THE INFORMATION NEEDS AND CHALLENGES OF AGRICULTURAL RESEARCHERS AND EXTENSION WORKERS IN ZIMBABWE

By

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DECLARATION

I declare that this study, "The information needs and challenges of agricultural researchers and extension workers in Zimbabwe", unless where specifically indicated otherwise, is my original work and has not been submitted to any other university for the award of any other degree.

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DEDICATION

This thesis is dedicated to Thembie, Tau, Lebo, Taka Jay (TJ), to my mother, Matseliso (Sebata) Mugwisi, and to all my family members for their support during the course of my study. The thesis is also dedicated to those family members who never lived to see the finalisation of this work.

"That some achieve great success, is proof to all that others can achieve it as well."

-Abraham Lincoln

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ABSTRACT

Agriculture is the dominant sector in Zimbabwe's economy, contributing significantly to the Gross Domestic Product (GDP) and providing an income to over 75% of the population. Agricultural research and extension is undertaken in both public and private sector institutions across the five agro-ecological regions of the country. The aim of this study was to investigate the information needs and challenges of agricultural researchers and extension workers in the public sector in Zimbabwe. The government is responsible for agriculture in Zimbabwe through the Ministry of Agriculture, Mechanisation and Irrigation Development (MoAMID). The study focused on researchers falling under the Department of Research and Specialist Services (DR&SS) and extension workers under the Department of Agricultural Technical and Extension Services (AGRITEX).

The study utilized both quantitative and qualitative methods; a questionnaire was distributed to researchers and extension workers, and interviews were conducted with key informants and librarians. An observation schedule on the state of agricultural libraries in Zimbabwe was also used. The respondents were drawn from eight provinces and research institutes as defined in the target population. Mashonaland Central Province produced the highest number of respondents because the population for the province included ward and village extension workers in addition to the district and provincial extension officers and supervisors targeted in each province. Forty four (44) districts participated from the projected sixty (60), while sixteen (16) out of seventeen (17) research institutes responded, although there were variations in responses per institute.

The findings of the study indicated that the respondents held qualifications ranging from certificates (for extension workers at ward level) to doctorates for senior researchers in their respective areas of work. The study also showed that the agricultural researchers were generally younger than extension workers, and on average the majority of both categories of respondents had less than 10 years working experience. The majority of the respondents also had less than five years working experience in their current positions. In terms of gender, there were more males than females in both categories of respondents. The study revealed that the information needs of the researchers and extension workers aligned with the major agricultural disciplines of crop science, animal science, agricultural engineering, although agricultural economics did not attract prominence.

The respondents were using various sources of information in fulfilling their information needs, ranging from libraries to internet sources (including databases and other electronic sources), consulting colleagues, workshops and seminars, and personal collections. The level of usage and preferences differed, but overall agricultural researchers showed a preference for electronic sources while extension workers preferred print sources. Departmental collections were especially prominent among the extension workers, and these were mentioned as their first point of call when they were in need of information. Library usage was low, and it was observed that the Ministry of Agriculture's libraries were not adequately equipped to meet the information needs of the researchers and extension workers. The materials were dated, and the libraries had no budget for the acquisition of new resources. Internet access was limited to institutions with access to internet connections and requisite technologies like computers; the TEEAL database, for example, was only available on standalone access at the Central Library. The different available resources were considered to be important sources of agricultural information. The use of indigenous knowledge by both researchers and extension workers in agriculture was also evident in the study.

The study revealed that agricultural research prioritisation was determined by the government, national needs, and the availability of funds in consultation with relevant stakeholders, including farmers. The research extension model that is used suggests a communication pattern where researchers reach the farmers through the extension system and also through direct contact with the farmers. The reverse – farmer to researcher - also shows communication in the opposite (upward) direction. Overall, the researchers and extension workers appear to play a pivotal role in disseminating agricultural information to the farmers. Various channels also appear to be used to communicate agricultural information, including the media, pamphlets and posters, and public gatherings like field days and agricultural shows. Lack of material in local languages was identified as a major challenge in the communication process, although some translation was being done. This challenge was exacerbated by the land reform programme, which has seen a massive increase in the number of people directly involved in farming.

The Ministry of Agriculture was seen to lack a clear policy on the management of information generated by its departments, including research and extension. This was despite mention by the respondents that the information was adequately captured. The study showed that ICTs were used to generate information which was subsequently distributed as hard copies. The distribution of such material was hampered by lack of resources like printers and toners. ICTs such as the radio, television, the internet, databases, and telephones were also being used to disseminate agricultural information, although databases were hampered by the lack of computers. Mobile phones, although not readily available as office equipment, were highly utilised in the communication process.

The study revealed that there is collaboration between agricultural researchers and extension workers and with other stakeholders at both local and international level in the areas of material production, research facilities, and training. Linkages were also evident with farmer organisations in the areas of funding, farm research, and materials production. The study concluded that funding was one of the main challenges facing research and extension in Zimbabwe, with donor funding having dried up in recent years. Although privatisation and charging for services have been considered as alternatives for income generation, they face criticism for discriminating against poor farmers. The study recommends that the Central Library should be empowered in terms of personnel and other resources in order to address the information needs of researchers and extension workers. It also recommends the strengthening of the delivery of research and extension services by capacitating research and extension institutions through adequate ICTs, funding and enhanced collaboration with relevant stakeholders among other issues.

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LIST OF ABBREVIATIONS

AGORA	Access to Global Online Research in Agriculture
AGRIBANK	Agricultural Bank of Zimbabwe
AGRITEX	Department of Agricultural Technical and Extension Services
AMA	Agricultural Marketing Authority
ARDA	Agricultural and Rural Development Authority
AREX	Department of Agricultural Research and Extension
ARI	Agronomy Research Institute
ART	Agricultural Research Trust
CA	Communal Areas
CABI	Commonwealth Agricultural Bureaux Index
CBI	Crop Breeding Institute
CFU	Commercial Farmers' Union
CGIAR	Centre for Consultative Group on International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Centre
COFRE	Committee on On-farm Research and Extension
CoRI	Coffee Research Institute
CRI	Cotton Research Institute
CSC	Cold Storage Commission
CTA	Technical Centre for Agriculture and Rural Development
DANIDA	Danish International Development Agency
DFID	Department for International Development (UK)
DR&SS	Department of Research and Specialists Services
ETD	Electronic Theses and Dissertations
FAO	Food and Agriculture Organisation of the United Nations
FCTZ	Farm Community Trust of Zimbabwe

FTLRRP	Fast Track Land Reform and Resettlement Programme
GMB	Grain Marketing Board
GDP	Gross Domestic Product
GOZ	Government of Zimbabwe
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome
HRI	Horticulture Research Institute
IAEA	International Atomic Energy Agency
ICIPE	International Centre for Insect Physiology and Ecology
ICART	Implementation and Coordination of Agricultural Research and Training
ICRAF	World Forestry Centre
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ILRI	International Livestock Research Institute
INASP	International Network for the Availability of Scientific Publications
ITOCA	Information Training and Outreach Centre for Africa
IWMI	International Water Management Institute
LRP	Land Reform Programme
LSCF	Large Scale Commercial Farmers
LVRI	Semi-Arid Lowveld Research Institute (LVRI)
MOA	Ministry of Agriculture
MoAMID	Ministry of Agriculture, Mechanization and Irrigation Development
NR	Natural Regions
NGO	Non-Governmental Organisation
OIE	World Organisation for Animal Health
PERI	Programme for the Enhancement of Scientific Publications
PIB	Pig Industry Board

PRAIS	Programme for Agricultural Information Services
QAS	Question and Answer Service
SADC – FANR	Southern African Development Community - Food, Agriculture and Natural Resources
SCC	Swedish Cooperative Centre
SIDA	Swedish International Development Cooperation Agency
SMA	Seed Maize Association
SMS	Subject Matter Specialists
SSCF	Small Scale Commercial Farmers
TEEAL	The Essential Electronic Agricultural Library
TIMB	Tobacco Industry and Marketing Board
TRB	Tobacco Research Board
ZARnet	Zimbabwe Academic Research Network
ZAPF	Zimbabwe Agricultural Policy Framework
ZBC	Zimbabwe Broadcasting Corporation
ZFU	Zimbabwe Farmers' Union

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CHAPTER ONE

INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 Introduction

This chapter provides the research background, conceptual setting, and statement of the problem, research objectives and research questions, and scope and limitations of the study**.** The contextual setting is only briefly outlined as it is discussed in detail in Chapter two.

1.2 Research background and conceptual setting

Agriculture can be defined as the broad industry engaged in the production of plants and animals for food and other resources, the provision of agricultural supplies and services, and the processing, marketing and distribution of agricultural products (Herren and Donahue, 1991:10; Burton, 2010:6). Specific disciplines within the study of agriculture include: crop science, soil science, agricultural economics, agricultural extension, agricultural education, agro-forestry and agricultural engineering, among others.

Food and Agriculture Organisation of the United Nations (1996) defines agro-ecological zones on the basis of combinations of soil, landform and climatic characteristics. The particular parameters used in FAO's definition focus attention on the climatic and edaphic (characteristics of the soil) requirements of crops and on the management systems under which crops are grown. Each zone has a similar combination of limitations and potentials of land use, for example farming systems, etc. Intensive agricultural systems are associated with high rainfall patterns and good soils, and characterised by the high utilisation of technologies such as pesticides and chemical fertilisers and/or by high inputs of both capital and labour in relation to the land farmed. In contrast, extensive systems or subsistence agriculture are characterised by low input of both labour and materials and are located in areas of low agricultural productivity, for example in areas with low average rainfall patterns (Filson, 2004; Jain, 2006; Encyclopaedia Britannica, 2010). Irrigation, which is the harnessing of water for agricultural purposes - is an example of a method in crop production that can improve yields in these areas (semi-arid regions).

Advancements in agricultural technologies through research have had an impact on agricultural systems and food production. Scientific advances and technological innovations, including the development of new plant varieties through gene modifications, have seen new crop varieties which can be grown all year round - some in greenhouses - thus improving food production (Gliessman, 2007:3). Similar developments have taken place in livestock research. These developments have also had an impact on agro-processing and agribusiness practice through trade liberalization.

Agriculture plays an important role in the economies of many developing economies, contributing significantly to their Gross Domestic Product (GDP), labour force, exports, and urban population (Stamoulis, 2001). Agriculture accounted for more than 30% of GDP and 60% of total employment in sub-Saharan Africa, excluding South Africa, in 2007 (World Bank, 2007). According to the World Bank (2008:45), "75% of the world's poor still live in the rural areas and rural poverty rates remain stubbornly high in South Asia and sub-Saharan Africa where the majority of their populations depend on agriculture." According to Dao (2009:168), "Statistics show that three quarters of the poor in developing countries live in rural areas where the majority's livelihoods are either directly or indirectly dependent on agriculture." Agriculture not only contributes towards the livelihood of people in rural areas, but also generates foreign currency through exports and raw materials for the manufacturing and processing industries (Maxwell and Percy, 2001:49). Diao (2007:1) posits that, "Agriculture led growth played an important role in slashing poverty and transforming the economies of many Asian and Latin American countries." Dao (2009) cites China as an example of where rapid growth in agriculture resulted in a large decline in poverty from 53% in 1981 to 8% twenty years later.

Most African countries still face challenges in meeting the criteria that would lead to a successful agricultural revolution. Dao (2009:168) observes that agricultural success stories have not been uniform. For example, cereal yields had increased by more than 50% and poverty had declined by 30% in South Asia, while yields and poverty rates had remained unchanged in sub-Saharan Africa in 2001. Poverty remains a major challenge and most countries have not benefited from globalisation. Africa's efforts to achieve economic growth have been hampered by conflict, insufficient investment, limited trade, debilitating debt burdens, weak growth in the agricultural sector, and lately the impact of HIV/AIDS (Clapp, 1997; Luiz, 2010). An investment in agriculture is essential in the fight against poverty because it empowers the poor who constitute the majority in developing economies. The World Bank (2007) observes that in agriculture-based economies, which include most of sub-Saharan Africa, agriculture and its associated industries are essential to growth and to reducing mass poverty and improving food security. The World Bank (2007) also observes that using agriculture as the basis for economic growth in agriculture-based economies requires a productivity revolution in small-holder farming.

1.2.1 Agricultural research, extension, and information dissemination

According to Ojiambo in Kiplang'at (2004:2), "Agricultural technology transfer depends on a holistic agricultural information system that comprises a research subsystem, the extension subsystem, farmers' subsystem and information subsystem." Agricultural research, on the other hand, can be broadly defined as "an activity aimed at improving productivity and quality of crops and animals through their genetic improvement, better plant protection, irrigation, efficient marketing and better management of resources" (Loebenstein and Thottappilly, 2007:3). Public and private research institutes play a complementary role in this respect, although poor funding tends to affect their performance, especially in developing economies.

Agricultural extension, "involves the transfer of agricultural information and technology to the farmers and similarly transferring information from farmers to researchers" (Pazvakavambwa and Hakutangwi, 2006:217). Umali-Deininger and Schwartz (1994:1) argue that: "The backbone of all agricultural extension endeavours is the transfer of agricultural information to enhance the productive capacity of farmers." These authors observe that embracing new technologies and production approaches in farming systems is essential in meeting the challenges of growing populations and the decreasing availability of productive land for agriculture. These efforts can be realised through the utilisation of various extension systems and approaches.

