they then become the most attractive candidates in the work-place considering their productive and advanced state in areas such as technology. The Government is also putting more emphasis on youth employment, hence employers are tasked to oblige to such conditions. Pezeshki-Raad and Dehkordi (2006) reported that respondents had an average research experience of 9 years and, Oladele and Mabe (2010) revealed that 92.5% of extension officers had at least 10 years of work experience.

However, about 44% of farmers highlighted that they have more than twenty years of farming experience. The disparity in level of experience might be a result of age whereby most of these farmers have been engaging into agricultural activities in the last decades when job opportunities were slim for Blacks in South Africa and agriculture was found to be the major source of employment and income generation. Adesoji et al (2006) noted that about twenty two percent of farmers have more than ten years of farming experience.

Table 4: Working experience of researchers, extension agents and farmers

Working experience	Researchers	Extension	Farmers
1-5	13 (26)	15 (30)	9 (18)
6-10	11 (22)	10 (20)	10 (20)
11-15	12 (24)	10 (20)	7 (14)
16-20	3 (6)	6 (12)	2 (4)
>20	11 (22)	9 (18)	22 (44)

*Figures in parenthesis are percentages

4.3 Farm characteristics

4.3.1 Crop production

Table 5 presents the results of crops produced by farmers. About 47% of farmers cultivate 51-100 ha of their lands for maize production with only 20% of them cultivating 11-50 ha while the other 20% were found to be cultivating 151-200 ha. Half (50%) of these farmers generate income of more than R30000 from their maize enterprises. This can be an attribute of the climatic conditions and land suitability for maize production in the Province. Baloyi (2013) reported that maize is the largest locally produced field crop, and the most important source of carbohydrates in the Southern African Development Community (SADC) region for animal and human consumption. South Africa is the main maize producer in the SADC region with the North West, Free State and Mpumalanga provinces being the major producers of the crop.

In terms of sunflower production, 38% of farmers taking part in revealed that they produce on a scale of 1-50 ha and the minority (30%) produce on a scale of more than 100 ha. However, the income earnings of these farmers are somehow contrary to their scales of production because most (33%) of them earn more than R35000 and only 22% of them are earning less than R5000. Lekunze et al (2011) suggested that the increase in demand for alternative energy such as bio-fuels has resulted to a sharp increase in the prices of sunflower seeds. The price per ton of sunflower has dramatically increased from approximately R1800 per ton in 2005 to over R4500 per ton based on forward contracts in 2008.

About 71% of farmers produce vegetables on lands less than 5ha and this is because vegetables can be efficiently produced on smaller fields and again, most of these farmers acknowledge that their outputs are sold as cash crops. However, 43% of the farmers earn less

than R5000 for their vegetable produce and this might be as a result of the nature of their market.

Furthermore, Table 5 indicates less prominent enterprises which were beans, peanuts and barley. Half (50%) of the participants asserted that they produce beans on pieces of land that were less than 5ha, all (100%) peanut producers cultivate 1-100ha for the enterprise and for barley, it was found that half (50%) of the farmers cultivate 1-100ha while the remaining half (50%) cultivated more than 100ha. In terms of income generation, a large number (67%) of participants earned more than a thousand-rand, peanut farmers had no income earnings from the enterprise, nonetheless, 50% of barley farmers earned less than twenty-thousands and another 50% generated just more than that. The low levels of bean production can be supported by the findings of DAFF (2010) who noted that North West Province is among the least producers for soya beans as it only contributes 5% to the total Country's production. Furthermore, NDA (2011) argued that in 2009 the Western Cape was the largest producer of barley in South Africa with a share of 73% followed by Northern Cape and North West Provinces with shares of 24% and 3% respectively. However, contrary to these findings, DAFF (2011) discovered that North West Province is amongst the largest producers of groundnuts in the Country.

Table 5: Crop production by farmers

Maize(Ha)	**F (%)**	**Income for maize**	**F (%)**
11-50	3 (20)	<10 000	3 (21)
51-100	7 (47)	10000-20000	4 (28)
101-150	2 (13)	20001-30000	1 (7)
151-200	3 (20)	>30000	7 (50)
Sunflower (Ha)	**F (%)**	**Income for sunflower**	**F (%)**
1-50	5 (38)	<5000	2 (22)
51-100	4 (31)	5000-35000	4 (44)
>100	4 (30)	>35000	2 (22)
Vegetables (Ha)	**F (%)**	**Income for vegetables**	**F (%)**
<5	5 (71)	<5000	3 (43)
5-15	2 (29)	5000-10000	2 (29)
		10001-20000	1 (14)
		>20000	1 (14)
Beans	**F (%)**	**Income for beans**	**F (%)**
<5	2 (50)	< 1000	1 (33)
5-100	1 (25)	> 1000	2 (67)
>100	1 (25)		
Barley	**F (%)**	**Income for barley**	**F (%)**
1-100	1 (50)	<20000	1 (50)
>100	1 (50)	>20000	1 (50)
Peanuts	**F (%)**	**Income for peanuts**	**F (%)**
1-100	1 (100)	0	0

4.3.2 Animal production

Table 6 indicates the results of animal production. Cattle production is a major component of Southern African rural agriculture and its products provide food for home consumption and are sources of income for many small-scale farmers and most of these farmers view livestock as a form of capital that can easily be converted into cash (Schwalbach et al 2001). Over half (52%) of farmers have 1 to 80 cattle and the 11% own 81 to 160 cattle and, about 48% of the farmers generate income of R5000 to R20000 whereas 9% generate less than R5000 per annum. Schwalbach et al (2001) reported contrary results that the income from cattle farming activities was low, with 75.4% of all farmers earning an income of R1000 or less per year from their cattle farming activities.

About 56% of farmers have less than 50 sheep and in terms of income, half (50%) of the farmers revealed that they get R5000 to R15000 per year. Their income generation can be attributable to lack of formal markets and they mostly sell to local communities and rarely sell in auctions. Tshabalala (2000) stated that sheep are an integral part of small-holder farming systems and they make a significant contribution to the total farm income, the stability of farming systems and human nutrition and all this is beneficial, especially to the poorest communities. Nonetheless, 40% of goat farmers indicated that they have 11 to 20 goats and 70% of them earn R1000 to R10000 from these enterprises. Approximately 83% of poultry producers in utilize 3 or less hectares of land for this enterprise and this can be owed to the fact that poultry production does not necessarily require large hectares of land.

Table 6: Animal production by farmers

Cattle	**F (%)**	**Income for cattle**	**F (%)**
1-80	14 (52)	<5000	2 (9)
81-160	3 (11)	5000-20000	11 (48)
>160	10 (36)	20001-35000	2 (9)
		35001-50000	4 (17)
Sheep	**F (%)**	**Income for sheep**	**F (%)**
<50	5 (56)	5000-15000	4 (50)
51-100	2 (22)	15001-25000	2(25)
101-150	2 (22)	>25000	2 (25)
Goats	**F (%)**	**Income for goats**	**F (%)**
1-10	3 (30)	1000-10000	7 (70)
11-20	4 (40)	10001-20000	3 (30)
21-30	1 (10)		
>30	2 (20)		
Poultry (Ha)	**F (%)**	**Income for poultry**	**F (%)**
≤3	5 (83)	>1000	2 (40)
>3	1 (17)	1000-6000	2 (40)
		<6000	1 (20)

4.3.3 Farmers' organizations

Results in Figure 7 show that majority (76%) of farmers are affiliates of the African Farmers Association of South Africa (AFASA) and the minority (24%) are rather members of the National African Farmers Union (NAFU) and this is because NAFU is being dissolved into AFASA which is somehow the most prominent and vibrant association for our African farmers in the province.

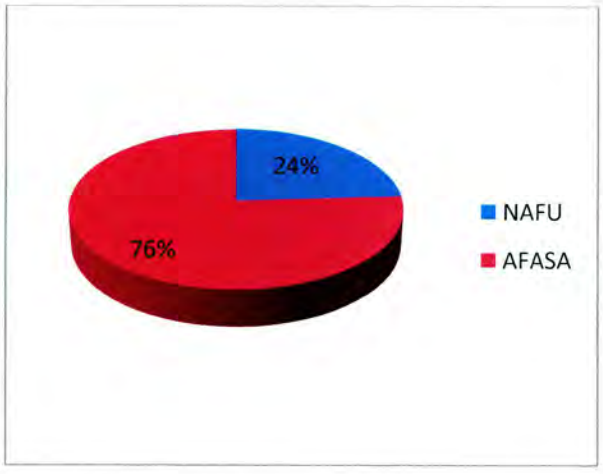

Figure 8: Farmers' organization

4.3.4 Contact with extension officers

Table 7 indicates that 82% of farmers receive extension services and only 18% of them do not have any contacts with extension agents. About 40% of those who stated that they have contacts with extension agents further revealed that the extension agents visit them regularly while 23% of them disclosed that the officers rarely come to them. This agrees with the findings of Moagi and Oladele (2012) whose results show that a large proportion (96.7%) of the respondents have contact with extension officers and the remaining 3.3% do not have any contacts with the extension officers.

Table 7: Farmers' contacts with extension officers

Contact with extension officers	**F (%)**
Yes	41 (82)
No	9 (18)
Extent Of Contact With Extension Officers	**F (%)**
Regularly	16 (40)
Occasionally	15 (38)
Rarely	9 (23)

4.3.5 Distance covered by farmers to extension offices

Table 8 indicates that 44% of farmers are located within a radius of less than 40km to extension offices and 18% of these farmers are located in areas that are more than 100km away from the extension offices. This can be an attribute of the local district centres of agriculture which are usually scattered in different municipalities to cater for nearby communities.

Table 8: Distance covered by farmers to extension offices

Distance to extension offices	Frequency	Percentage
<40	22	44
40-100	19	38
>100	9	18

4.4 Researchers and extension officers' contact with farmers

4.4.1 Contact with farmers by researchers and extension agents

A greater percentage of researchers (70%) and extension agents (98%) revealed that they meet with farmers (Figure 9). This can be because of their job descriptions which often require them to have field visits with farmers.

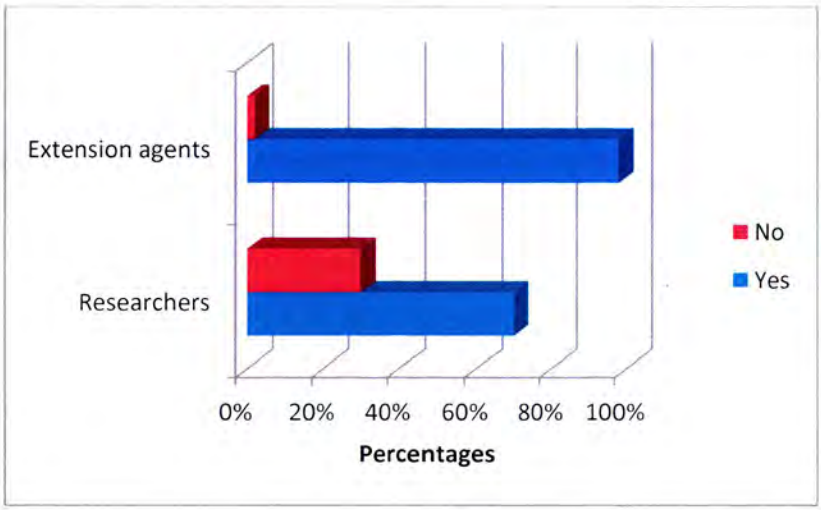

Figure 9: Contact with farmers by researchers and extension agents

4.4.2 Extent of contact with farmers by researchers and extension officers

Figure 10 presents the extent in which researchers and extension officers meet with farmers. About 44% of researchers revealed that they occasionally meet with farmers whereas 80% of extension officers exposed that they have regular contacts with farmers. This disparity can be credited to the primary duties that each of these actors is faced with.