Agricultural information systems ensure that the information generated by agricultural agencies, institutions, and researchers is collated and made available on request. Manda (2002:181) suggests that, "Unless agricultural research and extension institutions are transformed and infrastructure constraints removed, information will play a marginal role in the process of agricultural transformation." The significance of research and extension is further reiterated by Dulle (2000:121), who states that: "Information is one of the most important inputs for agricultural development … because of this; agricultural research results constitute an important knowledge base that should be made available to farmers for increased food production." Although agricultural growth has made a significant contribution towards poverty alleviation in many parts of the world, the agricultural sector in sub-Saharan Africa still has to overcome great challenges if it is to attain food security and the development targets set in the World Food Summit Plan of Action (FAO, 2004:1). Instilling institutions and opportunities that are underpinned by science and technology for the documentation and dissemination of the outputs of agricultural research provides ways in which the targets of the above programme can be realised.

According to Aiyepeku in Omekwu (2003:444), "Until specific audiences within the developing countries are identified and the information needs of each are ascertained, efforts at designing effective communication systems will continue to be governed by the funding agencies, researchers, and the priorities of information specialists rather than being a reflection of the identifiable information needs of the users in those countries." A national agriculture information system ensures that the information generated by agricultural agencies, institutions and researchers is collated and made available to a wider audience, including farmers, through channels that include the extension systems. Aina (1995:1) identifies the various agricultural information user populations and categorizes them as follows: policy makers and planners, researchers, extension staff, educators and students, agro-based industries and services staff, and farmers.

Libraries and information centres play an important role in the dissemination of agricultural information through their acquisition of books, journals and electronic resources on agriculture and related fields. Where required, the information is repackaged in levels and formats that are suitable to the different user groups.

1.2.2 Contextual setting

Agriculture in Zimbabwe follows the country's climatic pattern, which directly influences crop and livestock production. Stretching over an area of 390 757 square kilometres, Zimbabwe can be divided into five distinct natural regions (NR) on the basis of rainfall patterns, with only 37% of the country receiving more than the 700 mm annual average rainfall that is considered necessary for semi-intensive farming. Muir-Leresche (2006:102) characterises the agro-ecological zones as follows:

a. Natural region I, which receives 1,050 mm plus rainfall with some rain every month of the year and has relatively low temperatures. It covers 1.56% of total land.

b. Natural region II receives 700 – 1,050 mm rainfall per annum with rainfall confined to summer. It covers 18.68% of total land.

c. Natural region III receives 500 – 700 mm rainfall per annum with relatively high temperatures and infrequent, heavy falls of rain, and is subject to seasonal droughts. It covers 17.43% of total land.

d. Natural region IV receives 450 – 600 mm rainfall per annum and is subject to frequent seasonal droughts. It covers 33.03% of total land.

e. Natural region V normally receives less than 500 mm rainfall per annum. Rainfall can be very erratic. The northern Lowveld may have more rain but the topography and soils are poorer. It covers 26.2% of total land.

The agro-ecological zones are shown in Figure 1.1

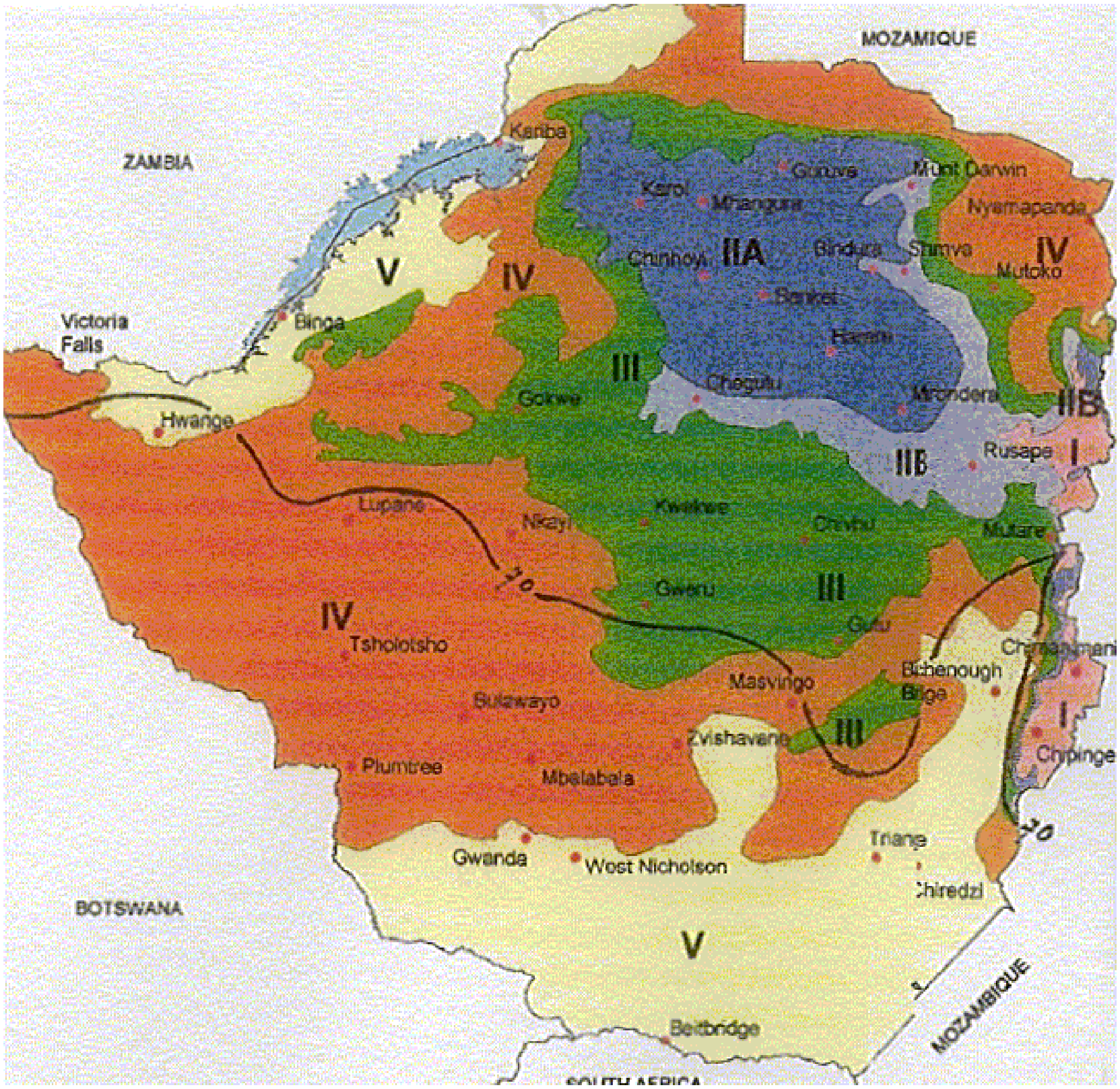

Figure 1.1 Agro-ecological zones of Zimbabwe

Natural regions

I - Specialised and Diversified Farming Region

IIA - Intensive Farming Region

IIB - Intensive Farming Region

III - Semi-Intensive Farming Region

IV – Semi-Extensive Farming Region

V - Extensive Farming Region

Source: http://www.fao.org/docrep/X5594E/X5594e03.htm Accessed: 19/05/2008

Agriculture remains the dominant sector in Zimbabwe's economy despite contributing only 15 -20% to the Gross Domestic Product (GDP) as it provides an income and livelihood to over 75% of the population (Muir-Leresche, 2006:99). The decline in GDP contribution from 23.7% in 1999 to 14.6% in 2003 is attributed in part to the reduction of area planted and in relation to crop type (Moyo, 2004). The government of Zimbabwe, through various local and external initiatives, is currently going through an agrarian reform programme which has had a significant impact on both food production and poverty alleviation. According to Mudhara (2004:61), "The ability of Zimbabwe to improve the contribution of agriculture to the country's Gross Domestic Product (GDP) lies in the ability of the A1[1] and A2[2] farmers maintaining the productivity of land to levels achieved before the land reform or even improving upon the levels previously attained by the large scale commercial farmers."

Agricultural research is undertaken in both public and private institutions across the five natural regions described above. Libraries and information centres can be found in universities, colleges, and the Ministry of Agriculture, Mechanisation and Irrigation Development and its related research institutes and colleges. This study investigated the information needs and challenges of agricultural researchers and extension workers and their role in communicating with farmers. It also looked at the impact of the accelerated land reform exercise in Zimbabwe and the changing nature and expectations of research and extension.

1.3 Statement of the problem

Kiplang'at (1999:115) argues that, "The key to increased agricultural production ultimately lies in the nation's ability to disseminate relevant information to the farming community, to facilitate the effective adoption of new production techniques, application of agricultural inputs, decision making on markets, prices and methods of conserving water, soil and vegetable resources." Agriculture extension plays an important role in this technology transfer process. According to Eicher and Swanson (in Pazvakavambwa, 2006:217), "Agricultural extension is the process of transferring agricultural information and technology to farmers for use in production and marketing decisions and similarly

[1] A1 represents newly resettled farmers in villages and self contained plots of about 5 hectares (2000-)
[2] A2 represents commercial farming land use meant to empower black indigenous farmers (2000-)

transferring information from farmers to researchers." This process is further enhanced when there is a strong and clearly identifiable research and extension system in place. Although these ideas seem sensible now, Pazvakavambwa (2006:228) observes that this has not always been the case; for a long time the extension worker was a mere visitor at research stations while the researcher remained unfamiliar with the farming realities on the ground. Swanson (1997:171) likewise observed that the lack of close working rapport "between national agricultural research and extension organisations, and with different categories of farmer organisations, is one of the difficult institutional problems confronting ministries of agriculture in many developing countries".

The agricultural extension system in Zimbabwe is experiencing challenges largely to do with staffing and inadequate access to information by extension staff in dealing with farmers' information needs. There is concern about the preparedness of extension workers to deal with challenges on the ground, such as the challenges faced by an extension worker with general farming knowledge who is deployed to work in an area where there is a need for expert advice in Soya bean production (The Herald, Tuesday March 14, 2006). There is also concern about information access and how lack of technical information on farming affects extension officers and leads to their failure to attend to farmers' problems in time (The Herald, Tuesday, November 27, 2006:B2). Such are the characteristics of the research and extension systems in Zimbabwe and the problems affecting the farmers. With this in mind, this study sought to provide a detailed analysis of agricultural information dissemination through research and extension and suggest solutions for better access and utilisation.

Various studies have been carried out on agricultural knowledge and information systems in Africa, for example: Mwala, (1997), Ekpenyong (2001) and Dulle (2001) focused on the role of libraries; Aina (1990), Kaniki (1992), Majid & Eisenschitz (2000), Stefano (2005), van den Ban (1999), and Meyer & Boon (2003) focused on the information needs of farmers and researchers; Mchombu (2001), Rivera (2000) and Rees (2000) looked at agricultural information sources; and Kiplanga't (2004), Enakrire (2007) and Chapman (2003) focused on the role of ICTs. Other studies have focused on agricultural knowledge and information systems at geographical level, for example Rees (2000) looked at agricultural knowledge and information systems in Kenya, Obaa (2005), looked at agricultural knowledge and information systems in Uganda, and Ozcatalbas, Brumfield and Ozkan (2004) looked at agricultural knowledge and information systems in Turkey. Wesseller and Brinkman (2003) looked at bridging information gaps between farmers, policy makers, researchers and development agents, and identified the information needs of each group. Studies on mobile telephone usage have recently been demonstrated in Dey, Newman and Prendergast (2011), Mittal, Gandhi and Triphathi (2010), among others.

1.4 Motivation of the study

The researcher worked as a subject librarian for agriculture in a large university library in Zimbabwe where he came into contact with both students and researchers seeking information on various aspects of the subject. During this period, the researcher became the country coordinator in the Question and Answer Service (QAS) project, an initiative of the Technical Centre for Agriculture and Rural Cooperation (CTA) and Programme for Agricultural Information Services (PRAIS). Initially, the purpose of the QAS was to serve as a conduit between the European Community and the African, Caribbean and Pacific Group of States (ACP) so that the extensive information resources of European countries could become freely available to ACP users. The move to decentralize was made as more information was generated. CTA developed a strategy for devolution that begun in 1997 that favours the development of regional QAS, taking into account the need to promote regional networking activities, subject orientation, and linguistic lines (CTA, 2010). In the SADC region, the programme is based at the University of the Free State (UFS) where it is known as the Programme for Agricultural Information Services (PRAIS). This programme covers 10 countries in the Southern African region. The researcher was part of the regional planning team, and in this capacity attended workshops in Malawi and Zambia and coordinated the Zimbabwe QAS launch in 2004. The researcher remains active in this project as a provincial coordinator of national QAS services and as a national taskforce member.

1.5 Aim of the study

The aim of this study was to investigate the information needs and challenges of agricultural researchers and extension workers in Zimbabwe.

1.6 Research objectives

"New agricultural technologies are generated by research institutes, universities, private companies and by farmers themselves … Agriculture extension services are expected to disseminate them among their clients, but due to poor linkages between research and extension, the adoption of new agricultural technologies by farmers in the developing world is often very slow and research is not focusing on the actual needs of farmers" (FAO, 2004:3). In light of the above statement and in fulfilling the aim of this study, the following objectives were pursued:

a. To investigate the information needs and information seeking behaviour of agricultural researchers and extension workers in Zimbabwe;

b. To examine the role played by agricultural researchers and extension workers in communicating agricultural information to farmers;

c. To investigate knowledge management systems within the Ministry of Agriculture's divisions and research institutes and find out the application and use of ICTs in the generation and dissemination of agricultural information;

d. To assess the role of agricultural researchers and extension stakeholders as potential uptake/dissemination pathways for agricultural technologies;

e. To examine the level of utilisation of indigenous agricultural knowledge by researchers and extension workers in the generation and dissemination of agricultural information;

f. To identify knowledge gaps, challenges, and constraints affecting the extension and dissemination of agricultural information; and

g. To make recommendations for a national agricultural information policy based on the outcome of the study

1.7 Research questions

From the stated objectives, the study sought to answer the following research questions:

a. What are the information needs of agricultural researchers and extension workers in Zimbabwe?

b. What are the information seeking behaviour patterns of agricultural researchers and extension workers in Zimbabwe?

c. What role do researchers and extension workers play in the dissemination of agricultural information to farmers?

d. What means and processes are in place for managing information generated by the Ministry of Agriculture, Mechanisation and Irrigation Development's research and extension divisions and research institutes?

e. What is the level of ICT development within the Ministry of Agriculture, Mechanisation and Irrigation Development's research and extension divisions and research institutes, and what is the impact of ICT on the generation and dissemination of agricultural information among researchers and extension workers?

f. What is the significance of stakeholders' collaboration with the Ministry of Agriculture, Mechanisation and Irrigation Development's research and extension systems and what role do stakeholders play in the generation and dissemination of agricultural information?

g. To what extent do researchers and extension workers utilize indigenous agricultural knowledge in the generation of agricultural information?

h. What knowledge gaps exist and what are the challenges and constraints affecting the extension and dissemination of agricultural information?

i. What recommendations on a national agricultural information policy can be derived from the study?

1.8 Scope and limitations of the study

1.8.1 Subject coverage

This study describes research and extension systems in Zimbabwe and investigates the information needs of agricultural researchers and extension workers in carrying out their functions as supported by libraries and other information services. Information services include channels of communication and the transmission of information in various formats.

1.8.2 Focus

The study investigated the information needs of researchers and extension workers in the public sector under the jurisdiction of the Ministry of Agriculture, Mechanisation and Irrigation Development. Included were the Department of Research and Specialists Services (DR&SS), the Department of Agricultural Technical and Extension Services (AGRITEX), and agricultural research stations and their libraries or documentation services. The Department of Livestock & Veterinary Services was not included in the main study but was used in the pilot study due to the overlap in its functions with the Department of Animal and Pastures Research of the DR&SS.

Although this study acknowledges the existence of other research institutes and organisations dealing with agriculture and its related subjects, these institutes and organisations were not the focus of this research. Researchers and extension workers were chosen because of the important role they play in generating new ideas through research and the dissemination of these ideas through the extension system.

1.8.3 Research environment

Zimbabwe is administratively divided into ten provinces of which two - Harare and Bulawayo - are urban, and sixty districts. In investigating the information needs of extension workers, the study focused on eight provinces excluding the urban provinces of Harare and Bulawayo, i.e. Matebeleland South, Matebeleland North, Midlands, Mashonaland West, Mashonaland Central, Mashonaland East, Manicaland, and Masvingo Provinces. The study investigated the provincial and district extension officers in all 8 of the provinces and 60 districts, but did not include the entire village and ward extension staff nationally due to the numbers involved. Instead, the researcher focused on

Mashonaland Province's village and ward extension personnel because the province was considered to be representative of the country in terms of agricultural practices. This is confirmed by Foti, Nyakudya, Moyo and Chikuvire (2007:30) in their observations: "Mashonaland Central is a province characterised by a wide variety of land tenure typologies: communal areas, newly resettled small-scale (A1), newly resettled large-scale (A2), small-scale and large-scale commercial and old resettlement, and is also made up of areas of varied agricultural potential ranging from agro-ecological region II to region V with the dominant extension system being provided and managed by government."

1.8.4 Methodological scope

This study employed both qualitative and quantitative research methodologies. The survey method was used to gather quantitative data while content analysis was employed to analyse in-depth interviews and open-ended questions from the questionnaire. Research methodology is discussed in detail in Chapter six.

1.8.5 Political limitations

The land reform programme in Zimbabwe has generated immense positive and negative publicity within the country and internationally. The study addressed the land reform programme by investigating how research and extension programmes have responded to the changing environment and needs of the new farming dispensation. The study addressed the research problems as they prevailed without any deliberate political bias, and the researcher referred to guidelines as documented by the Ministry of Agriculture and supporting legislation.

1.8.6 Time

As stated earlier, the study covered eight provinces and sixty districts in Zimbabwe, with a more detailed analysis of Mashonaland Province. This involved a lot of travelling, which was both time consuming and expensive. In order to cover as much of the geographical area as possible, the researcher utilised the provincial and district communication channels of AGRITEX, the Ministry of Agriculture's Head Office, as well as DR&SS's Head Office to reach out to researchers scattered around the research stations nationally. This allowed the researcher to access an ample number of respondents within the stipulated timeframe.

1.9 Significance of the study

As stated earlier, Zimbabwe has been going through a land reform programme which has seen prime agrarian land, formally the domain of approximately 6500 white commercial farmers, repossessed by the state and redistributed to formerly landless peasants. This has resulted in a lot of movement; new farmers have been resettled in areas alien to them and have had to practice new methods of farming. Under normal circumstances, this process requires that farmers first be educated and provided with appropriate information about the relevant farming practices. Information plays an important role in empowering farmers, and it is therefore important for extension workers to be well informed. It is also important for research to address farmers' issues and generate appropriate information and technologies for the extension process.

This study therefore sought to investigate the information needs of agricultural extension workers and researchers and the challenges that they face. Farmers rely on extension workers for their critical extension needs; where the latter are ill-equipped, agricultural production is compromised. The study hopes to contribute to growing literature on agricultural knowledge and information systems and to the researcher's knowledge in this area of study. The outcome of the study is expected to assist with policy formulation on agricultural information systems and research support in agriculture and its related fields.

1.10 Literature review

According to Neuman (2011:111), a literature review is based on the assumption that knowledge accumulates, and that people learn from and build on what others have done. Neuman (2011) and Leedy and Ormrod (2010:66) observe that literature reviews vary in scope and depth and all endeavour to fulfil one of the following goals:

- To demonstrate familiarity with a body of knowledge and establish credibility. A review tells the reader that the researcher knows the research in an area and knows the views and findings of other researchers in that area of study

- To show the path of prior research and how a current project is linked to it. A review outlines the direction of research in a question and shows the development of knowledge.

- To integrate and summarise what is known in an area. A review pulls together and synthesizes different results.

- To learn from others and stimulate ideas. A review outlines what others have found so that the researcher can benefit from the efforts of others. For example, it can show how others have handled methodological and design issues.

With the above in mind, the literature review identified research on the subject and related topics of interest published in peer-reviewed journals, theses and dissertations, books, electronic records, and grey literature.

1.11 Ethical considerations

According to Robson (1993:29), ethics refers to "rules of conduct; typically to conformity to a code or set of principles". Ethical issues centre on the rights of participants in a research activity. Leady (1997:116) explains, "No research should ever be conducted under circumstances in which total disclosure of the aims and purposes of the research cannot be set forth, preferably in writing, nor should any subject be lured into cooperating in any research endeavour without knowing fully what participation in the project will involve and what demands may be made on that subject." Ethical issues also relate to the researcher. These ethical issues mostly revolve around intellectual ownership and plagiarism. Ethical issues may also relate to the sponsoring organisation and how it may influence research results.

1.12 Dissemination of results

According to Ocholla (1999:141), "The possession of information without dissemination is useless and research is not complete until it is disseminated." The results of this study will be disseminated to the Government of Zimbabwe through the Ministry of Agriculture, Mechanisation and Irrigation Development as part of its contract with the researcher. The findings will also be disseminated through publication in journals and conference presentations. As part of legal depository requirements, copies will be left with the University of Zululand and University of Zimbabwe libraries for their theses collections. The growth of institutional repositories and Electronic Thesis and Dissertations (ETDs) will also help publicise the results to a wider audience. Findings of this research have been disseminated in conferences and journals which include:

a) Mugwisi, T., Ocholla, D.N. and Mostert, B.J. (2012). Is indigenous knowledge accessed and used by agriculture researchers and extension workers in Zimbabwe? *Innovation: journal of appropriate librarianship and information work in Southern Africa*, 44:101-125.

b) Mugwisi, T., Ocholla, D.N. and Mostert, B.J. (2012). The information needs of agricultural researchers and extension workers in Zimbabwe. An overview of the findings. Paper presented at the XX Standing Conference of East, Southern and Central Africa Library and Information Associations (SCECSAL), 4-8 June 2012, Nairobi, Kenya.

1.13 Structure of the thesis

Preliminaries

Chapter One:	Introduction and conceptual setting
Chapter Two:	Agricultural research, extension, and information services in Zimbabwe: A contextual setting
Chapter Three:	Conceptualising information, information needs, information seeking and information use
Chapter Four	Diffusion of Innovation theory
Chapter Five:	Perspectives of agricultural knowledge and information systems (AKIS)
Chapter Six:	Research methodology
Chapter Seven:	Analysis and interpretation of data
Chapter Eight:	Discussion of findings
Chapter Nine:	Summary, conclusions, and recommendations

1.14 Summary

This chapter introduced and presented the conceptual setting of the study. The chapter defined agriculture and identified its related disciplines and briefly discussed the role of agriculture in economic development and hunger and poverty alleviation with reference to developing economies. The chapter also highlighted the role of agricultural research and extension systems and how their activities need to be driven by informed research and extension personnel. The contextual setting was only briefly outlined as it is discussed in detail in the next chapter. The role of agriculture in Zimbabwe's economy was also discussed, and reference was made to the land reform programme and its impact on both agricultural research and extension. The chapter also provided the statement of the problem, motivation of the study, aim of the study, research objectives and research questions, scope and limitations of the study, and the significance of the study. The proposed structure of the thesis was also outlined. The next chapter provides a detailed discussion of the structure of agricultural knowledge and information systems in Zimbabwe.

CHAPTER TWO

AGRICULTURE IN ZIMBABWE: CONTEXTUAL SETTING

2.1 Introduction

The previous chapter briefly outlined the contextual setting in order to highlight the study area in relation to the problem statement and significance of the study. Aspects of the contextual setting that were introduced include the land reform programme and the role of agriculture in the Zimbabwean economy. This chapter addresses the following research objectives:

b. To examine the role played by agricultural researchers and extension workers in communicating agricultural information to farmers;

c. To investigate knowledge management systems within the Ministry of Agriculture's divisions and research institutes and find out the application and use of ICTs in the generation and dissemination of agricultural information;

d. To assess the role of agricultural researchers and extension stakeholders as potential uptake/dissemination pathways for agricultural technologies

The above objective was addressed by answering the following research questions:

a. What role do researchers and extension workers play in the dissemination of agricultural information to farmers?

b. What means and processes are in place for managing information generated by the Ministry of Agriculture, Mechanisation and Irrigation Development's research and extension divisions and research institutes?

c. What is the level of ICT development within the Ministry of Agriculture, Mechanisation and Irrigation Development's research and extension divisions and research institutes, and what is the impact of ICT on the generation and dissemination of agricultural information among researchers and extension workers?

d. What is the significance of stakeholders' collaboration with the Ministry of Agriculture, Mechanisation and Irrigation Development's research and extension systems and what role do stakeholders play in the generation and dissemination of agricultural information?

The chapter is largely descriptive and expands on the contextual setting by addressing the organisation of the Ministry of Agriculture's departments, divisions and parastatals, followed by a discussion of agricultural training and education in colleges and universities. The chapter also looks at agricultural research as provided by DR&SS, highlighting the major research institutes and their distribution and research emphasis. Discussion also centres on the role of public institutions like universities, private organisations, NGOs, and international organisations in agricultural research.

The chapter is divided into seven sections, namely, the role of the Ministry of Agriculture, agricultural training and education, agricultural research, role of the department of veterinary services, agricultural extension, agricultural information services, the role of farmer organisations in research and extension. The section on agricultural extension focuses on AGRITEX, the complementary role played by private extension services, and the extension methods used, including the media. Agricultural information services addresses the library and information centres of public and private sector stakeholders, initiatives directed at the provision of electronic agricultural information, and the dissemination of information and extension sources. The chapter concludes by addressing the role of farmer organisations in agricultural research and extension. Land reform is also discussed, specifically in terms of its impact on research and extension services.

The government is responsible for agriculture in Zimbabwe through the Ministry of Agriculture, Mechanisation and Irrigation Development (MoAMID), the private sector, which includes non-governmental organisations (NGOs), also takes an active role in agriculture in collaboration with government institutions. The government's commitment to agriculture is inscribed in Zimbabwe's Agricultural Policy Framework (ZAPF: 1995-2020). The main objectives of the framework centre on increased agricultural production, economic development, and poverty alleviation. ZAPF also addresses policy issues in agricultural research and development and agricultural training and education. Research objectives focus on providing smallholder farmers with appropriate technologies and services in order to increase production, while education and training objectives look at the creation of an agricultural education system that would produce graduates who would meet the needs of the agricultural market (ZAPF, 1996). However, according to Mutisi (2009), some of the objectives have not been met due to poor coordination among participating institutions, for example between research and extension services, and in relation to training with other stakeholders. Further problems include the general economic climate prevailing in the country and the Fast Track Land Reform and Resettlement Programme (FTLRRP), which has created insecurity of land tenure and discouraged long term investments.

2.2 The role of the Ministry of Agriculture in Zimbabwe

Agriculture in Zimbabwe falls under the jurisdiction of the Ministry of Agriculture, Mechanisation and Irrigation Development. The Ministry's mandate, as specified in its mission statement, is to promote and sustain a viable agricultural sector and to develop and manage land resources through the provision of appropriate technical, administrative and advisory services in order to optimise productivity and contribute to equitable and sustainable social and economic development in Zimbabwe (Ministry of Agriculture, Mechanisation and Irrigation Development, 2010). Mechanisation was incorporated into the Ministry from its original placement as a department under the Office of the President, with the added new responsibilities of rehabilitation, acquisition, and the distribution of agricultural machinery, among others. Figure 2.1 below illustrates the structure of the Ministry.