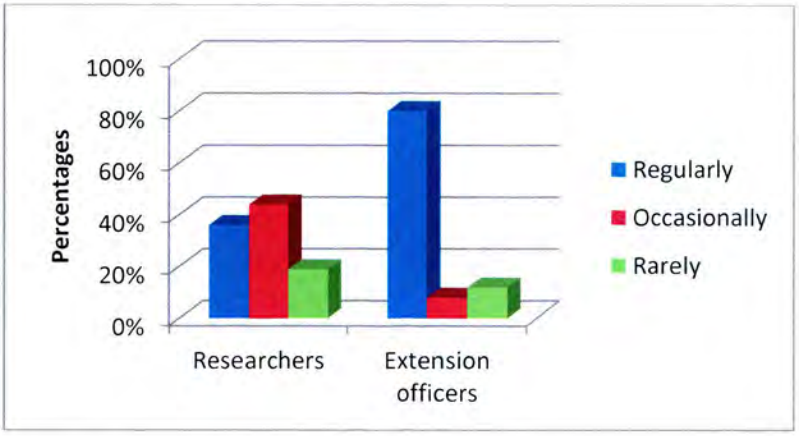

Figure 10: Extent of contact with farmers by researchers and extension officers

4.4.3 Distance covered by researchers and extension officers to farmers

Figure 11 shows that 61% of researchers travel more than 100 Kilometres to reach their farmers while 46% of extension officers indicated that their travel to farmers ranges between 40 Km and 100 Km, the other 46% exposed that they travel more than 100 Km to get to their farmers. Oladele and Mabe (2010) noted that 45% of extension officers in North West Province, South Africa, travel more than 40 Km to reach their farmers.

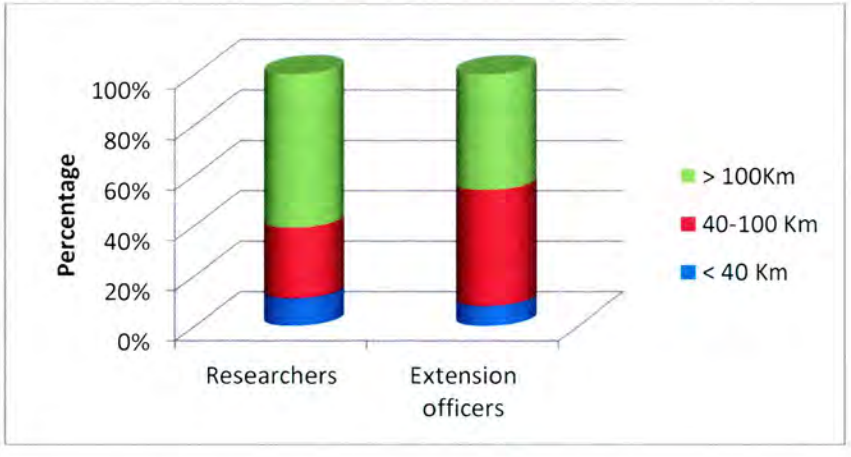

Figure 11: Distance covered by researchers and extension officers to farmers

4.4.4 Number of farmers covered by extension officers

About 60% of extension officers indicated that they have 1 to 150 farmers to attend to as their clients (Figure 12). Oladele and Mabe (2010) revealed that only 40% of the extension officers covered more than 500 farmers.

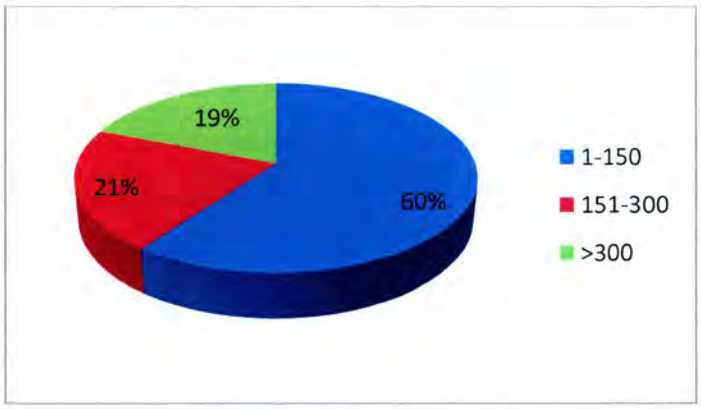

Figure 12: Number of farmers covered by extension officers

4.4.5 Job designation of researchers and extension officers

Table 9 highlights the job designation of researchers and extension officers. About 10% of researchers and 4% of extension agents held managerial positions and these lower percentages in such positions can be credited to the organizational structures of the institutions, that is, North-West University, Agricultural Research Council and the Department of Agriculture and Rural Development. This agrees with the findings of Pezeshki-Raad and Dehkordi (2006) who reported that about 78.4% of respondents did not hold any managerial positions.

Table 9: Job designation of researchers and extension officers

Research	F (%)	Extension	F (%)
Researcher	36 (72)	Extension officer	32 (64)
Senior researcher	9 (18)	Senior extension officer	10 (20)
Research institute manager	5 (10)	Deputy director	6 (12)
		Director	2 (4)

4.4.6 Area of specialization for researchers

Table 10 displays the areas of specialization for researchers. About 20% of researchers were found to be agronomist and this might be a characteristic of the Province's agriculture which comprises mainly of agronomic crops, making research in this field a bit more effective and efficient. However, 2% of researchers were in the profession of clinical veterinary services. Pezeshki-Raad and Dehkordi (2006) reported that most of the researchers (47.1%) were in the general area of agronomy, seed and plant improvements/breeding.

Table 10: Job specialization of researchers*

Agricultural Economics	4 (8)	Animal Nutrition	7(14)
Agricultural Extension	4(8)	Animal Breeding	4(8)
Plant breeding	4(8)	Animal Genetics	3(6)
Soil Science	8(16)	Beef, Dairy and Game production	3(6)
Agronomy	10(20)	Pig and Poultry production	6(12)
Horticulture	5(10)	Microbiology	2(4)
Pathology	2(4)	Clinical Veterinary Services	1(2)
Plant Genetics	2(4)	Other	3(6)

*Multiple responses

*Figures in parenthesis are percentages

4.4.7 Residency on job location for researchers and extension officers

Table 11 shows that, most researchers (76%) and extension officers (70%) are living in their job location and this might be influenced by the escalating fuel prices and tiring travels that these actors are trying to avoid. Mabe and Oladele (2012) reported similar findings that 79% of extension officers live in their job location.

Table 11: Job location for researchers and extension officers

Living in job location	Researchers	Extension officers
Yes	38 (76)	35 (70)
No	12 (24)	15 (30)

*Figures in parenthesis are percentages

4.4.8 Researchers' organization

It is evident in Figure 13 that 54% of researchers were found to be from the ARC and this can be attributed to the institutions' mandate, which is solely research as opposed to the University where lecturers do not only conduct research but also part-take in teaching which is the primary objective of the institution.

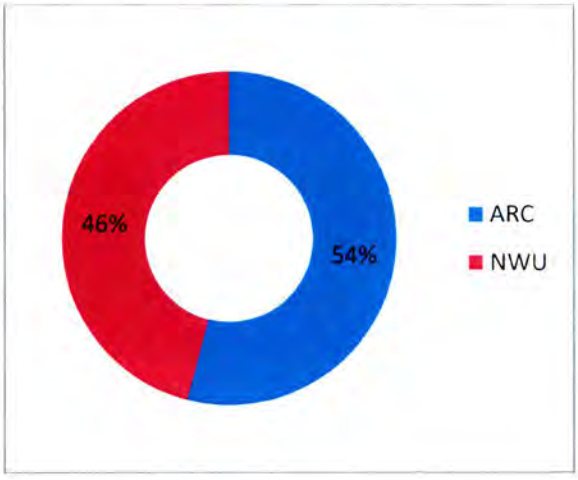

Figure 13: Researchers' organization

4.5 Linkage activities

4.5.1 Linkage activities of researchers

Table 12 shows linkage activities of researchers with extension officers and farmers. Most researchers gave a positive response for their collaboration with extension officers and farmers in the following activities: dissemination of knowledge (62%); joint problem identification (58%); collaborative professional activities (54%); joint seminar and workshop (54%) and evaluation surveys (54%).

It is evident that researchers never have staff rotation (96%); joint publications (82%); joint facilities (78%); joint financial resources (76%) and exchange of resources (76%) with extension officers. However, they indicated that they never do joint publication (92%); staff rotation (90%); joint financial resources (82%); joint facilities (80%) and joint reports (76%) with farmers.

Table 12: Linkage activities of researchers

	Yes	No	Frequency with Extension Officers			Frequency with Farmers		
			R	O	N	R	O	N
Joint problem identification	29 (58)	21 (42)	11 (22)	17 (34)	22 (44)	9 (18)	15 (30)	26 (52)
Joint priority setting and planning	20 (40)	30 (60)	6 (12)	12 (24)	32 (64)	9 (18)	12 (24)	29 (58)
Joint research contracts	21 (42)	29 (58)	8 (16)	11 (22)	31 (62)	6 (12)	10 (20)	34 (68)
Joint research activities	23 (46)	27 (54)	5 (10)	15 (30)	30 (60)	7 (14)	17 (34)	26 (52)
Collaborative professional activities	27 (54)	23 (46)	6 (12)	20 (40)	24 (48)	6 (12)	12 (24)	32 (64)
Exchange of resources	15 (30)	35 (70)	3 (6)	9 (18)	38 (76)	4 (8)	8 (16)	38 (76)
Joint facilities(e.g. laboratory)	11 (22)	39 (78)	2 (4)	9 (18)	39 (78)	2 (4)	8 (16)	40 (80)
Joint financial resources	12 (24)	38 (76)	3 (6)	9 (18)	38 (76)	2 (4)	7 (14)	41 (82)
Staff rotation	6 (12)	44 (88)	0	2 (4)	48 (96)	0	5 (10)	45 (90)
Dissemination of knowledge	31 (62)	19 (38)	10 (20)	18 (36)	22 (44)	19 (38)	11 (22)	20 (40)
Joint publication	10 (20)	40 (80)	1 (2)	8 (16)	41 (82)	0	4 (8)	46 (92)
Joint reports	15 (30)	35 (70)	6 (12)	11 (22)	33 (66)	4 (8)	8 (16)	38 (76)
Joint demonstration trials	23 (46)	27 (54)	8 (16)	15 (30)	27 (54)	7 (14)	16 (32)	27 (54)
Joint field days	26 (52)	24 (48)	14 (28)	14 (28)	22 (44)	12 (24)	16 (32)	22 (44)
Joint seminar and workshop	27 (54)	23 (46)	7 (14)	14 (28)	29 (58)	10 (20)	11 (22)	29 (58)
Evaluation survey	15 (30)	35 (70)	5 (10)	10 (20)	35 (70)	5 (10)	9 (18)	36 (72)
Evaluation field visits	27 (54)	23 (46)	7 (14)	19 (38)	24 (48)	8 (16)	17 (34)	25 (50)
Evaluation reports	19 (38)	31 (62)	7 (14)	12 (24)	31 (62)	7 (14)	9 (18)	34 (68)

* R – Regularly, O – Occasionally and N - Never
* Figures in parenthesis are percentages

4.5.2 Linkage activities of extension officers

Table 13 reveals the linkage activities of extension officers with researchers and farmers. Majority of them indicated that they take part in disseminating knowledge (92%); joint demonstration trials (88%); joint problem identification (86%) and joint field days (84%). When asked of their frequencies of collaboration with researchers, extension officers indicated that they occasionally do joint demonstration trials (48%); joint seminar and workshop (46%); joint field days (44%) and they never do staff rotation (76%); joint research contracts (74%); joint facilities (74%) and exchange of resources (70%).

Nonetheless, extension officers highlighted that they regularly disseminate knowledge (56%) and have joint field days (52%) with farmers and that; they occasionally do joint demonstration trials (52%) and joint problem identification (40%) with them. Most of these extension officers further indicated that they never do staff rotation (88%); joint facilities (88%); joint publication (86%); joint research contracts (84%) and exchange of resources (84%) with farmers.

Table 13: Linkage activities of extension officers

	Yes	No	Frequency with Researchers			Frequency with Farmers		
			R	O	N	R	O	N
	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)
Joint problem identification	43 (86)	7 (14)	4 (8)	17 (34)	29 (58)	11 (22)	20 (40)	19 (38)
Joint priority setting and planning	36 (72)	14 (28)	6 (12)	17 (34)	27 (54)	6 (12)	11 (22)	33 (66)
Joint research contracts	18 (36)	32 (64)	3 (6)	10 (20)	37 (74)	4 (8)	4 (8)	42 (84)
Joint research activities	19 (38)	31 (62)	4 (8)	14 (28)	32 (64)	2 (4)	7 (14)	41 (82)
Collaborative professional activities	33 (66)	17 (34)	9 (18)	16 (32)	25 (50)	9 (18)	10 (20)	31 (62)
Exchange of resources	26 (52)	24 (48)	5 (10)	10 (20)	35 (70)	3 (6)	5 (10)	42 (84)
Joint facilities(e.g. laboratory)	16 (32)	34 (68)	2 (4)	11 (22)	37 (74)	2 (4)	4 (8)	44 (88)
Joint financial resources	20 (40)	30 (60)	2 (4)	14 (28)	34 (68)	7 (14)	10 (20)	33 (66)
Staff rotation	8 (16)	42 (84)	4 (8)	8 (16)	38 (76)	4 (8)	2 (4)	44 (88)
Dissemination of knowledge	46 (92)	4 (8)	10 (20)	14 (28)	26 (52)	28 (56)	13 (26)	9 (18)
Joint publication	14 (28)	36 (72)	8 (16)	20 (40)	22 (44)	2 (4)	5 (10)	43 (86)
Joint reports	23 (46)	27 (54)	6 (12)	14 (28)	30 (60)	5 (10)	4 (8)	41 (82)
Joint demonstration trials	44 (88)	6 (12)	11 (22)	24 (48)	15 (30)	9 (18)	26 (52)	15 (30)
Joint field days	42 (84)	8 (16)	10 (20)	22 (44)	18 (36)	26 (52)	11 (22)	13 (26)
Joint seminar and workshop	38 (76)	12 (24)	12 (24)	23 (46)	15 (30)	14 (28)	18 (36)	18 (36)
Evaluation survey	31 (62)	19 (38)	9 (18)	15 (30)	26 (52)	7 (14)	7 (14)	36 (72)
Evaluation field visits	33 (66)	17 (34)	8 (16)	14 (28)	28 (56)	11 (22)	13 (26)	26 (52)
Evaluation reports	27 (54)	23 (46)	6 (12)	15 (30)	29 (58)	7 (14)	5 (10)	38 (76)

*R – Regularly, O – Occasionally and N – Never

*Figures in parenthesis are percentages

4.5.3 Linkage activities of farmers

Table 14 reveals the linkage activities that farmers engage in with researchers and extension officers, and also the frequencies that these activities occur. Most farmers indicated their involvement with researchers and extension officers in the following activities: joint problem identification (68%), dissemination of knowledge (68%), joint field days (74%) and evaluation field visits (72%). On the other hand, farmers highlighted that they never do joint research contracts (88%), joint facilities (90%), joint financial resources (80%), staff rotation (90%) and joint publications (86%) with researchers and extension agents. This signifies the lack of collaboration between researchers-extension officer-and farmers, meaning that farmers might sometimes be imposed with research and advisory services that they do not necessarily need because they often short-fall in these activities vital for a prosperous agricultural innovation system.

It is evident in the Table 14 that minority of farmers regularly do joint problem identification (4%), joint priority setting (4%) and dissemination of knowledge (6%) with researchers and this could mean that researchers do not frequently meet with farmers. Moreover, majority of the respondents publicized that they never engage in quite a number of activities with researchers: joint research contracts (88%), exchange of resources (92%), joint publication (90%) joint reports (94%) and evaluation reports (90%). This justifies why many farmers who were interviewed disclosed that they have never met a researcher in their entire lives. De Rosario (2010) argued that several research centres include local farmers in their research work, particularly during the experimental stages but only a few collaborate on a regular basis with farmers' organizations and this is detrimental because a continuous participation of farmers is crucial for well orientated and efficient research project.

However, farmers stated that extension officers regularly involve them in problem identification (38%) and dissemination of knowledge (42%) and this can be an element of the regular face-to-face or one-on-one meetings that extension agents often conduct with farmers. These farmers and extension workers occasionally do joint demonstration trials (48%), joint field days (48%) and joint seminar and workshop (52%) and this might be because such activities are only required on an occasional basis and need not be a day to day activity. Furthermore, farmers highlighted that they never have joint research contracts (94%), joint research activities (88%), joint facilities (98%), staff rotation (92%) and joint publications (94%) with extension agents and this might be due to the nature of extension duties.

Ogunremi and Olaniran (2012) argued that farmers were less involved in problem identification (23%) and not involved at all in staff rotation and their low level of involvement could be as a result of the research institutes and extension organization planning which make their participation inadequate.

Table 14: Linkage activities for farmers

	Yes	No	Frequency with Researchers			Frequency with Ext. agents		
			R	O	N	R	O	N
	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F (%)
Joint problem identification	34 (68)	16 (32)	2 (4)	12 (24)	36 (72)	19 (38)	14 (28)	17 (34)
Joint priority setting and planning	26 (52)	24 (48)	2 (4)	5 (10)	43 (86)	9 (18)	16 (32)	25 (50)
Joint research contracts	6 (12)	44 (88)	0	6 (12)	44 (88)	0	3 (6)	47 (94)
Joint research activities	11 (22)	39 (78)	0	10 (20)	40 (80)	1 (2)	5 (10)	44 (88)
Collaborative professional activities	21 (42)	29 (58)	0	13 (26)	37 (74)	9 (18)	11 (22)	30 (60)
Exchange of resources	11 (22)	39 (78)	0	4 (8)	46 (92)	0	9 (18)	41 (82)
Joint facilities(e.g. laboratory)	5 (10)	45 (90)	0	5 (10)	45 (90)	0	1 (2)	49 (98)
Joint financial resources	10 (20)	40 (80)		1 (2)	49 (98)	0	10 (20)	40 (80)
Staff rotation	5 (10)	45 (90)	0	2 (4)	48 (96)	1 (2)	3 (6)	46 (92)
Dissemination of knowledge	34 (68)	16 (32)	3 (6)	13 (26)	34 (68)	21 (42)	11 (22)	18 (36)
Joint publication	7 (14)	43 (86)	0	5 (10)	45 (90)	0	3 (6)	47 (94)
Joint reports	10 (20)	40 (80)	0	3 (6)	47 (94)	3 (6)	7 (14)	40 (80)
Joint demonstration trials	27 (54)	23 (46)	2 (40)	19 (38)	29 (58)	3 (6)	24 (48)	23 (46)
Joint field days	37 (74)	13 (26)	0	20 (40)	30 (60)	13 (26)	24 (48)	13 (26)
Joint seminar and workshop	27 (54)	23 (46)	0	13 (26)	37 (74)	2 (4)	26 (52)	22 (44)
Evaluation survey	24 (48)	26 (52)	0	10 (20)	40 (80)	9 (18)	11 (22)	30 (60)
Evaluation field visits	36 (72)	14 (28)	0	9 (18)	41 (82)	13 (26)	19 (38)	18 (36)
Evaluation reports	18 (36)	32 (64)	0	5 (10)	45 (90)	2 (4)	14 (28)	34 (68)

*R – Regularly, O –Occasionally and N – Never

*Figures in parenthesis are percentages

4.6 Constraints to collaboration among researchers, extension agents and farmers

Table 15 displays the results of the survey with regard to constraints faced by researchers, extension agents and farmers. Researchers indicated that their major constraints in descending order are: Weak channels of communication among researchers-extension agents-

and farmers (68%); finance allocation for technologies (62%); political issues influencing research and extension mandates (62%), inadequate research staff (58%); ineffective leadership and management (56%) and; poor administration of research and extension institutions (56%).

However, constraints ranked high by extension officers were: weak channels of communication among researchers-extension officers-and farmers (70%); inadequate extension staff (62%); inadequate knowledge of technologies (56%); poor administration of research and extension institutions (56%); job specialization of extension officers and; job qualification of extension officers (56%).

Moreover, constraints that ranked the highest by farmers also descended in the following order: Inadequate research staff (80%), weak channels of communication among researchers-extension agents and farmers (68%), ineffective leadership and management (66%), inadequate knowledge of technologies (64%), finance allocation for technologies (64%), poor administration of research and extension institutes (64%).