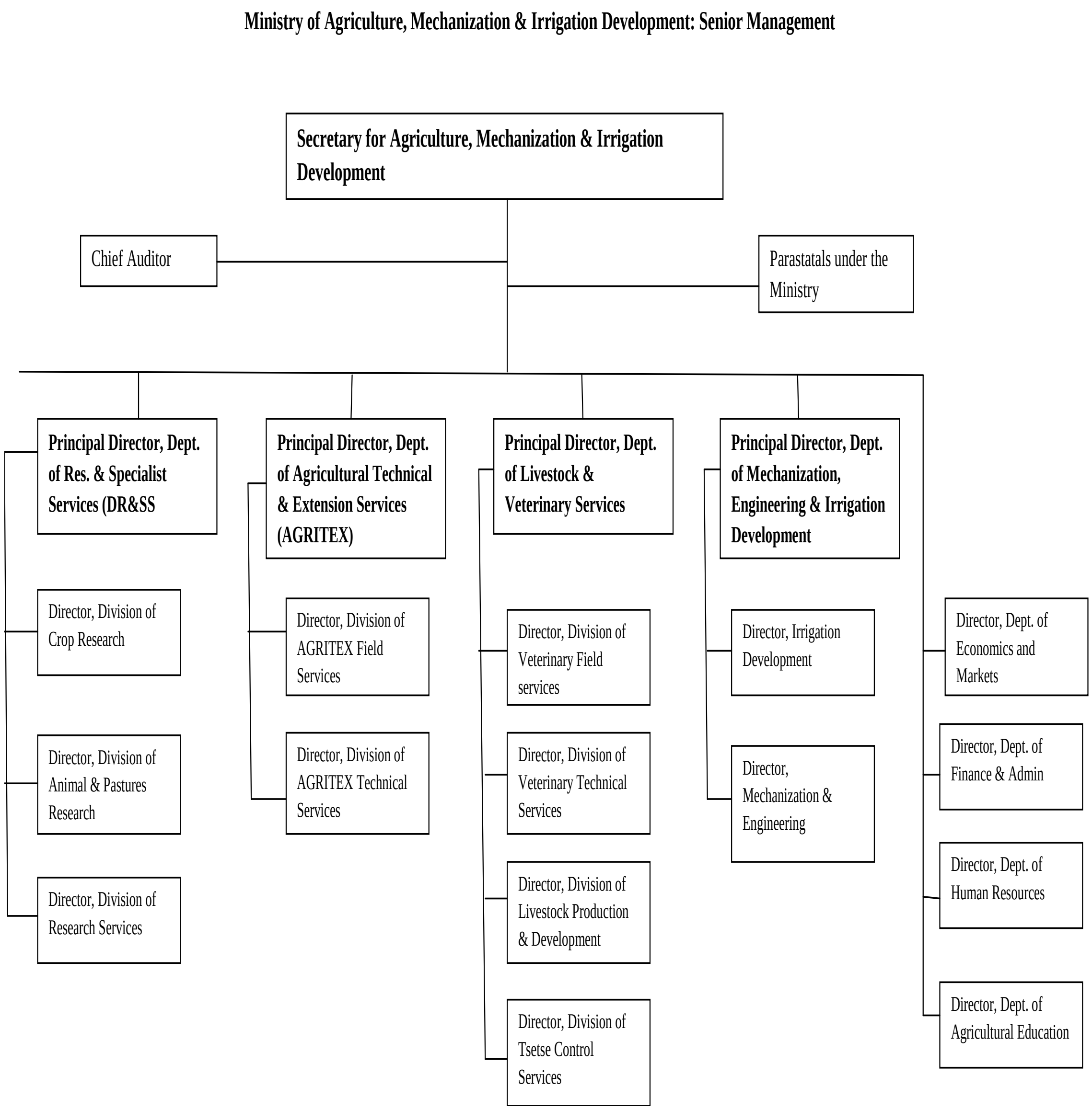

Figure 2.1: The Ministry of Agriculture, Mechanization & Irrigation Development: Senior staff

Adapted from: Ministry of Agriculture, Mechanization & Irrigation Development. (2009). *Senior Management*. Top Part as Approved by PSC on 14.05.09

This study investigates the information needs and challenges of researchers and extension workers in the public sector falling under the Ministry of Agriculture, Mechanisation and Irrigation Development's Department of Research and Specialist Services (DR&SS) and the Department of Agricultural Technical and Extension Services (AGRITEX). The Department of Livestock and Veterinary Services was the focus of the pilot study and was not included in the main study. The Departments of DR&SS and AGRITEX are discussed under 'agricultural research' and 'agricultural extension services' respectively, while the Department of Education is discussed under 'agricultural training and education'. The state enterprises, referred to as parastatals, and the Department of Economics and Markets (policy implementation) are also discussed.

2.2.1 The Department of Economics and Markets

The Department of Economics and Markets provides the agricultural planning framework for the Ministry. It conducts economic research and policy analyses and reviews, and provides policy advice and information to the agricultural industry (MoAMID, Department of Economics and Markets, 2010). Policy makers in agriculture need to be kept updated on local and international trends in order to make informed decisions. This process encompasses information and decisions generated through research and extension processes, among other sources.

2.2.2 Parastatals of the MoAMID

Parastatals falling under the Ministry of Agriculture, Mechanisation and Irrigation Development are primarily responsible for the marketing of commodities that fall under their portfolios in conjunction with the Agricultural Marketing Authority (AMA). Parastatals are also directly or indirectly involved in research and extension. Their functions are highlighted below.

2.2.2.1 Grain Marketing Board – GMB

GMB is responsible for the marketing of white maize, soybeans, wheat, sunflower seed and coffee (controlled products), in addition to red sorghum, white sorghum, pearl millet, groundnuts, edible beans and rice (regulated products) (Chimhowu, 2009).

2.2.2.2 Pig Industry Board – PIB

The Pig Industry Board was established under the Pig Industry Act, Chapter 18:15, and its functions are to carry out pig research in Zimbabwe, establish and operate pig litter testing stations, and to advise the Minister on all matters relating to the production and marketing of pigs (GoZ, Pig Industry Board Act 18:15: Section IV).

2.2.2.3 Tobacco Industry and Marketing Board – TIMB

TIMB's mandate includes controlling and regulating the marketing of tobacco; licensing merchants, auction floors and commercial graders; and distributing market studies and information related to the marketing, manufacture and consumption of tobacco. It is also responsible for granting tobacco export permits, among other responsibilities (TIMB, 2010; GoZ, Tobacco Industry and Marketing Act 18:20: Part III).

2.2.2.4 Tobacco Research Board - TRB

Globally, Zimbabwe is one of the leading competitive producers of high quality tobacco. The tobacco industry plays a vital role in the economy by generating foreign currency and creating employment. The highest production ever achieved for flue-cured tobacco was 237 million kilograms in 2000 (Tobacco Research Board, 2010). The importance of tobacco prompted the establishment of the Tobacco Research Board, a statutory body under the Tobacco Act of 1950, which is mandated to direct, control, and conduct research on tobacco. It has a plant clinic and provides services in GMO screening, chemical analysis, pesticide residue analysis, microbial analysis, advisory services, and contract research. Because of the widespread research undertaken at its stations, the TRB library has the largest collection of literature on tobacco in the region. The TRB is funded mostly by tobacco levies from growers and merchants, government grants, and income generated from commercial products and services (Tobacco Research Board, 2010).

2.2.2.5 Agricultural and Rural Development Authority – ARDA

ARDA, a state farming agency, was initially established as a development agency mandated to spearhead agricultural and rural development, including irrigation, but later became active in managing state farms (Makhadho, Matondi, Munyuki-Hungwe, 2006; Rukuni, 2006). ARDA was also initially involved in the government's programme of rehabilitating the livestock sector through financial support for breeding and feeding schemes before these were transferred to the Livestock Department. Like most parastatals, it soon incurred debts: "The ARDA farms, as with state farms in many countries, has not been commercially viable, accumulating a debt of ZW$100 million resulting in input suppliers limiting sales to the parastatal" (Muir-Leresche, 2006:105).

2.2.2.6 Cold Storage Commission – CSC

The Cold Storage Commission was established in 1937 as Zimbabwe's sole major abattoir. Its initial mandate included the wholesale supply of beef, management of abattoirs, and the processing and preservation of meat. With the liberalisation of the economy and the beef industry in the early 1990s, CSC lost its monopoly to emerging private abattoirs (Rukuni, 2006).

2.2.2.7 Agricultural Marketing Authority – AMA

The Agricultural Marketing Authority was established as a statutory body in 1967 under the Agricultural Products Marketing Act and abolished in 1993. It was resuscitated in 2007 and tasked with regulating, supervising, developing and administering the marketing of agricultural products. AMA is also expected to protect farmers by promoting fairness in pricing and promoting programmes and regulations that would boost export earnings (GoZ, Agricultural Marketing Authority Act 18:04: Part III; The Herald, Tuesday February 2, 2010).

2.2.2.8 Agricultural Bank of Zimbabwe - AGRIBANK

The Agricultural Bank of Zimbabwe was established in 1999 to succeed the Agricultural Finance Corporation (AFC) which had been around since 1971. The mobilisation of deposits and credit provision to the non-farming sector are the main new features of AGRIBANK in comparison to the former AFC. The bank manages, on behalf of the Government of Zimbabwe, a small window facility that supports the developing sector of farming in Zimbabwe (Agricultural Development Assistance Fund). Its main objective is to support emerging farming clients until they are mature enough to qualify for credit facilities from other commercial banks. The bank is now a fully-fledged commercial bank that offers commercial banking services like savings facilities, investment banking, etc (FAO, 2010; AGRIBANK, 2011).

2.3 Agricultural training and education in Zimbabwe

To a large extent, researchers and extension workers are products of agricultural training and educational institutions. According to Abalu (2001:11), agricultural education is essential in providing the leadership and technical and field personnel required to evolve a vibrant agricultural system: “It involves a systematic programme of instruction for students who wish to learn about the science, business, and technology of agriculture in all its manifestations.” There are three distinct qualification levels in agricultural education in Zimbabwe, namely certificate level, diploma (including higher diploma) level, and degrees from universities up to doctoral level. Agricultural education is offered through both public and private universities, colleges, and vocational centres. Short courses are also offered, although without certification. Table 2.1 below indicates the institutions that offer agricultural programmes.

Table 2.1: Institutions offering agricultural training and education in Zimbabwe, 2009-

Universities	**Colleges**	**Other farmer training institutions**
Africa University	Chibero College of Agriculture	Blackfordby
Bindura University of Science Education	Gwebi College of Agriculture	Trelawney
Chinhoyi University of Technology	Mlezu College of Agriculture	Dozmary
Great Zimbabwe University	Esigodini College of Agriculture	Wenleydale
Midlands State University	Mazowe/Hendeson (Veterinary College)	Nyamazura
Lupane State University	Rio Tinto College of Agriculture	Provincial Training Centres, e.g. Mupfure
University of Zimbabwe	Kushinga Phikelela College of Agriculture	Cotton Training Centre
Women's University in Africa	Harare Polytechnic (Diploma in Horticulture)	Nyamasinga
Zimbabwe Open University	Chaminuka College of Agriculture	Panorama
National University of Science and Technology	Magamba College of Agriculture	Hlekweni Rural friends
	Kaguvi College of Agriculture	
	Mushagashe College of Agriculture	
	Mashayamombe College of Agriculture	

*Adapted from Pazvakavambwa and Hakutangwi (2006) with modifications from the Central Library, Ministry of Agriculture, Mechanization and Irrigation Development

2.3.1 Department of Agricultural Education

The Department Agricultural Education of the Ministry of Agriculture, Mechanization and Irrigation Development participates directly in the management and administration of the agricultural colleges listed above (with the exception of Harare Polytechnic). Its mandate includes:

a) Providing advisory services on policy matters relating to training in agriculture

b) Developing, drafting, and reviewing the curricula of agricultural colleges and training institutions

c) Maintaining educational standards by setting, facilitating, and administering examinations

d) Providing career advice to agricultural students and members of the public

e) Providing farmer training (MoAMID, Agriculture Education, 2010)

Agricultural colleges offer programmes from certificate level to diploma level, covering subjects such as animal husbandry, agricultural engineering, crop science, and farm management. Colleges have expanded from six in 1982 to the current numbers (fourteen) following the upgrade of formerly vocational training centres. The Government of Zimbabwe and DANIDA (1991: i) "commissioned a project whose main objective was to bring the physical facilities of the then four national institutes of agriculture (Esigodini, Mlezu, Kushinga-Phikelela and Rio Tinto), up to an acceptable standard and to improve the standard of the agricultural certificate training". The outcome was to train graduates who would be employed as extension agents. The colleges have been chiefly responsible for the training of extension personnel.

2.3.2 Agricultural training in universities

Higher education in agriculture continues to play an important role in rural development and sustainable agricultural production. Universities have made important contributions to research capacity development through the training of research scientists at undergraduate and postgraduate levels. Zimbabwe currently has ten universities offering degrees from undergraduate level to postgraduate level in agriculture and related disciplines (see Table 2.1). These institutions include eight state universities, of which the University of Zimbabwe's Faculty of Agriculture is the oldest. The two private universities are Africa University (AU), a pan-African and United Methodist related institution established in 1992 (Africa University, 2010), and Women's University in Africa (WUA), established in 2002 (WUA, 2010).

Distance education programmes in agriculture are offered at the Zimbabwe Open University up to Master's degree level. Other universities, like the Midlands State University, also offer agriculture related degree programmes on part-time basis (MSU, 2010). These two study options are popular with people who are already employed and whose contracts would not allow them to attend university on a full-time basis. Extension and development workers from NGOs are among the students registered for these programmes.

2.3.3 Private agricultural training institutes

The expansion of large scale commercial farming prior to the land reform programme and the diversification of agricultural activities led to the establishment of private training institutions focusing on specific crops, e.g. tobacco at Blackfordby. Others include Trelawney, Dozmary Wenleydale, and Nyamazura, as shown in Table 2.1. The activities of some of these institutions were affected by the land reform programme. Private organisations, which include farmer organisations, and fertiliser and seed companies, frequently organise short courses or workshops for new farmers on specific areas, e.g. farm equipment use and maintenance, chemical use and handling, and growing specific crops like tobacco and flowers.

2.4 Agricultural research in Zimbabwe

Agricultural research generates new agricultural technologies which are used by farmers and agro-industries to enhance agricultural production and contribute to economic growth. This process involves a network of organisations that work independently or in collaboration, engaging with each other on what research activities to undertake. Collaborative research involves the sharing of resources and/or human, material and technical expertise. In Zimbabwe, research is carried out by research institutes, universities, and private companies.

Agricultural research is undertaken by both public and private institutions across the five natural regions described in 1.1.1. The Agricultural Research Council, through the Agricultural Research Act Chapter 18:05, Acts 31/1970/18/1975, S.I. 566/1979, is responsible for prioritising and funding research. The functions, duties and powers of the Council as stipulated in the Act are:

a. To review agricultural research in Zimbabwe, with particular attention to the adequacy of such research address for the needs of Zimbabwe

b. To promote all aspects of agricultural research and to ensure maximum co-ordination between persons or authorities who are undertaking or about to undertake any form of agricultural research

c. With the approval of the Minister, to carry out agricultural research (GoZ ARC Act, 18:05:146)

2.4.1 The Department of Research and Specialist Services (DR&SS)

The Department of Research and Specialist Services (DR&SS), under the Ministry of Agriculture, Mechanization & Irrigation Development, is the main publicly funded research organisation focus on crop, animal and pastoral research. According to Mutisi (2009:23) and MoAMID, DR&SS (2010), the objectives of the DR&SS are to improve food security and promote the growth of the national economy through the provision of appropriate agricultural technologies and services to resource-poor farmers. The department has a mandate to carry out research and provide research based information on all agricultural aspects except pigs, sugar, and tobacco.

Tawonezvi and Hikwa (2006:197) explain that the foundation of the present national research structure was laid down in 1948 with the establishment of the DR&SS. According to Mudimu (1986:27) agricultural research initially fell under the Department of Agriculture which was established in 1903 to promote the development of the agricultural industry. Mutangadura (1997), Mudimu (1986), and Tawonezvi and Hikwa (2006) divide the development of agricultural research in Zimbabwe into three historical periods, beginning with the period before the Unilateral Declaration of Independence (UDI[3]) when research focused on testing the suitability of imported livestock and crop varieties to local conditions. The second stage was the period during the UDI. During this

[3] UDI refers to the Unilateral Declaration of Independence from Britain by Ian Smith in 1965. The British government considered the action rebellious and lobbied the world to impose economic sanctions on Rhodesia (now Zimbabwe) from 1965 up to 1980.

phase, economic sanctions affected tobacco sales which had become a major export crop. In 1967, the agricultural diversification scheme was established to help tobacco farmers reduce or stop growing tobacco and move on to other crops (Tawonezvi and Hikwa, 2006:200). This process led to the establishment of the Agricultural Research Council, and focus shifted to other crops including maize, cotton and soya bean. Crop and livestock production changed considerably during this period as the government set its sights on returning agricultural production to levels that would sustain the economy under sanctions.

The third stage covers the period from independence in 1980[4] to 2003. This period was characterised by a change in research orientation to black smallholder (resource-poor) farmers and rural communities who had been neglected during the colonial period when research had focused on large scale commercial farmers. Interestingly, communal (black, smallholder) land maize production surpassed large scale commercial production in 1984, and this situation was maintained for many years (Mashingaidze, 2006:364).

The Ministry of Agriculture, Mechanisation and Irrigation Development has faced major restructuring over the years, and the DR&SS has been a casualty of these changes. In 2001, it was merged with the Department of Agricultural Technical & Extension Services, AGRITEX, to form the Department of Agricultural Research and Extension, AREX. In 2009, the Ministry was re-structured again and the two departments were separated, reverting to their original structures and mandates. The DR&SS consists of three divisions, namely the Division of Crop Research, Division of Animal and Pastures Research, and the Division of Research Services. Figure 2.2 below provides an outline of the DR&SS.

[4] Zimbabwe gained its independence from the United Kingdom on 17 April 1980.

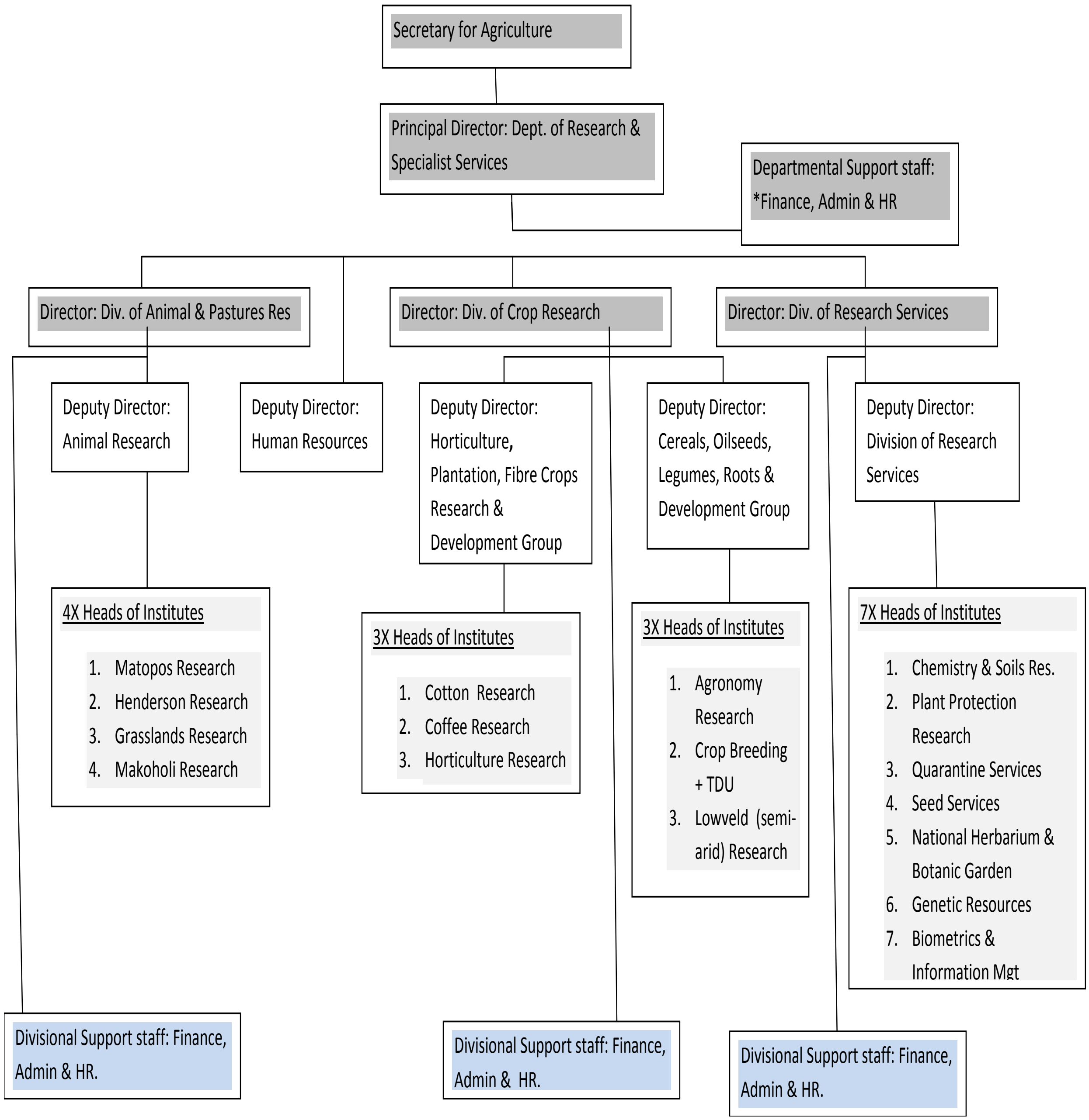

Figure 2.2: Structure of the Department of Research & Specialist Services (DR&SS)

Adapted from: Ministry of Agriculture, Mechanization & Irrigation Development. (2009). *Senior Management*. Top Part as Approved by PSC on 14.05.09

2.4.1.1 The Division of Crop Research

The Division of Crop Research directly engages farmers and extension workers in the transfer of technologies and the dissemination of information from research findings generated by its six institutes. One of the division's expected outcomes is the development of informed farmers who can make informed decisions in their areas and knowledgeable extension workers who can effectively support farmers. The major functions of the division include:

- Developing new crop varieties that are adaptable to the country's five agro-ecological zones
- Provision of breeders' seed and seed houses to support foundation seed production and subsequently, certified seed for the market
- Carrying out research for the development of appropriate field and horticultural crop production technologies for use by farmers
- Packaging and disseminating research-based crop management technologies, knowledge, and information aimed at increasing agricultural productivity in an environmentally sustainable manner
- Collection, characterisation, and conservation of plant and crop genetic resources for input into future crop variety development and for propagation and distribution to growers
- Developing and sharing technologies on crop produce handling and processing - value adding technologies
- Providing advisory services on crop production (MoAMID: Department of Research and Specialist Services, 2011)

Research is carried out at the stations and on farms together with farmers and extension workers. The DR&SS's Division of Crops Research (2009) lists among its achievements for 2009: the training of extension trainers from districts - who would in turn train farmers - on weed identification and the use and storage of herbicides (ARI); training supervisors from coffee farms on coffee production and management (CoRI); training of staff from non-governmental organisations (World Vision International) and students from Women's University in Africa (HRI); and preparation of a draft manual on weed control for sale to farmers.

This study focused on the research and extension systems and processes in Zimbabwe, hence an account of the activities of individual research institutes was deemed necessary. This description is based on the DR&SS Management Report (MoAMID, Department of Research and Specialist Services, 2011) and information from the Ministry of Agriculture's website (2010). The Division of Crop Research has six research institutes, some with sub-stations and sub-units in various parts of the country. The six institutes and their activities are briefly outlined below.

2.4.1.1.1 Agronomy Research Institute (ARI)

ARI has its headquarters in Harare, with six research units specialising in crop agronomy technologies and weed management in the high and medium altitude areas of the country. The institute focuses on natural regions II, III, and IV, and also includes testing agronomy technologies on farms in the three natural regions.

2.4.1.1.2 Crop Breeding Institute (CBI)

CBI has its headquarters in Harare and includes a Variety Testing Centre. Its main focus is the development, maintenance and provision of seed varieties including cereal, oilseeds and legumes. It is currently the sole breeder of Irish potato and improved bambara groundnut *(vigna subterranea)* varieties. The institute also tests varieties across all regions.

2.4.1.1.3 Semi-Arid Lowveld Research Institute (LVRI)

LVRI focuses on the development and testing of crop agronomy and horticultural technologies for the dry semi-arid environments of natural region V (NR V). Its mandate includes developing water management and irrigation based technologies for smallholder gardens and for commercial production. The institute and its two stations are all based in NR V and also conduct tests in agronomy and horticultural technologies on farms in the semi-arid region.

2.4.1.1.4 Cotton Research Institute (CRI)

CRI has its headquarters in Kadoma, NR III, and is a single commodity institute tasked with the development, maintenance and provision of certified cotton seed for the market.

The institute also conducts tests nationally on cotton varieties across all the natural regions. Currently, all the cotton varieties being grown in Zimbabwe were developed by this institute.

2.4.1.1.5 Coffee Research Institute (CoRI)

CoRI is another single commodity institute mandated to develop coffee agronomy technologies, including crop protection technologies to fight diseases and insects and pests that affect crops. The institute has its headquarters in Chipinge, NR I, and a station in NR II, and is the only supplier of improved coffee seed for commercial production in the country.

2.4.1.1.6 Horticulture Research Institute (HRI)

The Horticulture Research Institute is situated in Marondera, NR II, and has a research station in Nyanga, NR I. It is mandated to develop and test horticultural agronomy technologies as well as providing advisory services to stakeholders on horticultural crop production. HRI also sells ‘ready-to-plant’ seedlings to fruit producers.

The Division of Crops Research has linkages nationally and internationally for funding and collaborative research purposes. Nationally, these include parastatals like ARDA and private sector organisations involved in seed and fertiliser production. Internationally, the division has ties with the World Forestry Centre, (ICRAF), and International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), International Maize and Wheat Improvement Centre (CIMMYT), International Centre for Insect Physiology and Ecology (ICIPE), Commonwealth Agricultural Bureaux Index (CABI), the United Nations’ FAO, and the International Atomic Energy Agency (IAEA), among others.

2.4.1.2 The Division of Animal and Pastures Research

The Division of Animal and Pastures Research is responsible for livestock research, health, and development at its five institutes. The division conducts research on cattle, sheep, goats, poultry, donkeys, fish, and rangeland pastures, and its mandate is to efficiently and effectively produce animal products such as meat, milk, eggs and draught animal power (MoAMID, Division of Animal and Pastures Research, 2010). Table 2.2 summarizes the major functions of the institutes of this division and their natural region locations. Research functions of this division stem from national and local priorities as well as responding to the changing needs of clients.