Table 15: Constraints faced by researchers, extension officers and farmers on collaboration

Constraints	Researchers		Extension officers		Farmers	
	Yes	No	Yes	No	Yes	No
Inadequate research staff	29 (58)	21 (42)	24 (48)	26 (52)	40 (80)	10 (20)
Inadequate extension staff	24 (48)	26 (52)	31 (62)	19 (38)	30 (60)	20 (40)
Inadequate knowledge of technologies	19 (38)	31 (62)	28 (56)	22 (44)	32 (64)	18 (36)
Not aware of existing technologies	15 (30)	35 (70)	19 (38)	31 (62)	26 (52)	24 (48)
Finance allocation for technologies	31 (62)	19 (38)	24 (48)	26 (52)	32 (64)	18 (36)
Lack of interest	21 (42)	29 (58)	22 (44)	28 (56)	30 (60)	20 (40)
Distance between research centers and extension offices	16 (32)	34 (68)	18 (36)	32 (64)	15 (30)	35 (70)
Social standards (status)	10 (20)	40 (80)	24 (48)	26 (52)	23 (46)	27 (54)
Job tenure of researchers	17 (34)	33 (66)	13 (26)	37 (74)	17 (34)	33 (66)
Job tenure of extension agents	19 (38)	31 (62)	16 (32)	34 (68)	19 (38)	31 (62)
Job specialization of researchers	16 (32)	34 (68)	18 (36)	32 (64)	16 (32)	34 (68)
Job specialization of extension agents	19 (38)	31 (62)	26 (52)	24 (48)	22 (44)	28 (56)
Job qualification of researchers	18 (36)	32 (64)	12 (24)	38 (76)	10 (20)	40 (80)
Job qualification of extension agents	25 (50)	35 (50)	26 (52)	24 (48)	14 (28)	36 (72)
Lack of recognition from colleagues	25 (50)	25 (50)	15 (30)	35 (70)	17 (34)	33 (66)
Incentives for research and extension activities	23 (46)	27 (54)	18 (36)	32 (64)	19 (38)	31 (62)
Ineffective leadership and management	28 (56)	22 (44)	25 (50)	25 (50)	33 (66)	17 (34)
Limited farmer participation	22 (44)	28 (56)	23 (46)	27 (54)	20 (40)	30 (60)
Weak channels of communication among researchers-extension agents-and farmers	34 (68)	16 (32)	35 (70)	15 (30)	34 (68)	16 (32)
Poor administration of research and extension institutions	28 (56)	22 (44)	28 (56)	22 (44)	32 (64)	18 (36)
Political issues influencing research and extension mandates	31 (62)	19 (38)	24 (48)	26 (52)	20 (40)	30 (60)
Other			4 (8)	1 (2)		

*Figures in parenthesis are percentages

4.7 Knowledge of Agricultural Innovation Systems (AIS)

Table 16 discloses Knowledge of Agricultural Innovation Systems by researchers, extension officers and farmers. Farmers agreed that agricultural innovation system play an important role in generating income (84%); agricultural innovation depends on innovation and innovation systems (72%); agricultural research is a key component for agricultural innovation systems (78%) and also that; stronger interaction and coordination can also induce all actors in an innovation system, particularly public research and extension organizations, to be more aware and responsive to the needs and concerns of other actors i.e. farmers (84%). This implies that most of these farmers have some knowledge of agricultural innovation systems and believe that such systems can improve their earnings and address relevant issues when coordinated exceptionally. They acknowledged research as being a key component in agricultural innovations and this can be owed to the mind-set of farmers who portray researchers as the master minds of innovations.

However, over half of the farmers stated that innovation is neither a science nor technology but rather the application of knowledge of all types to achieve desired social and economic outcomes (62%); agricultural innovation systems can be triggered by markets (52%) and that agricultural innovation systems can be triggered by policies (66%). This signifies that farmers are practically orientated and not too familiar with the theoretical frameworks thereof.

Researchers and extension officers on the other hand, seem to be more knowledgeable about Agricultural Innovation Systems as it is evident in Table 16 that most of them agreed to the statements. Almost all the researchers indicated that agricultural research is a key component to AIS (94%); better coordination can improve the design and implementation of innovation policies by allowing more actors to voice their needs and concerns (92%); stronger interaction and coordination can also induce all actors in an innovation system, particularly public research and extension organizations, to be more aware and responsive to the needs and concerns of other actors i.e. farmers (92%) and also that; in innovation systems, tasks such as policy assessment, monitoring and evaluation are vital to maintaining learning, performance and accountability (92%). A vast majority of extension officers also stated that agricultural research is a key component of AIS (96%); innovation system is a network of organizations, enterprises and individuals focused on bringing new products, new processes, and new forms of organization into economic use (94%); AIS play an important role in generating income (92%) and that; in innovation systems, tasks such as policy assessment, monitoring and evaluation are vital to maintaining learning, performance and accountability

(92%). These results can be justified by the level of education that researchers and extension officers often have.

Table 16: Knowledge of Agricultural Innovation Systems by researchers, extension officers and farmers

	Researchers		Extension officers		Farmers	
Statement	**True**	**False**	**True**	**False**	**True**	**False**
Innovation is neither a science nor technology but rather the application of knowledge of all types to achieve desired social and economic outcomes.	35 (70)	15 (30)	39 (78)	11 (22)	19 (38)	31 (62)
It is a process by which organizations master and implements the design and production of goods and services that are new to them, irrespective of whether they are new to their competitors, their country or the world.	40 (80)	10 (20)	35 (70)	15 (30)	30 (60)	20 (40)
Innovation system is a network of organizations, enterprises and individuals focused on bringing new products, new processes, and new forms of organization into economic use.	43 (86)	7 (14)	47 (94)	3 (6)	32 (64)	18 (36)
AIS is a major source of improved productivity and competitiveness	40 (80)	10 (20)	37 (74)	13 (26)	29 (58)	21 (42)
AIS play an important role in creating jobs.	42 (84)	8 (16)	40 (80)	10 (20)	30 (60)	20 (40)
AIS play an important role in generating income.	40 (80)	10 (20)	46 (92)	4 (8)	42 (84)	8 (16)
AIS play an important role in alleviating poverty.	42 (84)	8 (16)	41 (82)	9 (18)	34 (68)	16 (32)
AIS play an important role in driving social development.	42 (84)	8 (16)	35 (70)	15 (30)	26 (52)	24 (48)
Agricultural development depends on innovation and innovation systems.	45 (90)	5 (10)	37 (74)	13 (26)	36 (72)	14 (28)
AIS can be triggered by policies	39 (78)	11 (22)	34 (68)	16 (32)	17 (34)	33 (66)
AIS can be triggered by the markets.	44 (88)	6 (12)	43 (86)	7 (14)	24 (48)	26 (52)
AIS can be triggered by the natural environment (e.g. climate change)	45 (90)	5 (10)	45 (90)	5 (10)	28 (56)	22 (44)
Researchers, extension agents and farmers innovate in isolation.	32 (64)	18 (36)	27 (54)	23 (46)	34 (68)	16 (32)
Investment in science and technology is a good strategy for creating and maintaining innovative ideas and practices.	45 (90)	5 (10)	45 (90)	5 (10)	34 (68)	16 (32)
Agricultural research is a key component of AIS	47 (94)	3 (6)	48 (96)	2 (4)	39 (78)	11 (22)
Agricultural extension is a key component to AIS	40 (80)	10 (20)	39 (78)	11 (22)	33 (66)	17 (34)
Education and Training are key components to AIS			37 (74)	13 (26)	34 (68)	16 (32)
Better coordination can improve the design and implementation of innovation policies by allowing more actors to voice their needs and concerns.	46 (92)	4 (8)	45 (90)	5 (10)	35 (70)	15 (30)
Stronger interaction and coordination can also induce all actors in an innovation system, particularly public research and extension organizations, to be more aware and responsive to the needs and concerns of other actors i.e. farmers.	46 (92)	4 (8)	40 (80)	10 (20)	42 (84)	8 (16)
In innovation systems, tasks such as policy assessment, monitoring and evaluation are vital to maintaining learning, performance and accountability.	46 (92)	4 (8)	46 (92)	4 (8)	28 (56)	22 (44)
AIS require a range of skills i.e. scientific, technical, managerial, and entrepreneurial skills.	38 (76)	12 (24(	45 (90)	5 (10)	29 (58)	21 (42)

*Figures in parenthesis are percentages

4.8 Knowledge of collaboration among researchers, extension officers and farmers

Table 17 depicts knowledge of collaboration among researchers, extension officers and farmers. Majority of farmers trust that collaboration can promote development and reduce poverty (88%); collaboration improves quality of innovation outputs (86%); collaboration requires development of trust (82%) and that collaboration requires researchers, extension agents and farmers' willingness to work together. This proclaims that farmers are longing for collaboration and believe that it will be fruitful to their livelihoods provided there is an exceptional level of trust and preparedness to work with other actors within the system.

About 78% of farmers falsified that collaboration may encourage dependency because they believe that every actor in the system will know exactly what is expected of them in these collaborative efforts and they will always be eager to perform tasks assigned to them and spare themselves any embarrassment thereof. Over half (52%) of them do not agree that researchers, extension officers and farmers have different comparative advantage in the generation and dissemination of agricultural technology and this might be an attribute of their minimal understanding of the duties assigned to the two actors i.e. researchers and extension officers. It might be a bit unclear for most farmers to detect the exact deliverables that each of these two actors is supposed to deliver.

However, researchers and extension agents revealed some positive thoughts towards collaboration. All (100%) researchers admitted that collaboration can promote development and reduce poverty by providing farmers with access to knowledge and technologies; collaboration requires researchers, extension agents and farmers' willingness to work together (100%) while a large proportion of them also indicated that collaboration improves relevancy innovations (96%); collaboration requires development of trust between researchers, extension officers and farmers (94%) and that collaboration encourages better decision-making as a result of advice obtained from colleagues in other institutions (94%).

The entire population of extension officers in the study also highlighted that collaboration requires development of trust between researchers, extension officers and farmers (100%); and again, the majority indicated that collaboration requires researchers, extension agents and farmers' willingness to work together (96%); collaboration can promote development and reduce poverty by providing farmers with access to knowledge and technologies (94%) and that Collaboration requires the creation of a shared vision for the future (92%).

Table 17: Knowledge of collaboration among researchers, extension officers and farmers

tement	Researchers		Extension officers		Farmers	
	True	False	True	False	True	False
llaboration can promote development and reduce poverty by providing rmers with access to knowledge and technologies.	50 (100)	0	47 (94)	3 (6)	44(88)	6 (12))
llaboration is fruitful in realizing the synergies (extra energy, power, ccess) in innovation.	45 (90)	5 (10)	34 (68)	16 (32)	32(64)	18(36)
llaboration may encourage dependency.	29 (58)	21 (42)	38 (76)	12 (24)	12(24)	38(76)
llaboration exploits complementariness i.e. it leads to the cumulation of complementary abilities, skills and resources.	44 (88)	6 (12)	34 (68)	16 (32)	35(70)	15(30)
an lead to higher competitiveness and better market positioning as a sult of improved competencies.	46 (92)	4 (8)	43 (86)	7 (14)	31(62)	19(38)
nsaction costs and risks can be reduced through collaboration.	40 (80)	10 (20)	32 (64)	18 (36)	26(52)	24(48)
mbining of resources through collaborative efforts will lead to proved service effectiveness and efficiency.	45 (90)	5 (10)	43 (86)	7 (14)	38(76)	12(24)
llaboration improves quality of innovation outputs.	42 (84)	8 (16)	44 (88)	6 (12)	43(86)	7 (14)
llaboration improves relevancy innovations.	48 (96)	2 (4)	46 (92)	4 (8)	38(76)	12(24)
llaboration ensures greater adoption by farmers.	38 (76)	12 (24)	41 (82)	9 (18)	34 (68)	16 (32)
llaboration requires awareness raising for researchers, extension ficers and farmers.	44 (88)	6 (12)	45 (90)	5 (10)	33(66)	17(34)
llaboration requires development of trust between researchers, ension officers and farmers.	47 (94)	3 (6)	50 (100)	0	41(82)	9 (18)
llaboration requires researchers, extension agents and farmers' llingness to work together.	50 (100)	0	48 (96)	2 (4)	40(80)	10(20)
llaboration requires the creation of a shared vision for the future.	45 (90)	5 (10)	46 (92)	4 (8)	36(72)	14(28)
searchers, extension officers and farmers have different comparative vantage in the generation and dissemination of agricultural technology	39 (78)	11 (22)	40 (80)	10 (20)	24(48)	26(52)
llaboration encourages better decision-making as a result of advice tained from colleagues in other institutions.	47 (94)	3 (6)	35 (70)	15 (30)	33(66)	17(34)

*Figures in parenthesis are percentages

4.9 Attitude of researchers-extension agents-and farmers towards collaboration

4.9.1 Attitude of researchers towards collaboration

Table 18 portrays the attitude of researchers towards collaboration. Researchers strongly agreed that collaboration with other organizations is very important to their own organizations (68%) and also that the vision and mission of institutions are different (48%).They further agreed that different institutions have different mandates (52%) and that colleagues knowledge and experience differ (52%). This means that researchers do acknowledge that collaboration can be fruitful, given the different expertise of individuals who will be working together towards attaining the specified goals.