Table 2.2: Division of Livestock Research

<table>
<tr><th>INSTITUTE</th><th>LOCATION/ NATURAL REGION</th><th>MAJOR FUNCTIONS OF THE DIVISION</th></tr>
<tr><td>Matopos Research Institute</td><td>Matebeleland South Province
30km outside Bulawayo city
Natural Region IV</td><td rowspan="5">• Conduct research and development in appropriate and sustainable technologies for livestock production and health in intensive, semi-intensive and extensive systems in the different agro-ecological zones (I-V)
• Conduct analysis of constraints, challenges and opportunities for livestock production and health and formulation of appropriate research priorities and programmes to meet stakeholder requirements for information and technologies for livestock production and health, including reproductive physiology and fertility (embryo transplants)
• Develop, conserve and utilise animal and plant genetic resources for distribution to the agricultural industry
• Develop and produce animal health products (vaccines, drugs, technologies) to meet the requirements of the livestock industry
• Create linkages and smart partnerships with stakeholders in the agricultural industry to facilitate joint identification and responses to challenges
• Disseminate and scale-up new technologies and relevant livestock production and health information
• Commercial production of agricultural products to generate funds to support livestock production and health research activities and maintenance of capital items and infrastructure.</td></tr>
<tr><td>Makoholi Research Institute</td><td>Masvingo Province
30km outside Masvingo city
Natural Region IV</td></tr>
<tr><td>Grasslands Research Institute</td><td>Mashonaland East Province
5km outside Marondera town
Natural Region IIb</td></tr>
<tr><td>Henderson Research Institute</td><td>Mashonaland Central Province
30km outside Harare
Natural Region IIb</td></tr>
<tr><td>Animal Health Research Institute</td><td>New institute currently based at the Department of Veterinary Services, Harare. Sub-units will be based at the four livestock institutes listed above.</td></tr>
</table>

*Adapted from the Division of Animal Research and Development's Outline and Selected Projects, 2009

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Linkages are important to the division's operations because they ensure efficiency while reducing duplicity, and save resources while bringing relevance to research activities (MoAMID, Division of Animal and Pastures Research, 2010). The division has internal linkages/ ties within the Ministry as well as with parastatals such as the Cold Storage Company and ARDA, and with local and international universities. International research and funding organisations include the International Livestock Research Institute (ILRI), International Water Management Institute (IWMI), ICRAF, ICRISAT, and World Organisation for Animal Health (OIE), FAO and IAEA.

2.4.1.3 The Division of Research Services

This division's research and services are carried out in five institutes, namely: Plant Protection, Biometrics, National Herbarium and Botanical Gardens, Chemistry and Soils, and Genetic Resources and Biotechnology. The other institutes include Plant Quarantine Services, Seed Services and Fertilizers, and Farm Feeds and Remedies, and these accommodate research programmes from other disciplines (Ministry of Agriculture, Mechanisation and Irrigation Development, Department of Research and Specialist Services, 2011).

The major functions of the Division of Research Services include:

i. Disseminate new technologies and relevant agricultural information

ii. Conduct farmer and trader training on appropriate agricultural technologies and best farming practices

iii. Carry out seed and pest assessments for national early warning purposes

iv. Provide sanitary and phytosanitary services on plant imports and exports

v. Provide testing and advisory services on soils, pesticides, animal feeds, agricultural chemicals, seeds, and crop protection technologies (Ministry of Agriculture, Mechanisation and Irrigation Development, Division of Research, 2010)

The Division of Research Services is headed by a director and a deputy director and consists of seven (7) institutes as follows:

a. Chemistry & Soils Research

   Major responsibilities include the chemical analysis of soils, plants, irrigation water, agricultural affluent, and fertilisers. The institute also conducts soil analysis and fertiliser recommendation to farmers and other stakeholders across the country.

b. Plant Protection Research

This institute is responsible for research into entomology, nematology, and plant pathology.

c. Quarantine Services

Provides regulatory services on port health and enforces government acts on plant materials, fertilisers, pesticide testing, and registration.

d. Seed Services

This unit's responsibilities include: implementing the seed certification scheme, including seed crop inspection and testing; administering the Seed Act; issuing international seed certificates; and protecting the rights of plant breeders under the Plant Breeders Rights Act.

e. National Herbarium & Botanic Gardens

The unit is nationally and internationally responsible for plant classification and certification, including protected plants, especially those with medicinal value.

f. Genetic Resources and Biotechnology

This institute is the national gene bank or repository of plant materials and is linked to the regional gene bank of the SADC at the Lusaka Centre, Zambia.

g. Biometrics & Information Management

The unit is responsible for the analysis of all data produced in the research department. It runs and operates a computer service for the department and supplies statistical and biometric advice in experiment testing and evaluation.

(Mutangadura, 1997:205; MoAMID, Division of Research Services, 2010)

2.4.2 Agricultural research in state universities

Institutions of higher learning, in particular universities, play an important role in agricultural research. The teaching process stimulates students and lecturers to undertake further research on topics of interest, and students conduct research as part of higher degree requirements. The University of Zimbabwe conducts higher degree research at

MPhil and DPhil levels in the fields of soil science, crop science, and animal science, among others. Universities also generate research as part of outsourcing for external organisations because of their capacity (in terms of staff and other resources) to conduct such research. Universities in Zimbabwe have been allocated farms so that they have land on which to conduct research besides generating an income.

Research at universities is also generated as part of national and regional collaboration with other universities and research centres. For example, the DR&SS and Veterinary Services work closely with the University of Zimbabwe in areas of crop research and animal health and research. Africa University is an example of a private institution that is conducting research in agriculture. Because academics are required to publish for recognition and promotional purposes, they conduct research in their respective institutions as single authors or jointly with colleagues. This researcher is part of the technical team responsible for the production of the *Southern African Journal of Education, Science and Technology* (*SAJEST*). Most of the articles in the journal are jointly authored by staff within and across different universities.

Lastly, universities contribute to agricultural research by training graduates who are absorbed into the work sector as researchers or in other positions within the agricultural sector upon completion of their studies.

The research capacity of public universities in Zimbabwe has been greatly affected by the economic environment, resulting in a high staff turnover which has affected both teaching and research across university departments, agriculture included. Donor funding, which used to sustain most research in agriculture, has dried up due to political and economic factors, including the global recession. Examples include SIDA-SAREC funding at the University of Zimbabwe which has led to the discontinuation of some research projects.

2.4.3 Private organisations & agricultural research

Private sector research is carried out by some of the parastatals mentioned previously, such as the Tobacco Research Board, Pig Industry Board, and Agricultural Research Trust (ART). Other organisations include Pioneer Seed, Pannar SeedCo, Cargill, Windmill, and the Zimbabwe Fertiliser Company (ZFC). Private companies involved in agricultural research are mostly interested in seed and chemical manufacturing (e.g. fertilisers, pesticides and herbicides).

2.4.3.1 Rattray Arnold Research Station, Seed Co.

Rattray Arnold is a world renowned research station and one of two research stations owned by Seed Co Ltd., a listed seed company on the Zimbabwe Stock Exchange. The station was bought by the Seed Maize Association (SMA) in 1972, which merged with the Crop Seed Association in 1983 to form the Seed Co-operative Company of Zimbabwe. Through its two breeders (Harry Arnold and Alan Rattray)[5], the SMA introduced the world's first commercially produced single-cross white maize hybrid in 1960. Research focus areas include yield, quality, disease tolerance, and the agro-ecological adaptability of maize, soya beans, beans, wheat and groundnuts. The station also conducts the screening of other crops for suitability to local conditions (Borlaug Global Rust Initiative, 2010).

Kadoma Research Centre is the second research station owned by Seed Co and is located in NR III. It focuses on evaluating seed varieties in the smallholder farming sector. Seed Co is ISO 9001 accredited and has expanded to six research stations in Zimbabwe, Zambia, Malawi, South Africa and Mozambique (Seed Co, 2012).

2.4.3.2 Agricultural Research Trust (ART)

ART was established in 1981 by the Commercial Oilseeds Producers' Association (COPA), a division of the Commercial Farmers' Union (CFU), as a research base for its members. Its expansion saw the incorporation of the Commercial Grain Producers' Association (CGPA), Zimbabwe Cereals Producers' Association (ZCPA), and the Cattle Producers' Association (CPA). The Trust's objectives include research row and horticultural crops to instil land management input and skills for production in commercial farmers in Zimbabwe and to provide contract research to any organisation that might need it. Other areas include pasture management, horticulture, cattle and pig production demonstrations as practiced on commercial farms, on call extension services, and the testing of agricultural machinery (ART, 2008). The Trust also runs an off-station

[5] The station derives its name from the two breeders, Harry Arnold and Alan Rattray. Arnold began breeding in 1932 as a government breeder before being joined by Rattray, releasing the first maize hybrid, Salisbury White, for sale in 1949.

research programme with some 30 sites around the country for summer and winter research, and assists college and university students with practical training and industrial attachment. With the FTLRP, some of these activities have been affected.

2.4.3.3 Zimbabwe Sugar Association Experiment Station (ZSAES)

The Zimbabwe Sugar Association Experiment Station was established in 1966 to conduct research on the production of sugarcane under irrigation in Zimbabwe's Lowveld, NR V. Besides providing research and extension services to sugarcane growers, the station provides analytical and advisory services to members of the Sugar Association such as fertiliser and disease inspection services, and a seed cane certification scheme (Kangasniemi, 2002). The station also conducts research in soybean production which is grown in rotation with sugar. ZSAES collaborates locally with the government's LVRI and externally with South African sugar research centres. Funding is provided by the sugar industry through the Zimbabwe Sugar Association.

2.4.3.4 Biotechnology Trust of Zimbabwe (BTZ)

The Biotechnology Trust of Zimbabwe is a non-profit organisation established in 1997 that is mandated to support biotechnology research with the full participation of end-users, with particular focus on resource-poor farmers in Zimbabwe and the SADC (Biotechnology Trust of Zimbabwe, 2010). BTZ promotes and facilitates the development and application of biotechnology in the areas of agriculture, environment, medicine, the mining industry and forestry. An example is the project on the provision of pathogen-free sweet potato planting stock to smallholder farmers of Hwedza and Buhera districts**.** The Research Trust conducts its research in collaboration with other institutions; the cited project was carried out by BRT, TRB and HRI.

2.4.4 Non-governmental organisations (NGOs) and agriculture in Zimbabwe

Mutisi (2009) observes that some NGOs engage in agricultural research in addition to extension, development, and relief services in Zimbabwe. Areas of research include conservation agriculture, the production and processing of foods, and micro-irrigation technologies. These NGOs collaborate with each other and with other agricultural organisations and tend to have adequate funding and a stable human resource base. Traditionally, NGOs have mostly concentrated on rural communities, but this trend is changing; examples include the peri-urban projects of CARE International and World

Vision. NGOs that are involved in agriculture include CARE International, World Vision International, Catholic Relief Services, Action Aid, Plan International, and Christian Care, to name a few.

2.4.5 International research stations in Zimbabwe

The role of international organisations in agricultural research in Zimbabwe has mostly been collaborative, and this collaboration has mostly been through funding and participation in research activities (see **2.4.1.1** and **2.4.1.2**). Two international research organisations are highlighted below.

2.4.5.1 International Maize and Wheat Improvement Centre (CIMMYT)

CIMMYT is a non-profit research and training centre with headquarters in Mexico focusing on wheat and maize research. Its research is focused on: producing high yielding, stress tolerant wheat and maize varieties and unique collections of maize and wheat genetic resources; productivity enhancing resource conserving farming practices; and training and providing information services to support these activities (CIMMYT, 2010). The CIMMYT research centre in Zimbabwe is situated 10km outside Harare, NR II. It is the largest regional office outside CIMMYT's headquarters and has been operational since 1985.

2.4.5.2 International Crops Research Institute for Semi-Arid Tropics (ICRISAT)

ICRISAT is a non-profit, non-political organisation that conducts agricultural research for development in Asia and sub-Saharan Africa, with partners across the globe. It conducts research on chickpea, pigeon pea, pearl millet, and groundnuts. ICRISAT and its partners work to empower poor and marginalized communities in order to help them overcome poverty and hunger and a degraded environment through better agricultural practices. It belongs to the consortium of centres supported by the Consultative Group on International Agricultural Research (CGIAR) (ICRISAT, 2010).

ICRISAT signed a Memorandum of Understanding with the Government of Zimbabwe in 1984 and is based in Bulawayo, NR V. Through its partnership with FAO, ICRISAT developed and promoted Farmer Field Schools for integrated soil, water and nutrition management, culminating in a Farmer Field School Facilitators' Manual which is now widely used by the Catholic Relief Services (ICRISAT/FAO, 2009).

2.4.6 SADC research and training - food, agriculture and natural resources: ICART Project

The SADC-FANR Directorate, in 2006 launched the Implementation and Coordination of Agricultural Research and Training (ICART) project. The objective of the ICART project is to strengthen the capacity of the directorate to coordinate agricultural research and training activities within the sub-region. The overall objective of the project is to contribute to regional economic growth and poverty alleviation through innovative research and training activities, and devising improved technologies and policies that would enable resource-poor smallholder farmers to increase agricultural production and their incomes and thus improve their livelihoods (SADC, FANR, 2008:200).

2.5 Department of Livestock and Veterinary Services

The Department of Livestock and Veterinary Services was established in 2003 following the merger of the Department of Veterinary Services and the Department of Livestock Production and Development. The department is headed by a Principal Director, with four deputy directors who each head the following divisions;

a) Division of Veterinary Field Services

b) Division of Veterinary Technical Services

c) Division of Livestock Production and Development

d) Division of Tsetse Control Services

The department provides advisory and extension services through the implementation of regulatory and technical services focusing on the prevention and control of animal diseases and pests, and through the promotion of animal welfare and public health (MoAMID, Department of Veterinary Services, 2010). Research is conducted in areas that include: the laboratory diagnosis of animal diseases and pests; surveys and detection of animal diseases and pests; and monitoring and reporting of occurrences of animal pests and diseases such as foot and mouth, black leg, etc. The Veterinary Technical Division's functions include diagnostics and public health. Veterinary Field Services has eight provincial veterinary officers and eight epidemiologists in each of the country's eight provinces, with sixty district veterinary officers and more than one thousand veterinary assistants at ward and village level (MoAMID, Department of Veterinary Services, 2010; Mutisi, 2009).