However, researchers strongly disagreed that collaboration is a waste of time (58%) and that collaboration is not within their scope of work (54%). This shows that most of these researchers are keen to collaborate with other actors. About 40% of researchers disagreed that colleagues are unwilling to seek input and learn from others while another 40% disputed that collaboration cost a significant amount of the organization' financial resources.

Table 18: Attitude of researchers towards collaboration

	SA	A	U	D	SD
Collaboration with other organizations is very important to my own organization	34 (68)	11 (22)	3 (6)	2 (4)	0
Different institutions have different mandates	16 (32)	26 (52)	4 (8)	3 (6)	1 (2)
The vision and mission of institutions are different	24 (48)	17 (34)	4 (8)	2 (4)	3 (6)
Collaboration is not within our scope of work	3 (6)	2 (4)	2 (4)	16 (32)	27 (54)
Collaboration is a waste of time	1 (2)	2 (4)	4 (8)	14 (28)	29 (58)
Collaboration with other organizations costs a significant amount of staff time	9 (18)	11 (22)	6 (12)	14 (28)	10 (20)
Collaboration costs a significant amount of organizations' financial resources	3 (6)	6 (12)	12 (24)	20 (40)	9 (18)
Collaboration creates difficulty in setting and enforcing rules	5 (10)	9 (18)	6 (12)	16 (32)	14 (28)
Colleagues are arrogant	2 (4)	7 (14)	11 (22)	18 936)	12 (24)
Colleagues' knowledge and experience differ	13 (26)	26 (52)	4 (8)	5 (10)	2 (4)
Our values clash	5 (10)	16 (32)	7 (14)	14 (28)	8 (16)
I do not trust working with other people/institutions	2 (4)	3 (6)	7 (14)	19 (38)	19 (38)
Collaboration creates conflicts	2(4)	10(20)	6(12)	21(42)	11(22)
There is lack of transparency in collaboration	2(4)	6(12)	6(12)	18(36)	18(36)
Collaboration reveals the organizations' weaknesses	5(10)	14(28)	5(10)	14(28)	12(24)
Colleagues are unwilling to seek input and learn from others	3(6)	9(18)	3(6)	20(40)	15(30)
Colleagues are unwilling to share expertise and information	4(8)	11(22)	5(10)	17(34)	13(26)
One organization always reaps more benefits from the collaborative efforts than others	1(2)	12(24)	7(14)	18(36)	12(24)
One organization always has more decision making power than others	4(8)	18(36)	9(18)	10(20)	9(18)
Other organizations tend to take less responsibility in collaborative efforts.	9(18)	18(36)	3(6)	13(26)	7(14)
Collaboration helps break down bureaucratic barriers between organizations	11(22)	23(46)	9(18)	5(10)	2(4)
My organization is very active in collaborating with others	7(14)	21(42)	10(20)	8(16)	4(8)

*SA – Strongly Agree, A – Agree, U – Undecided, D – Disagree and SD – Strongly Disagree

*Figures in parenthesis are percentages

4.9.2 Attitude of extension officers towards collaboration

The results showing the attitude of extension officers towards collaboration are shown in Table 19. It is evident that extension officers in the survey strongly agreed that collaboration helps break down bureaucratic barriers between organizations (42%) because they believe that the liaison of organizations might ease the organizational policies and restrictions. About 38% of extension officers indicated that their organization is very active in collaborating with others. They also agreed that collaboration with other organizations is very important to their own organization (44%) and that the vision and mission of institutions are different (38%).

Nonetheless, 44% of extension officers denied that collaboration is not within their scope of work, 40% disagreed that collaboration is a waste of time, another 40% of these extension officers differed when asked if collaboration creates conflicts and, 38% strongly disagreed when asked if they do not trust working with other people/institutions. The results unveil the positive attitude towards collaboration that most of these extension officers expressed during interviews.

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Table 19: Attitude of extension officers towards collaboration

	SA	A	U	D	SD
Collaboration with other organizations is very important to my own organization	19(38)	22(44)	5(10)	4(8)	0
Different institutions have different mandates	14(28)	18(36)	8(16)	8(16)	2(4)
The vision and mission of institutions are different	19(38)	19(38)	2(4)	7(14)	3(6)
Collaboration is not within our scope of work	2(4)	6(12)	5(10)	22(44)	15(30)
Collaboration is a waste of time	4(8)	4(8)	5(10)	20(40)	17(34)
Collaboration with other organizations costs a significant amount of staff time	6(12)	13(26)	6(12)	13(26)	12(24)
Collaboration costs a significant amount of organizations' financial resources	8(16)	13(26)	6(12)	13(26)	10(20)
Collaboration creates difficulty in setting and enforcing rules	11(22)	11(22)	7(14)	11(22)	10(20)
Colleagues are arrogant	4(8)	6(12)	8(16)	18(36)	14(28)
Colleagues' knowledge and experience differ	10(20)	16(32)	11(22)	7(14)	6(12)
Our values clash	4(8)	12(24)	9(18)	14(28)	11(22)
I do not trust working with other people/institutions	2(4)	7(14)	5(10)	17(34)	19(38)
Collaboration creates conflicts	4(8)	7(14)	7(14)	20(40)	12(24)
There is lack of transparency in collaboration	5(10)	12(24)	6(12)	18(36)	9(18)
Collaboration reveals the organizations' weaknesses	8(16)	16(32)	7(14)	13(26)	6(12)
Colleagues are unwilling to seek input and learn from others	3(6)	10(20)	6(12)	17(34)	14(28)
Colleagues are unwilling to share expertise and information	4(8)	8(16)	7(14)	20(40)	11(22)
One organization always reaps more benefits from the collaborative efforts than others	5(10)	12(24)	7(14)	19(38)	7(14)
One organization always has more decision making power than others	6(12)	7(14)	9(18)	17(34)	11(22)
Other organizations tend to take less responsibility in collaborative efforts.	14(28)	11(22)	8(16)	14(28)	3(6)
Collaboration helps break down bureaucratic barriers between organizations	21(42)	13(26)	5(10)	7(14)	4(8)
My organization is very active in collaborating with others	19(38)	12(24)	7(14)	8(16)	4(8)

*SA – Strongly Agree, A – Agree, U – Undecided, D – Disagree and SD – Strongly Disagree

*Figures in parenthesis are percentages

4.9.3 Attitude of farmers towards collaboration

Table 20 reveals the attitude of farmers towards collaboration. Over half (54%) of the participants strongly agreed that collaboration with other organizations is very important to their own organizations and this can be attributable to their eagerness to collaborate and anticipated benefits thereof. Farmers intensely agreed that other organizations tend to take less responsibility in collaborative efforts (44%) and that collaboration reveals the organizations' weaknesses (34%). This is an attribute of the emphasis they put during the interviews that when a lot of people are involved in performing tasks, others drag behind but will ultimately share credit when it is due. They also emphasized that collaboration might expose underperforming organizations because if certain tasks assigned to them are delayed then the whole chain will be affected and, the perpetrators can be easily detected. Furthermore, 38% of the respondents strongly agreed that collaboration can help break down bureaucratic barriers between organizations because they believe that the liaison of organizations will ease the organizational policies and restrictions.

About 32% of farmers dispute that the vision and mission of institutions differ because they trust that all actors in the agricultural system have the same vision and that ought to be, among other factors, increased productivity and competitiveness within the sector and their assignment is to accomplish such. They also disagreed that collaboration with other organizations costs a significant amount of staff time (30%) and that one organization always reaps more benefits from the collaborative efforts than others (40%). This is because they think that duties will be coordinated and not necessarily diverge with day-to-day individual duties and better yet, there will be more manpower and deadlines will be effectively maintained thorough collaborative efforts thus all the institutions will benefit in this regard. Furthermore, 42% of the participants strongly disagreed that colleagues are unwilling to seek input and learn from others as they stressed that they source information mostly from their fellow colleagues and they are often inspired by those who prosper and definitely aspire to be like them as they mimic their acts where applicable.

Table 20: Attitude of farmers towards collaboration

	SA	A	U	D	SD
Collaboration with other organizations is very important to my own organization	27 (54)	16 (32)	5 (10)	1 (2)	1 (2)
Different institutions have different mandates	8 (16)	12 (24)	11 (22)	11 (22)	8 (16)
The vision and mission of institutions are different	7 (14)	11 (22)	12 (24)	16 (32)	4 (8)
Collaboration is not within our scope of work	2 (4)	3 (6)	7 (14)	20 (40)	18 (36)
Collaboration is a waste of time	2 (4)	2 (4)	4 (8)	16 (32)	26 (52)
Collaboration with other organizations costs a significant amount of staff time	6 (12)	8 (16)	8 (16)	15 (30)	13 (26)
Collaboration costs a significant amount of organizations' financial resources	3 (6)	12 (24)	8 (16)	12 (24)	15 (30)
Collaboration creates difficulty in setting and enforcing rules	10 (20)	16 (32)	6 (12)	10 (20)	8 (16)
Colleagues are arrogant	6 (12)	19 (38)	2 (4)	18 (36)	5 (10)
Colleagues' knowledge and experience differ	14 (28)	24 (48)	4 (8)	6 (12)	2 (4)
Our values clash	2 (4)	9 (18)	7 (14)	11 (22)	21 (42)
I do not trust working with other people/institutions	2 (4)	6 (12)	6 (12)	24 (48)	12 (24)
Collaboration creates conflicts	6 (12)	22 (44)	3 (6)	11 (22)	8 (16)
There is lack of transparency in collaboration	8 (16)	11 (22)	8 (16)	14 (28)	9 (18)
Collaboration reveals the organizations' weaknesses	17 (34)	16 (32)	4 (8)	8 (16)	5 (10)
Colleagues are unwilling to seek input and learn from others	2 (4)	10 (20)	1 (2)	16 (32)	21 (42)
Colleagues are unwilling to share expertise and information	6 (12)	18 (36)	3 (6)	10 (20)	13 (26)
One organization always reaps more benefits from the collaborative efforts than others	3 (6)	8 (16)	7 (14)	20 (40)	12 (24)
One organization always has more decision making power than others	4 (8)	13 (26)	8 (16)	15 (30)	10 (20)
Other organizations tend to take less responsibility in collaborative efforts.	22 (44)	18 (36)	5 (10)	3 (6)	2 (4)
Collaboration helps break down bureaucratic barriers between organizations	19 (38)	14 (28)	9 (18)	8 (16)	0
My organization is very active in collaborating with others	6 (12)	15 (30)	5 (10)	14 (28)	10 (20)

*SA – Strongly Agree, A – Agree, U – Undecided, D – Disagree and SD – Strongly Disagree

*Figures in parenthesis are percentages

4.10 Regression analysis

4.10.1 Regression analysis for researchers

The results of the multiple regression analysis showing the relationship between socio-economic characteristics and collaboration of researchers are presented in Table 21. The independent variables were significantly related to collaboration among researchers with an F value of 14.60. The R value of 0.88 showed that there was a strong correlation between the independent variables and collaboration. The results further predicted 77% of the variation in collaboration of researchers with extension officers and farmers. Significant determinants were age ($t = 2.654$, $p<0.05$), household size ($t = 2.238$, $p<0.05$), organization ($t = 2.841$, $p<0.05$), contact with farmers ($t = 2.045$, $p<0.05$), frequency of contact with farmers ($t = 1.921$, $p<0.05$), constraints to collaboration ($t = 2.857$, $p<0.05$) and attitude towards collaboration ($t =-2.075$, $p<0.05$). These findings imply that as researchers grow older and their household sizes escalate, they gain interest in collaboration maybe with the hope that it will ease their workload. Moreover, as researchers get contact with farmers on a regular basis, they tend to have an increased level of interest in collaboration. Researchers working for Agricultural Research Council are more actively involved in research than those in the North West University because they solely concentrate on research. Constraints were also positively correlated to collaboration and this means that as researchers experience an increasing number of constraints they become zealous to collaborate with other actors in order to overcome such constraints. The researchers' attitude towards collaboration is negatively correlated to their willingness to collaborate with other actors, meaning that as researchers become deleterious towards collaboration, their willingness to collaborate will ultimately decrease.

Table 21: Multiple regression analysis showing the relationship between socio-economic characteristics and collaboration among researchers

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	15.695	33.291		.471	.640
Marital status	4.532	3.406	.132	1.331	.191
Age	.447	.169	.263	2.654	.011
Household size	1.840	.822	.184	2.238	.031
Organization	10.086	3.549	.252	2.841	.007
Contact with farmers	12.565	6.144	.289	2.045	.047
Frequency of contact with farmers	4.544	2.365	.263	1.921	.062
Constraints to collaboration	1.164	.407	.243	2.857	.007
Knowledge of AIS	-.937	.646	-.115	-1.449	.155
Attitude towards collaboration	-.355	.171	-.182	-2.075	.044
F	14.598				
P					
R	.876				
R Square	.767				

4.10.2 Regression analysis for extension officers

The results of the multiple regression analysis showing the relationship between socio-economic characteristics and collaboration of extension officers are presented in Table 22. The independent variables were significantly related to collaboration among extension officers with an F value of 2.53. The R value of 0.65 showed that there was a strong correlation between the independent variables and collaboration. The results further predicted 42% of the variation in collaboration of extension officers with researchers and farmers. Significant determinants were age ($t = -1.950$, $p<0.05$), working experience ($t = -1.918$, $p<0.05$), constraints to collaboration ($t = 3.207$, $p<0.05$) and attitude towards collaboration (t

=-1.850, $p<0.05$). These findings imply that as extension officers grow older and gain more experience, they become hesitant to collaborate with other actors. The extension officers' attitude towards collaboration is negatively correlated to their willingness to collaborate with other actors, meaning that as extension officers get a bad attitude towards collaboration, their willingness to collaborate declines. However, constraints were positively correlated to collaboration and this means that those who have more constraints are more eager to collaborate in order to overcome such constraints.

Table 22: Multiple regression analysis showing the relationship between socio-economic characteristics and collaboration among extension officers

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	50.79	22.111		2.297	.027
Gender	2.290	1.969	.162	1.164	.252
Ethnic group	1.967	2.964	.096	.664	.511
Age	-.385	.197	-.607	-1.950	.059
Household size	-.348	.449	-.101	-.775	.443
Income	.000	.000	-.259	-.995	.326
Working experience	-3.045	1.587	-.628	-1.918	.063
Frequency of contact with farmers	.939	1.789	.102	.525	.603
Number of farmers covered	.005	.005	.227	.859	.396
Distance to farmers	1.316	1.596	.130	.826	.414
Constraints to collaboration	1.071	.334	.443	3.207	.003
Attitude towards collaboration	-.183	.099	-.244	-1.850	.072
F	2.529				
P	0.00				
R	0.650				
R Square	0.423				

4.10.3 Regression analysis for farmers

The results of the multiple regression analysis showing the relationship between socio-economic characteristics and collaboration of farmer are presented in Table 23. The independent variables were significantly related to collaboration with an F value of 6.05. The R value of 0.78 showed that there was a strong correlation between the independent variables and collaboration. The results further predicted 68% of the variation in collaboration of farmers with extension officers and researchers. Significant determinants were age ($t = -1.999$, $p<0.05$) and knowledge of Agricultural Innovation Systems ($t = 2.898$, $p<0.05$). These findings imply that as farmers grow old they become more reluctant to collaborate with other actors. However, the more they get capacitated with knowledge of Agricultural Innovation Systems their willingness to collaborate escalates.

Table 23: Multiple regression analysis showing the relationship between socio-economic characteristics and collaboration among farmers

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	16.678	7.761		2.149	.038
Gender	-.685	.983	-.080	-.697	.490
Marital status	.088	.412	.027	.214	.832
Ethnic group	-.058	1.247	-.005	-.047	.963
Religion	.651	1.139	.068	.571	.571
Household size	-.039	.038	-.170	-1.040	.305
Age	-.321	.161	-.235	-1.999	.053
Income	2.421E-005	.000	.042	.324	.748
Knowledge of AIS	.257	.089	.464	2.898	.006
Attitude towards collaboration	.029	.048	.073	.600	.552
Constraints	.060	.098	.067	.613	.544
F	6.05				
P	0.00				
R	0.78				
R Square	0.68				

4.10.4 Duncan Multiple Range Test

The results of the Duncan Multiple Range Tests showing the comparison between researchers, extension officers and farmers are presented in the Table 24. The analysis of variance shows that a significant difference exists in the level of involvement of researchers, extension officers and farmers in linkage activities ($F=30.29$, $P<0.05$). The mean involvement score showed that researchers (78.58) are highly involved in linkage activities followed by farmers (72.86) and extension officers (56.10). Other significant variables were knowledge of agricultural innovation system ($F=18.25$, $P<0.05$) and collaboration ($F=27.20$, $P<0.05$). The mean score for farmers with regard to knowledge of agricultural innovation ranked the lowest (34.10), meaning that farmers have little knowledge of the system as opposed to researchers (38.66) and extension officers (38.02). Furthermore, highest mean sores for collaboration were those of researchers (29.98) and extension agents (30.56) and this entails that researchers and extension agents collaborate more than farmers, who had a lower mean score of 26.80.

Table 24: Duncan Multiple Range Test

		Sum of squares	df	Mean Square	F	Groups	Means
Linkage	Between Groups	13649.440	2	6824.720	30.288	Extension	56.10
	Within Groups	33122.700	147	225.324		Farmers	72.86
	Total	46772.140	149			Researchers	78.58
Constraints	Between Groups	9.373	2	4.867	.351	Extension	30.56
	Within Groups	1961.320	147	13.342		Farmers	31.02
	Total	1970.693	149			Researchers	31.14
Knowledge of AIS	Between Groups	609.493	2	304.747	18.250	Farmers	34.10
	Within Groups	2454.700	147	16.699		Extension	38.02
	Total	3064.193	149			Researchers	38.66
Collaboration	Between Groups	409.773	2	204.887	27.200	Farmers	26.80
	Within Groups	1107.300	147	7.533		Researchers	29.98
	Total	1517.073	149			Extension	30.56
Attitude towards Collaboration	Between Groups	86.333	2	43.167	.840	Researchers	62.94
	Within Groups	13208.660	147	89.855		Farmers	64.44
	Total	13294.993	149			Extension	64.64

4.11 Chapter summary

The chapter presented the results of the study and covered demographic characteristics of researchers, extension officers and farmers; linkage activities among researchers, extension officers and farmers; constraints to collaboration and; attitude of researchers, extension agents and farmers towards collaboration.

Chapter 5

Summary, findings, conclusions, recommendations

5.1 Introduction

This chapter reviews the summary of the study, key findings, draws some conclusions based on the key findings and, gives recommendations from the results. Section 5.2 presents the summary, Section 5.3 presents the key findings, Section 5.4 the conclusion and, Section 5.5 presents recommendations

5.2 Summary

The study assessed collaboration among research-extension-and farmers for agricultural innovation; determined the personal characteristic of researchers-extension-and farmers and; investigated their attitude towards collaboration. The study further investigated the linkage activities among researchers-extension-and farmers and their knowledge of agricultural innovation system. It also identified and analysed the constraints hindering collaboration of researchers-extension agents-and farmers.

The population of the study comprised of researchers from Agricultural Research Council and North West University, extension officers from Department of Agriculture and Rural Development and affiliated farmers of either National African Farmers' Union or African Farmers Association of South Africa. The study area was North West Province and all four districts in the province were considered, and those are: Bojanala, Dr Kenneth Kaunda, Dr Ruth Segomotsi Mompati and Ngaka Modiri Molema. A total sample of 150 was selected from researchers, extension officers and farmers and, the size for each group was 50. A structured questionnaire was used to elicit information from respondents and it contained six sections, namely: demographic characteristics, attitude of researchers-extension officers-and farmers towards collaboration, extent of collaboration among researchers-extension agents-and farmers, linkage activities among researchers-extension officers-and farmers, researchers-extension agents-and farmers' knowledge of agricultural innovation systems and, constraints hindering collaboration. Collected data was analysed using the SPSS and frequency count percentages, mean and standard deviations were used to describe the data and, linear multiple regressions and Duncan multiple range tests were used to assess the collaboration among researchers-extension officers-and farmers for agricultural innovation.

5.3 Major findings

It was revealed that most researchers are males (64%), married (56%), Black (74%), fell in the age bracket of 36-47 years (34%), had Doctorate degrees (36%) and working experience of 1 to 5 years (26%). A large number of extension officers were males (52%), married (50%), Black (94%), within the ages of 36 and 47 (38%), had Bachelor's degree (34%) and working experience of 1 to 5 years (30%). Furthermore, it was found that majority of farmers were also males (82%), married (52%), Black (74%), more than 60 years of age (36%), had more than 20 years of working experience (40%) and only a least number (14%) of them had any tertiary qualifications.

Linkage activities ranked high by researchers were: dissemination of knowledge (62%); joint problem identification (58%); collaborative professional activities (54%); joint seminar and workshop (54%) and evaluation surveys (54%). Highest linkage activities ranked by extension officers were: disseminating knowledge (92%); joint demonstration trials (88%); joint problem identification (86%) and joint field days (84%) while farmers indicated high involvement in the following activities: joint problem identification (68%), dissemination of knowledge (68%), joint field days (74%) and evaluation field visits (72%). Prevailing constraints for researchers, extension officers and farmers were found to be "weak channels of communication among researchers-extension officers-and farmers" and "poor administration of research and extension institutes".

5.4 Conclusion

In order to realize an effective collaboration among researchers-extension agents-and farmers, their level of involvement in linkage activities need to be addressed. Based on the findings of the study, it can be concluded that though there is linkage existing in some of the activities carried out by researchers, extension officers and farmers; the extent at which such activities occur is low. There seem to be loop holes in these linkage activities among the three components and they need to be closed so that agricultural production can be improved. Researchers, extension officers and farmers have shown zealous appetite towards collaboration

It is therefore imperative that the constraints that were ranked high by the actors in the study be mitigated in every way possible as their hindrance to collaboration can be detrimental to agricultural productivity. Collaboration can thus be of great value in the agricultural sector if done properly because then farmers will be able to communicate their needs in a sense that will assist researchers to conduct studies that will address the actual needs of farmers.