2.6 Agricultural extension in Zimbabwe

Agricultural extension services were established throughout Africa during the colonial period and were primarily oriented towards promoting the production of crops for export (Eicher and Baker, 1982:151). According to Eicher and Baker (1982:150), extension programmes in Africa have been plagued by the same problems that affect extension throughout the developing world, namely too few agents (in some countries), low pay, poor training, insufficient logistical support, dilution of efforts, low status, lack of collaboration/ effective ties with research units, and inappropriate technical packages.

Agricultural extension can be viewed as an essential mechanism for delivering information, advice and technology in modern farming that involves researchers, extension workers, and farmers (Mutangadura, 1997; Jones and Garforth, 1997). According to Kaniki (1995:26), the information needs of agricultural researchers include: identifying and controlling pests; credit sources and cooperatives; proper handling of pesticides; and marketing of agricultural produce. These needs are reflective of the tasks that they carry out when assisting farmers.

Agricultural extension in Zimbabwe has mostly been public sector driven through the Ministry of Agriculture. Private extension services are largely undertaken and supported by farmers' unions, private research organisations, and agricultural input suppliers such as seed and fertiliser companies as part of their business marketing. NGOs also provide their own extension services. The next section addresses extension in the public and private sectors, extension methods, and information dissemination.

2.6.1 The Department of Agricultural, Technical and Extension Services (AGRITEX)

Agricultural extension was introduced in Zimbabwe in 1927 by Emory D. Alvord with the help of nine field demonstrators (FAO, 2003). The Department of Agricultural Technical and Extension Services (AGRITEX) was established in 1981 following the merger of the Department of Conservation and Extension (CONEX) and the Department of Agricultural Development (DEVAG). CONEX had previously provided extension to large scale commercial farms while DEVAG catered for communal/ rural farmers (Rukuni, 2006). The structure of AGRITEX is illustrated in Figure 2.3 below. AGRITEX is headed by a Principal Director and seconded by two directors who are responsible for the Technical Division and Field Division respectively.

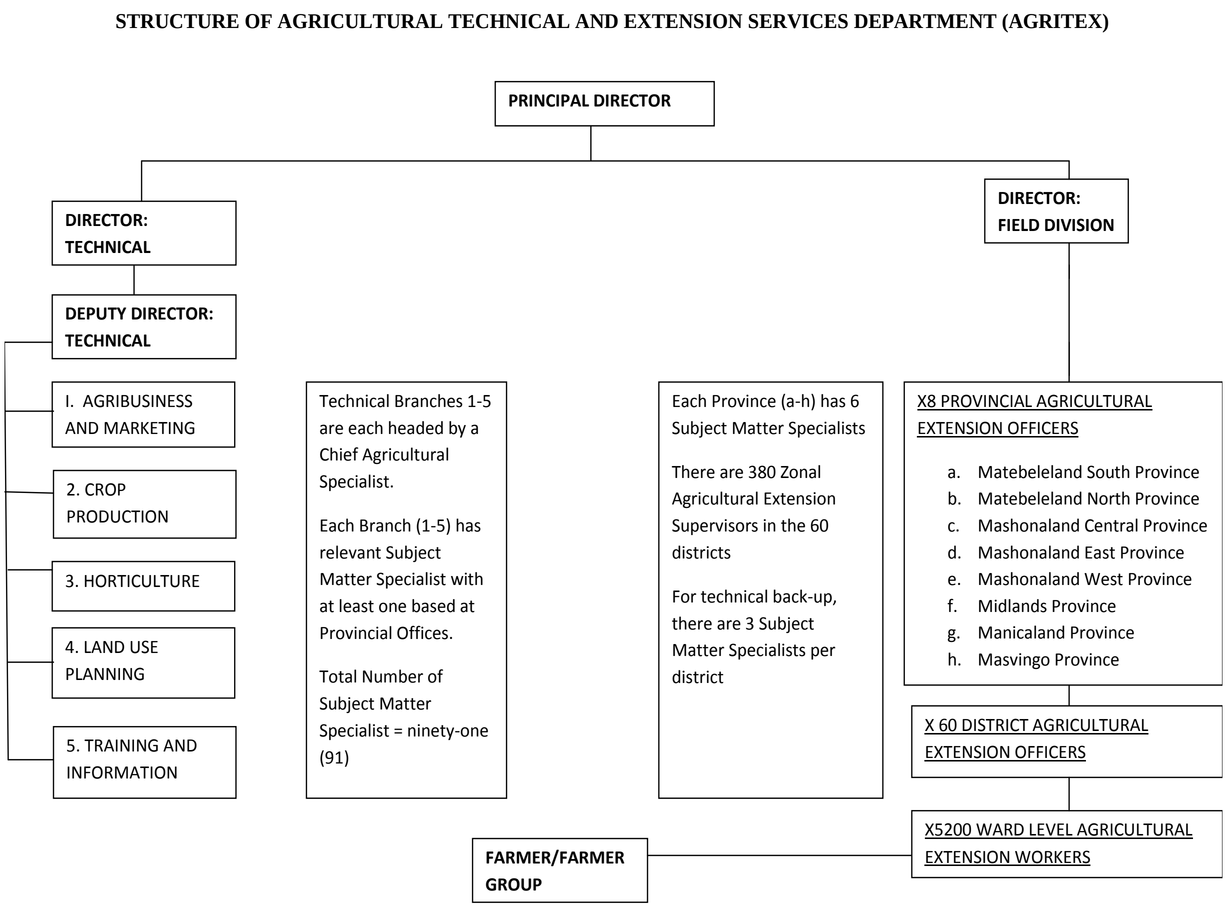

Figure 2.3: AGRITEX structure

Adapted from the Ministry of Agriculture: Agritex structure (2010)

2.6.1.1 AGRITEX: Technical Division

The Technical Services Division is headed by a director who is responsible for five technical branches, i.e. Agribusiness and Marketing, Crop Production, Horticulture, Land Use Planning, and Training and Information. The technical branches are each headed by a chief agricultural specialist, with at least one based at each of the provincial offices (MoAMID, Department of AGRITEX, 2010). Subject matter specialists’ roles include:

i. Keeping field staff up to date in their particular disciplines by means of in-service training

ii. Initiating and conducting surveys and adaptive research

iii. Conducting trials in consultation with DR&SS, universities, and other relevant stakeholders

iv. Assisting field staff with problem cases and transmitting problems requiring investigation by researchers

v. Providing specialised training for farmers

vi. Generating information through publications

Subject matter specialists (SMS) provide technical back-up/ support and supplement field services by obtaining and disseminating research and other updated information in their respective subject areas, including adaptive research to suit local conditions (MoAMID, Department of AGRITEX, 2010).

2.6.1.2 AGRITEX: Field Division

The Field Division is headed by a director who is directly responsible for (8) eight provincial extension officers. Below the provinces are sixty (60) district extension officers, and below them are ward level extension personnel. Each province has six subject matter specialists (SMS). At district level (all sixty districts), there are three subject matter specialists and three hundred and eighty (380) zonal agricultural extension supervisors.

The flow of information in the communication process follows both the top down model and the bottom up approach. Through AGRITEX officers based at the district offices, information is passed on to the AGRITEX extension supervisors and extension workers and then to the farmers. The officers and agricultural extension workers are also responsible for transmitting indigenous knowledge technologies, practices and problems from farmers to specialists and researchers. This creates a research extension network that is critical for appropriate research and extension messages/ communication (MoAMID, Department of AGRITEX, 2010).

2.6.1.3 Linkages

The AGRITEX Department has ties internally with other divisions of the Ministry as well as externally with other stakeholders. Within the Crops Research and Animal Research Division, for example, research is carried out at stations and on farms with farmers and extension workers. The extension workers help to identify potential farmers for research, manage on-farm trials, and organise field days and visits (MoAMID, Department of AGRITEX, 2010).

2.6.2 Private extension services

Private extension services in Zimbabwe are provided through farmers' unions and organisations, and through input supply and marketing companies. Examples include the Commercial Farmers Union, a large body of white farmers who provided a comprehensive research and extension support system to members. According to Pazvakavambwa and Hakutangwi (2006:227), "Private extension services have played a significant role in maintaining and improving the production of certain specialised crops, particularly those with export potential, but there is no clear line of distinction between the areas where private extension services can work and those covered by the national extension services." Input supply and marketing companies have recruited personnel from the government, and this has weakened the national system. However, even while it provides a valuable extension alternative, the private extension system has been criticised for: i) creating monopolies because sponsoring/ member companies advertise their products; and ii) threatening to reverse the extension system to the pre-independence era when there were two parallel extension systems.

2.6.3 Extension methods used in Zimbabwe

Zimbabwe's agro-ecological patterns make the agricultural systems in the country diverse, with different practices being adopted in different areas. The land reform programme created a new group of farmers, some engaging in farming for the first time and others moving into the commercial farming of crops that they were not familiar with. In both cases, many of these farmers completely lacked experience with the different farming practices and crop types. For these farmers, it was a 'learning on the job' scenario which resulted in a lot of expectations from the extension system. According to Axinn (1988 in Nagel, 1997:14), the success of an agricultural extension programme is often directly related to the extent to which its approach fits the programme goals for which it was established. Several agricultural extension approaches have been adopted in Zimbabwe, each with its own strengths and shortcomings. Studies by Hanyani-Mlambo (2002) and Pazvakavambwa and Hakutangwi (2006) have identified the following approaches:

a) Group extension approach

This method involves giving advice to a group of farmers and assumes that the group is homogeneous with similar challenges. A development from the 1960s and 70s, this approach was found to only address the needs of the average farmer, although it remains widely used.

b) Master farmer training scheme

The scheme was established in the 1930s with the objective of spreading modern and scientific farming techniques to communal farmers. Farmers were regularly tested through written or oral examinations depending on their levels of competence over a period of 2 to 3 years. Certificates and badges were awarded to master farmers who adopted and practiced new technologies.

c) Training and visit approach

Developed for the World Bank, this method is highly decentralised and offers intensive training and follow-ups by extension workers. When the system was adopted as a pilot study in the Midlands Province of Zimbabwe, it was found to be too mechanical and lacked flexibility to suit smallholder farmers, and was also too expensive in terms of required resources. The system was modified to use extension groups instead of contact farmers and was successful with irrigation projects. The involvement of subject matter specialists enhances the research extension system while visits provide farmer contact.

d) Radio listening group

This approach brings farmers together in groups to listen to programmes on farming issues which they then discuss, identifying or linking them to their own experiences. This approach has faced criticism for timing, relevance of issues to farmers, and absence of feedback.

e) Farming systems research and extension

Developed in response to the low success rate of other models, this approach centres on problem solving and involves farmers in their own environment, for example in farm trials.

f) Commodity based approach

This approach is organised through parastatals and is important for exports and cash crops like cotton, sugar, and horticultural products. The challenge of this approach is that by focusing on a specific crop, farmers' requirements with respect to secondary crops are ignored.

Extension approaches continue to evolve, largely as a response to research and its influence on farming systems. Hanyani-Mlambo (2002) and Pazvakavambwa and Hakutangwi (2006) list the following among emerging approaches: participatory extension approaches, participatory rural appraisals, rapid rural appraisals, farmers' field schools, look and learn tours, and farmer to farmer extension, where extension workers respond to farmers' requests and visits only when required. The information flow channels are discussed as part of agricultural information services below.

2.7 Agricultural information services in Zimbabwe

Agricultural information is generated by researchers and institutions and is made available in both print and electronic format for consumption by end-users. One of the main challenges affecting the adaption or adoption of new technologies by farmers is lack of information. Research generates information, and the extension system disseminates this information to farmers. In turn local knowledge held by farmers helps researchers understand farmers' problems. This can be communicated either directly by the farmers or through extension channels. The absence of a coordinated national agricultural information system creates information gaps in an AKIS environment. Libraries and information centres, in conjunction with international partners, play an important role in availing and disseminating agricultural information in Zimbabwe.

2.7.1 Electronic resources and initiatives

Collection development policies in libraries have responded to information and communication technologies and electronic publishing by adopting the 'just in time' acquisition policy which provides information on request/ demand compared to the traditional 'just in case' policy where material is acquired in case it is asked for. The internet and electronic publishing have enabled access to remote databases or sources of information. Libraries in Zimbabwe face challenges in replenishing their collections due to inadequate financial resources and poor infrastructure. However, not all resources require payment as publishers are increasingly making more resources available in the public domain through open source (OS) initiatives. The biggest challenge lies in awareness. Researchers require current information and electronic resources to meet this requirement. There are several alternative information provision platforms available to libraries in Zimbabwe, and these are briefly discussed below.

2.7.1.1 International Network for the Availability of Scientific Publications (INASP)

The International Network for the Availability of Scientific Publications (INASP), through its Programme for the Enhancement of Scientific Publications (PERIii), cooperates with publishers and library consortia to enable online access to research material to qualifying institutions within developing and emerging countries. INASP negotiates with publishers and content owners for access to resources at a price proportionate to the socio-economic development of each country, enabling heavily subsidised or free access to countries that qualify (INASP, 2010). Zimbabwe participates in this programme, meaning that virtually all its libraries can get access to the free resources upon registration. Subscriptions remain prohibitive, with university libraries just managing to renew their contracts annually. Resources include databases such as EBSCO, Taylor and Francis, Wiley Inter-Science, Blackwell Publishing, CABI International, Cambridge Journals, Oxford Online Journals, and Emerald Insight, among others. These databases provide a wealth of information, full text articles and abstracts that benefit not only students and lecturers, but also researchers and extension staff. The principal challenge of this programme is that it requires ICT infrastructure, in particular the internet. However, even where the programme is available, the resources are not marketed well to attract usage. This researcher is part of the INASP Africa team on e-resource registration and troubleshooting.