Extension on the other hand will be playing a pivotal role in disseminating technologies brought-up by researchers and ensure that farmers adopt such technologies. It will also transfer farmers' needs to researchers and give feedback on existing technologies; hence extension agents are viewed as catalysts in innovation systems. This means that innovations will be more appropriate in improving production and bettering the living standards of farmers and their families because technologies will be people orientated and demand driven.

5.5 Recommendations

To make growth and development effective through technology generation and dissemination, this paper recommends operative linkage among researchers-extension agents-and farmers. There should be joint activities in the areas of problem identification, priority setting and planning, research contracts, research activities, publications, reports, demonstration trials, field days and, seminars and workshops. Research institutes should ensure that researchers determine research priorities based on the authentic needs identified by farmers and extension officers. Extension institutes should also see to it that the results are easily translated to farmers and that they are of assistance in their day-to-day activities. Researchers, extension agents and farmers should be taken for training whereby the importance of collaboration can be highlighted to them and they can be briefed on how they can effectively coordinate with each other. Universities are liable and must ensure that they graduate young agricultural experts so that the innovation system can be continuous and sustainable for future economic prosperity.

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Annexure 1

Questionnaire for: Assessment of collaboration among Research – Extension - Farmers for Agricultural Innovation in North West Province, South Africa.

Dear respondents

This questionnaire is for data collection for research on Assessment of collaboration among Research – Extension - Farmers for Agricultural Innovation in North West Province, South Africa. The information provided will be treated as confidential, hence, no names are required and analysis will be group referenced.

Can you please spare some of your valuable time in responding to this questions. Thanking you in anticipation.

SECTION A:

Researchers

1. Gender : Male ☐ Female ☐
2. Marital Status:

   Single ☐ Married ☐ Divorced ☐ Widowed ☐
3. Ethnic Group:

   Black ☐ White ☐ Indian ☐ Colored ☐ Other (specify) _____
4. Religion:

   Christian ☐ Hinduism ☐ Muslim ☐ Islamic ☐

   Other (specify) _____
5. Age: _____
6. Household size: _____
7. Income (per month): _____
8. What is your specialty?

Agricultural Economics		Animal Nutrition	
Agricultural Extension		Animal Breeding	
Biotechnology		Animal Genetics	
Soil Science		Beef, Dairy and Game production	
Agronomy		Pig and Poultry production	
Horticulture		Control diseases	
Pathology		Clinical Veterinary Services	
Plant Genetics		Pharmaceutical	
Viticulture		Other (specify)	

9. Highest educational level:

   Certificate ☐ Diploma ☐ Degree ☐ Honors ☐ Masters ☐ PhD ☐

10. Are you currently studying for a higher qualification? Yes ☐ No ☐

11. Research experience (in years):

    1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ >20 ☐

12. What is your job designation?

    Researcher ☐ Senior researcher ☐ Research Institute Manager ☐

13. Which organization do you work for?

    Agricultural Research Council ☐ North West University ☐

14. Are you living in your job location? Yes ☐ No ☐

15. Do you have contact with farmers? Yes ☐ No ☐

16. If yes, how often? Regularly ☐ Occasionally ☐ Rarely ☐

17. Distance to farmers? < 40 Km ☐ 40-100 Km ☐ > 100 Km ☐

SECTION B:

1. Please indicate whether or not you participate in the following linkage activities and if you do, how frequent? Regularly (R); Occasionally (O) and Never (N).

Activity	Yes	No	Frequency with Researchers			Frequency with Ext. agents			Frequency with farmers		
			R	O	N	R	O	N	R	O	N
Joint problem identification											
Joint priority setting and planning											
Joint research contracts											
Joint research activities											
Collaborative professional activities											
Exchange of resources											
Joint facilities(e.g. laboratory)											
Joint financial resources											
Staff rotation											
Dissemination of knowledge											
Joint publication											
Joint reports											
Joint demonstration trials											
Joint field days											
Joint seminar and workshop											
Evaluation survey											
Evaluation field visits											
Evaluation reports											

2. Please indicate on the existing constraints to collaboration

Constraint	Yes	No
Inadequate research staff		
Inadequate extension staff		
Inadequate knowledge of technologies		
Not aware of existing technologies		
Finance allocation for technologies		
Lack of interest		
Distance between research centers and extension offices		
Social standards (status)		
Job tenure of researchers		
Job tenure of extension agents		
Job specialization of researchers		
Job specialization of extension agents		
Job qualification of researchers		
Job qualification of extension agents		
Lack of recognition from colleagues		
Incentives for research and extension activities		
Ineffective leadership and management		
Limited farmer participation		
Weak channels of communication among researchers-extension agents-and farmers		
Poor administration of research and extension institutions		
Political issues influencing research and extension mandates		
Other (specify) _____ _____		

3. Please indicate whether the following statements about Agricultural Innovation Systems (AIS) are "true" or "false".

Statement	True	False
Innovation is neither a science nor technology but rather the application of knowledge of all types to achieve desired social and economic outcomes.		
It is a process by which organizations master and implement the design and production of goods and services that are new to them, irrespective of whether they are new to their competitors, their country or the world.		
Innovation system is a network of organizations, enterprises and individuals focused on bringing new products, new processes, and new forms of organization into economic use.		
AIS is a major source of improved productivity and competitiveness		
AIS play an important role in creating jobs.		
AIS play an important role in generating income.		
AIS play an important role in alleviating poverty.		
AIS play an important role in driving social development.		
Agricultural development depends on innovation and innovation systems.		
AIS can be triggered by policies		
AIS can be triggered by the markets.		
AIS can be triggered by the natural environment (e.g. climate change)		
Researchers, extension agents and farmers innovate in isolation.		
Investment in science and technology is a good strategy for creating and maintaining innovative ideas and practices.		
Agricultural research is a key components of AIS		
Agricultural extension is a key component to AIS		
Education and Training are key components to AIS		
Better coordination can improve the design and implementation of innovation policies by allowing more actors to voice their needs and concerns.		
Stronger interaction and coordination can also induce all actors in an innovation system, particularly public research and extension organizations, to be more aware and responsive to the needs and concerns of other actors i.e. farmers.		
In innovation systems, tasks such as policy assessment, monitoring and evaluation are vital to maintaining learning, performance and accountability.		
AIS require a range of skills i.e. scientific, technical, managerial, and entrepreneurial skills.		

4. Please indicate whether the following statements about collaboration are 'true" or "false"

Statement	True	False
Collaboration can promote development and reduce poverty by providing farmers with access to knowledge and technologies.		
Collaboration is fruitful in realizing the synergies (extra energy, power, success) in innovation.		
Collaboration may encourage dependency.		
Collaboration exploits complementariness i.e. it leads to the accumulation of complementary abilities, skills and resources.		
It can lead to higher competitiveness and better market positioning as a result of improved competencies.		
Transaction costs and risks can be reduced through collaboration.		
Combining of resources through collaborative efforts will lead to improved service effectiveness and efficiency.		
Collaboration improves quality of innovation outputs.		
Collaboration improves relevancy innovations.		
Collaboration ensures greater adoption by farmers.		
Collaboration requires awareness raising for researchers, extension officers and farmers.		
Collaboration requires development of trust between researchers, extension officers and farmers.		
Collaboration requires researchers, extension agents and farmers' willingness to work together.		
Collaboration requires the creation of a shared vision for the future.		
Researchers, extension officers and farmers have different comparative advantage in the generation and dissemination of agricultural technology		
Collaboration encourages better decision-making as a result of advice obtained from colleagues in other institutions.		

5. Please reveal your attitude towards collaboration practices.

	SA	A	U	D	SD
Collaboration with other organizations is very important to my own organization					
Different institutions have different mandates					
The vision and mission of institutions are different					
Collaboration is not within our scope of work					
Collaboration is a waste of time					
Collaboration with other organizations costs a significant amount of staff time					
Collaboration costs a significant amount of organizations' financial resources					
Collaboration creates difficulty in setting and enforcing rules					
Colleagues are arrogant					
Colleagues' knowledge and experience differ					
Our values clash					
I do not trust working with other people/institutions					
Collaboration creates conflicts					
There is lack of transparency in collaboration					
Collaboration reveals the organizations' weaknesses					
Colleagues are unwilling to seek input and learn from others					
Colleagues are unwilling to share expertise and information					
One organization always reaps more benefits from the collaborative efforts than others					
One organization always has more decision making power than others					
Other organizations tend to take less responsibility in collaborative efforts.					
Collaboration helps break down bureaucratic barriers between organizations					
My organization is very active in collaborating with others					

Annexure 2

Questionnaire for: Assessment of collaboration among Research – Extension - Farmers for Agricultural Innovation in North West Province, South Africa.

Dear respondents

This questionnaire is for data collection for research on Assessment of collaboration among Research – Extension - Farmers for Agricultural Innovation in North West Province, South Africa. The information provided will be treated as confidential, hence, no names are required and analysis will be group referenced.

Can you please spare some of your valuable time in responding to this questions. Thanking you in anticipation.

SECTION A:

Extension Agents

1. Gender : Male ☐ Female ☐
2. Marital Status:

   Single ☐ Married ☐ Divorced ☐ Widowed ☐
3. Ethnic Group:

   Black ☐ White ☐ Indian ☐ Colored ☐ Other (specify): _____
4. Religion:

   Christian ☐ Hinduism ☐ Muslim ☐ Islamic ☐

   Other (specify): _____
5. Age: _____
6. Household size: _____
7. Income (per month): _____
8. Highest educational level:

   Certificate ☐ Diploma ☐ Degree ☐ Honors ☐ Masters ☐ PhD ☐
9. Are you currently studying for a higher qualification? Yes ☐ No ☐
10. Working experience (in years):

    1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ >20 ☐
11. What is your job designation?

    Extension officer ☐ Senior extension officer ☐ Deputy-Director ☐ Director ☐
12. Are you living in your job location? Yes ☐ No ☐
13. Do you have contact with farmers? Yes ☐ No ☐

14. If yes, how often? Regularly ☐ Occasionally ☐ Rarely ☐

15. How many farmers do you cover? _____

16. Distance to farmers? < 40 Km ☐ 40-100 Km ☐ > 100 Km ☐

SECTION B:

1. Please indicate whether or not you participate in the following linkage activities and if you do, how frequent? Regularly (R); Occasionally (O) and Never (N).

Activity	Yes	No	Frequency with Researchers			Frequency with Ext. agents			Frequency with farmers		
			R	O	N	R	O	N	R	O	N
Joint problem identification											
Joint priority setting and planning											
Joint research contracts											
Joint research activities											
Collaborative professional activities											
Exchange of resources											
Joint facilities(e.g. laboratory)											
Joint financial resources											
Staff rotation											
Dissemination of knowledge											
Joint publication											
Joint reports											
Joint demonstration trials											
Joint field days											
Joint seminar and workshop											
Evaluation survey											
Evaluation field visits											
Evaluation reports											

2. Please indicate on the existing constraints to collaboration

Constraint	Yes	No
Inadequate research staff		
Inadequate extension staff		
Inadequate knowledge of technologies		
Not aware of existing technologies		
Finance allocation for technologies		

Lack of interest		
Distance between research centers and extension offices		
Social standards (status)		
Job tenure of researchers		
Job tenure of extension agents		
Job specialization of researchers		
Job specialization of extension agents		
Job qualification of researchers		
Job qualification of extension agents		
Lack of recognition from colleagues		
Incentives for research and extension activities		
Ineffective leadership and management		
Limited farmer participation		
Weak channels of communication among researchers-extension agents-and farmers		
Poor administration of research and extension institutions		
Political issues influencing research and extension mandates		
Other (specify) _____ _____		

3. Please indicate whether the following statements about Agricultural Innovation Systems (AIS) are "true" or "false".

Statement	True	False
Innovation is neither a science nor technology but rather the application of knowledge of all types to achieve desired social and economic outcomes.		
It is a process by which organizations master and implement the design and production of goods and services that are new to them, irrespective of whether they are new to their competitors, their country or the world.		
Innovation system is a network of organizations, enterprises and individuals focused on bringing new products, new processes, and new forms of organization into economic use.		
AIS is a major source of improved productivity and competitiveness		
AIS play an important role in creating jobs.		
AIS play an important role in generating income.		
AIS play an important role in alleviating poverty.		
AIS play an important role in driving social development.		
Agricultural development depends on innovation and innovation systems.		
AIS can be triggered by policies		
AIS can be triggered by the markets.		
AIS can be triggered by the natural environment (e.g. climate change)		
Researchers, extension agents and farmers innovate in isolation.		
Investment in science and technology is a good strategy for creating and maintaining innovative ideas and practices.		
Agricultural research is a key components of AIS		
Agricultural extension is a key component to AIS		
Education and Training are key components to AIS		
Better coordination can improve the design and implementation of innovation policies by allowing more actors to voice their needs and concerns.		
Stronger interaction and coordination can also induce all actors in an innovation system, particularly public research and extension organizations, to be more aware and responsive to the needs and concerns of other actors i.e. farmers.		
In innovation systems, tasks such as policy assessment, monitoring and evaluation are vital to maintaining learning, performance and accountability.		
AIS require a range of skills i.e. scientific, technical, managerial, and entrepreneurial skills.		

4. Please indicate whether the following statements about collaboration are 'true" or "false"

Statement	True	False
Collaboration can promote development and reduce poverty by providing farmers with access to knowledge and technologies.		
Collaboration is fruitful in realizing the synergies (extra energy, power, success) in innovation.		
Collaboration may encourage dependency.		
Collaboration exploits complementariness i.e. it leads to the accumulation of complementary abilities, skills and resources.		
It can lead to higher competitiveness and better market positioning as a result of improved competencies.		
Transaction costs and risks can be reduced through collaboration.		
Combining of resources through collaborative efforts will lead to improved service effectiveness and efficiency.		
Collaboration improves quality of innovation outputs.		
Collaboration improves relevancy innovations.		
Collaboration ensures greater adoption by farmers.		
Collaboration requires awareness raising for researchers, extension officers and farmers.		
Collaboration requires development of trust between researchers, extension officers and farmers.		
Collaboration requires researchers, extension agents and farmers' willingness to work together.		
Collaboration requires the creation of a shared vision for the future.		
Researchers, extension officers and farmers have different comparative advantage in the generation and dissemination of agricultural technology		
Collaboration encourages better decision-making as a result of advice obtained from colleagues in other institutions.		

5. Please reveal your attitude towards collaboration practices.

	SA	A	U	D	SD
Collaboration with other organizations is very important to my own organization					
Different institutions have different mandates					
The vision and mission of institutions are different					
Collaboration is not within our scope of work					
Collaboration is a waste of time					
Collaboration with other organizations costs a significant amount of staff time					
Collaboration costs a significant amount of organizations' financial resources					
Collaboration creates difficulty in setting and enforcing rules					
Colleagues are arrogant					
Colleagues' knowledge and experience differ					
Our values clash					
I do not trust working with other people/institutions					
Collaboration creates conflicts					
There is lack of transparency in collaboration					
Collaboration reveals the organizations' weaknesses					
Colleagues are unwilling to seek input and learn from others					
Colleagues are unwilling to share expertise and information					
One organization always reaps more benefits from the collaborative efforts than others					
One organization always has more decision making power than others					
Other organizations tend to take less responsibility in collaborative efforts.					
Collaboration helps break down bureaucratic barriers between organizations					
My organization is very active in collaborating with others					

Annexure 3

Questionnaire for: Assessment of collaboration among Research – Extension - Farmers for Agricultural Innovation in North West Province, South Africa.

Dear respondents

This questionnaire is for data collection for research on Assessment of collaboration among Research – Extension - Farmers for Agricultural Innovation in North West Province, South Africa. The information provided will be treated as confidential, hence, no names are required and analysis will be group referenced.

Can you please spare some of your valuable time in responding to this questions. Thanking you in anticipation.

SECTION A:

Farmers

1. Gender : Male ☐ Female ☐
2. Marital Status:

   Single ☐ Married ☐ Divorced ☐ Widowed ☐
3. Ethnic Group:

   Black ☐ Indian ☐ Colored ☐ Other (specify): _____
4. Religion:

   Christian ☐ Hinduism ☐ Muslim ☐ Islamic ☐

   Other (specify): _____
5. Age: _____
6. Household size: _____
7. Income (per month): _____

8. Which enterprise(s) are you involved in, and what is the farm size and income generation of those enterprises?

Crops	**Farm Size (Ha)**	**Income (per month)**
Maize		
Sunflower		
Cotton		
Sorghum		
Wheat		
Tobacco		
Vegetables		
Other (specify) _____ _____	_____ _____	_____ _____
Animals		
Cattle		
Sheep		
Goats		
Pigs		
Poultry		
Other (specify) _____ _____ _____	_____ _____ _____	_____ _____ _____

9. Highest educational level:

   No formal educatio☐ Primary Scho☐ Secondary sc☐l High☐hool College ☐niversity

10. Farming experience (in years):

    1-5☐ 6-10☐ 11-15☐ 16-20☐ >20☐

11. Which organization are you an affiliate of?

    National African Farmers' Union ☐ African Farmers Association of South Africa☐

12. Do you have contact with extension officers? Yes ☐ No ☐

13. If yes, how often? Regularly ☐ Occasionally ☐ Rarely ☐

14. Distance to extension offices? < 40 Km☐ 40-100 Km☐ > 100 Km☐

15. How is your linkage with the following?

SECTION B:

1. Please indicate whether or not you participate in the following linkage activities and if you do, how frequent? Regularly (R); Occasionally (O) and Never (N).

Activity	**Yes**	**No**	**Frequency with Researchers**			**Frequency with Ext. agents**			**Frequency with farmers**		
			R	O	N	R	O	N	R	O	N
Joint problem identification											
Joint priority setting and planning											
Joint research contracts											
Joint research activities											
Collaborative professional activities											
Exchange of resources											
Joint facilities(e.g. laboratory)											
Joint financial resources											
Staff rotation											
Dissemination of knowledge											
Joint publication											
Joint reports											
Joint demonstration trials											
Joint field days											
Joint seminar and workshop											
Evaluation survey											
Evaluation field visits											
Evaluation reports											

2. Please indicate on the existing constraints to collaboration

Constraint	Yes	No
Inadequate research staff		
Inadequate extension staff		
Inadequate knowledge of technologies		
Not aware of existing technologies		
Finance allocation for technologies		
Lack of interest		
Distance between research centers and extension offices		
Social standards (status)		
Job tenure of researchers		
Job tenure of extension agents		
Job specialization of researchers		
Job specialization of extension agents		
Job qualification of researchers		
Job qualification of extension agents		
Lack of recognition from colleagues		
Incentives for research and extension activities		
Ineffective leadership and management		
Limited farmer participation		
Weak channels of communication among researchers-extension agents-and farmers		
Poor administration of research and extension institutions		
Political issues influencing research and extension mandates		
Other (specify) _____ _____		

3. Please indicate whether the following statements about Agricultural Innovation Systems (AIS) are "true" or "false".

Statement	True	False
Innovation is neither a science nor technology but rather the application of knowledge of all types to achieve desired social and economic outcomes.		
It is a process by which organizations master and implement the design and production of goods and services that are new to them, irrespective of whether they are new to their competitors, their country or the world.		
Innovation system is a network of organizations, enterprises and individuals focused on bringing new products, new processes, and new forms of organization into economic use.		
AIS is a major source of improved productivity and competitiveness		
AIS play an important role in creating jobs.		
AIS play an important role in generating income.		
AIS play an important role in alleviating poverty.		
AIS play an important role in driving social development.		
Agricultural development depends on innovation and innovation systems.		
AIS can be triggered by policies		
AIS can be triggered by the markets.		
AIS can be triggered by the natural environment (e.g. climate change)		
Researchers, extension agents and farmers innovate in isolation.		
Investment in science and technology is a good strategy for creating and maintaining innovative ideas and practices.		
Agricultural research is a key components of AIS		
Agricultural extension is a key component to AIS		
Education and Training are key components to AIS		
Better coordination can improve the design and implementation of innovation policies by allowing more actors to voice their needs and concerns.		
Stronger interaction and coordination can also induce all actors in an innovation system, particularly public research and extension organizations, to be more aware and responsive to the needs and concerns of other actors i.e. farmers.		
In innovation systems, tasks such as policy assessment, monitoring and evaluation are vital to maintaining learning, performance and accountability.		
AIS require a range of skills i.e. scientific, technical, managerial, and entrepreneurial skills.		

4. Please indicate whether the following statements about collaboration are 'true" or "false"

Statement	True	False
Collaboration can promote development and reduce poverty by providing farmers with access to knowledge and technologies.		
Collaboration is fruitful in realizing the synergies (extra energy, power, success) in innovation.		
Collaboration may encourage dependency.		
Collaboration exploits complementariness i.e. it leads to the accumulation of complementary abilities, skills and resources.		
It can lead to higher competitiveness and better market positioning as a result of improved competencies.		
Transaction costs and risks can be reduced through collaboration.		
Combining of resources through collaborative efforts will lead to improved service effectiveness and efficiency.		
Collaboration improves quality of innovation outputs.		
Collaboration improves relevancy innovations.		
Collaboration ensures greater adoption by farmers.		
Collaboration requires awareness raising for researchers, extension officers and farmers.		
Collaboration requires development of trust between researchers, extension officers and farmers.		
Collaboration requires researchers, extension agents and farmers' willingness to work together.		
Collaboration requires the creation of a shared vision for the future.		
Researchers, extension officers and farmers have different comparative advantage in the generation and dissemination of agricultural technology		
Collaboration encourages better decision-making as a result of advice obtained from colleagues in other institutions.		

5. Please reveal your attitude towards collaboration practices.

	SA	A	U	D	SD
Collaboration with other organizations is very important to my own organization					
Different institutions have different mandates					
The vision and mission of institutions are different					
Collaboration is not within our scope of work					
Collaboration is a waste of time					
Collaboration with other organizations costs a significant amount of staff time					
Collaboration costs a significant amount of organizations' financial resources					
Collaboration creates difficulty in setting and enforcing rules					
Colleagues are arrogant					
Colleagues' knowledge and experience differ					
Our values clash					
I do not trust working with other people/institutions					
Collaboration creates conflicts					
There is lack of transparency in collaboration					
Collaboration reveals the organizations' weaknesses					
Colleagues are unwilling to seek input and learn from others					
Colleagues are unwilling to share expertise and information					
One organization always reaps more benefits from the collaborative efforts than others					
One organization always has more decision making power than others					
Other organizations tend to take less responsibility in collaborative efforts.					
Collaboration helps break down bureaucratic barriers between organizations					
My organization is very active in collaborating with others					