2.7.1.2 The Essential Electronic Agricultural Library (TEEAL)

The TEEAL initiative or ‘Library in a Box” is supported by Cornell University in association with the Rockefeller Foundation (USA), and is a scholarly database designed specifically for agricultural and natural resource scientists, lecturers, and students in developing countries. It is available on CD-ROM or as an external hard drive which can be installed on a Local Area Network (LAN TEEAL) to provide institutional access to simultaneous users (ITOCA, 2010).

2.7.1.3 Access to Global Online Research in Agriculture (AGORA)

The AGORA programme was set up by Cornell University, the Rockefeller Foundation and FAO in conjunction with major publishers to enable developing countries to gain access to an outstanding digital library collection in the fields of food, agriculture, environmental sciences, and other related social sciences. It is intended for use by researchers, extension workers, students and lecturers, and non-profit making organisations, and is available free of charge. Registration is required in order to obtain password access. AGORA provides institutions in 107 countries with access to 1278 journals (AGORA, 2010; ITOCA, 2010).

2.7.2 Libraries and information centres

Libraries provide access to information ranging from broad subject coverage to specific disciplines depending on the intended clientele and institutions that they represent. The material formats range from books or print to electronic and web sources. As already discussed in 2.7.1, there is a growing trend towards the adoption of electronic information resources, although institutional capacities vary. This study sought to understand the information behaviour of researchers and extension workers, and it was therefore necessary to detail the different information access facilities and unique resources that are at their disposal within and outside their institutions.

2.7.2.1 Ministry of Agriculture, Mechanisation and Irrigation Development libraries

The Ministry of Agriculture, Mechanization & Irrigation Development and its related institutes are supported by the Central Library which is housed in the Ministry's Head Office. It has branch libraries in its departments, research stations, and agricultural colleges. The library's collection includes books and journals as well as access to the LanTeeal database. The Central Library is part of the regional consortium of agricultural libraries of the Southern African Development Community (SADC) under the SACCAR programme, which is coordinated by the SADC secretariat in Botswana.

2.7.2.3 University libraries (including private universities)

Universities and colleges that offer agriculture and related courses provide access to both print and online databases in addition to the traditional collection of books, journals, theses and dissertations, and seminar papers. The University of Zimbabwe provides the bulk of the agricultural information that is available in libraries. University libraries participate in INASP, AGORA and TEEAL, and extend these facilities to other organisations like government departments, NGOs, and private research institutions. The University of Zimbabwe library is a legal depository centre of all United Nations publications, and hence has a wealthy collection of literature on agriculture and related disciplines, including publications from FAO.

2.7.2.4 Private institutions and parastatals

Private and parastatal organisations have subject-specific collections depending on their specialty. International and private research stations have collections that cater for the information requirements of their researchers. Information can also be sought from other institutional libraries, for example the University of Zimbabwe extends its readership to non-university users at a fee. The libraries of these organisations include CIMMYT, Rattray Arnold, and the Tobacco Research Board (TRB), among others. The TRB library is renowned for the biggest collection of tobacco related literature in the region.

2.7.3 Dissemination of information and extension sources in Zimbabwe

Kiplang'at (2003:9) explains that, "Agricultural information is provided through various formal and informal channels and sources which include the mass media, electronic and printed media, interpersonal communication, libraries and information centres." Table 2.3

shows key information providers as identified by Pazvakavambwa and Hakutangwi (2006:226).

Table 2.3: Information and extension sources in Zimbabwe

SOURCE	TYPE OF INFORMATION	MEDIUM
Media		
Radio programmes	• Nhau dzevarimi (Farming news) on Radio Zimbabwe • Tirimurimi wanhasi (Today's farmer) on radio • ZFU radio listening groups • Farmworker issues	ZBC in association with MoAMID ZFU FCTZ
Video units	• Farming documentaries • Livestock and agronomy videos	MoAMID
Television programmes	Talking farming	ZBC in association with MoAMID
Organisational based		
Publications	• 40 000 copies of Kunzwa/Ukuzwa (Listening) produced 3 times a year • ZFU publishes Murimi-Umlimi (Farmer), a bi-monthly magazine	MoAMID
Electronic information	• Internet-based information used by well resourced farmers • Government is promoting ZARnet for mass internet utilisation	Individuals Ministry of Science and Technology
Community radios	Rural dialogue with an emphasis on agricultural information	MoAMID
Public gatherings		
Agricultural shows	Agro-processors and government departments provide information to the public through publications and talks	Joint public-private sector partnership
Community meetings	Regular community meetings to which extension workers and others are invited by the community	MoAMID and private sector (for example processors, Cottco, CSC)
Field days	Field-based examples where farmers learn from successful farmers	MoAMID, NGOs, agro-processors
Training and education		
Adult education	Study circles, books and materials	SFU, SCC, Study Circle Alliance of Zimbabwe

Adapted from Pazvakavambwa and Hakutangwi (2006:226) with modifications from DR&SS

Key: MoAMID = Ministry of Agriculture, Mechanization and Irrigation Development

CSC = Cold Storage Commission

FCTZ = Farm Community Trust of Zimbabwe

NGO = Non-Governmental Organisation

SCC = Swedish Cooperative Centre

ZBC = Zimbabwe Broadcasting Corporation

ZFU = Zimbabwe Farmers' Union

ZARnet = Zimbabwe Academic Research Network

2.7.3.1 Print media

Print media provide news on current events or address specific topics in agriculture. Business columns may provide information on the marketing of commodities, price indices, etc. The Herald, for example, provides a weekly report on agricultural news. The vernacular Shona edition of "Kwayedza" has a weekly column on "Nhau dzevarimi" (Farmers' news) with the Ndebele version of "Izindaba zabalimi" The print media in Zimbabwe have agricultural reporters who cover agricultural news, culminating with the annual award for the 'agricultural reporter of the year'.

Farmer organisations, input supply companies, and other organisations disseminate information in the form of pamphlets, posters and magazines on various aspects of agriculture, including fertilizer and chemical handling, how to grow certain crops, post-harvest handling, etc. Publications include, "*The Farmer"* and "*Kupfuwa huku*" (poultry keeping), among others. The Seed Company of Zimbabwe, SeedCo, produces agronomy reports and producer manuals which are used by extension workers and farmers. AGRITEX has a publication unit which produces in-house publications, including booklets and manuals, and these are used for training as well as for extension purposes. The challenge with print sources of information is the language of publication, which is mostly English, although material in Shona and Ndebele is also available. Minority languages like Shangaan, Tonga, Kalanga, Venda and Sotho are often left out.

2.7.3.2 Broadcasting media

Zimbabwe has one public broadcaster with four radio channels and two television channels. Two radio channels, Radio Zimbabwe and National FM, include farming news programmes in local vernacular, i.e.:

- 'Nhau dzevarimi' – Farmers' news (Shona)
- 'Izindaba zabalimi'- Farmers' news (Ndebele)
- Kuchengetwa kwezvipfuyo – Livestock management (Shona)
- Ukugcinwa kwezifuyo – Livestock management (Ndebele)
- Tinokushevedzai varimi – Calling on farmers (Shona)
- Sibiza abalimi – Calling on farmers (Ndebele)

Other minority languages, including Kalanga, Sotho, and Shangaan, also get airtime on the two radio channels. Television broadcasting is dominated by the ZBC TV channel, with the newly introduced Channel 2 focusing more on entertainment programmes. The most prominent programme is "Talking Farming", where guests are invited from AGRITEX, DR&SS and other private organisations to address specific topics. Viewers get the opportunity to phone in and ask questions or participate in the discussions. Radio programmes also sometimes invite guests to their shows. The interactive nature of these programmes helps to attract a wider audience.

2.7.3.3 Internet

The use of the internet has become widespread in Zimbabwe, with organisations increasing their visibility through the web. As shown in 2.6.1, agricultural information is available electronically and can be accessed where connections are available. Some of the organisations described above maintain websites from which information can be downloaded. This type of information includes profiles, activities, contacts, and manuals and reports, as in the case of SeedCo. The Ministry of Agriculture maintains a website from which information on its activities can be accessed. The TIMB website, for example, provides information on tobacco pricing and allows farmers to make their bookings online. Using search websites like Google can also provide easy and quick access to information which can assist both researchers and extension workers.

2.8 The role of farmer organisations and producer associations in Zimbabwe

Farmers' organisations and producers' associations play a crucial role in the agricultural processes in Zimbabwe. Their role in research and extension has already been noted in this chapter. Farmers' organisations mobilise farmers' participation in the research process, for example the Seed Maize Association's research on maize varieties led to the subsequent establishment of the Rattray Arnold Research Station. The efforts of the Sugar Producers' Association were also highlighted. Prior to the land reform programme, the Commercial Farmers' Union used to have a strong research and extension network among its members. These activities, although still available, have scaled down.

Producers' associations play an important role in negotiating producer prices of commodities on behalf of their members. Two incidents occurred in Zimbabwe during the 2010 marketing season involving the Cotton and Tobacco Producers' Associations and overpricing. The first involved cotton prices which buyers had pegged at US$0.30 per kilogramme, and which the farmers felt was too low. Instead of selling, the Cotton Producers Association instructed its members to withhold the crop while negotiating for better prices. The outcome was positive and the price went beyond US$0.45 per kg for the lowest grade. There are several Tobacco growers' associations in Zimbabwe. They also faced similar challenges of unfair pricing resulting in the boycott and withholding of tobacco on auction floors. This resulted in government intervention after lobbying by the association. As shown in 2.2.2.7, issues of unfair commodity pricing prompted the government to re-introduce the Agricultural Marketing Authority.

2.9 Summary

This chapter elucidated the contextual setting of the research, including the factors that impinge on the implementation of various strategies by the government and other agencies. The discussion articulated the government's structures with respect to agricultural education, research, extension, and information services, the main components of an agricultural knowledge and information system. The Zimbabwe Agricultural Policy Framework provides a twenty five year plan of action for agriculture, which is a reflection of foresight on the part of government. The Ministry's hierarchical structure is clear and reflects on the different divisions that are evident in agricultural systems, for example the organisation of departments by area of specialisation. Agricultural education contributes to the development of researchers and extension workers and also empowers farmers with requisite skills. Education is central to this study in that it offers an indication of the potential academic levels of the agricultural personnel in the country. Besides government institutions, private sector involvement is evident in agricultural education by way of private training, collaborative support, and the funding of scholarships in government colleges and universities. Some private organisations, such as the Tobacco Research Board, also provide access to their facilities, especially access to laboratories by students. While colleges offer training from certificate level up to higher diploma, universities offer agricultural education from degree to doctorate level**.** According to Danida (1991), Zimbabwe had trained sufficient graduates to occupy positions in agriculture from certificate level to postgraduate level. However, these people have not been absorbed by the government, leading to the current high vacancy rate shown above. This has been attributed to poor remunerations, resulting in a high staff turnover.

By all appearances, agricultural research is being carried out in both public and private sector enterprises. The government's research stations are distributed across different agro-ecological zones, specialising in various agricultural products and farming activities (tea, sugar, cotton, maize, etc.). A reporting structure is in place that cascades all the way back to the Ministry's Head Office. Agricultural extension within the government follows a similar hierarchical reporting structure which cascades down from the Head Office (national level) to village and ward level. This information guided the researcher when addressing the issues of sampling and representativeness in the methodology section of the study.

The role of NGOs in both agricultural research and extension was also described in this chapter, demonstrating a collaborative relationship with government institutions. Private sector institutions are portrayed as being well funded and staffed (Borlaug Global Rust Initiative, 2010; CIMMYT, 2010) in comparison to government institutions (Mutisi, 2009; Mutangadura, 1997). It emerges that there is often staff movement from government institutions to these private sector organisations. It could be argued that private sector agricultural organisations have thus strengthened their human resources capacity by ‘weakening’ government institutions.

The land reform programme, discussed in Chapter one, caused a massive migration into agriculture, for some as first time farmers, and others as a move into commercial farming. This group of farmers would initially be dependent on the existing research system (either directly or indirectly) and the extension system, which is currently depleted in terms of staff and financial support. This places a lot of strain on the research and extension systems. Researchers have to embark on new research as well as consolidate ongoing research. The extension workers also need to expand their horizons in order to use and diffuse the new technologies emanating from research. This includes identifying the needs of their clientele and how best they can be addressed.

Agricultural information services play an important role in the provision and dissemination of information to researchers and extension workers, both in the government and in the private sector. These range from colleges and universities to research libraries and information centres. Various initiatives in information provision were identified in this chapter, including external support programmes like AGORA and TEEAL whose focus is electronic information delivery. Government information services were identified as inferior to those provided by private organisations and universities. The Ministry of Agriculture library faces challenges in meeting the information needs of researchers and extension workers. Researchers and extension workers have to resort to information resources from universities and other special libraries. Extension methods vary depending on the targeted group. One of the aims of this study was to investigate the availability and extent of use of information and communication technologies (ICTs) in government research and extension services because this is important in accessing as well as disseminating information**.**

The chapter has also shown the different information and extension methods used in the dissemination of agricultural information. The media (radio, television and newspapers) plays an active role in disseminating agricultural information, especially to farmers.

Radio and television services disseminate agricultural information and provide an appropriate avenue for extension workers to reach marginalised groups, although very little is offered in minority languages,

The next chapter looks at and conceptualises information behaviour.

CHAPTER THREE

CONCEPTUALISING INFORMATION, INFORMATION NEEDS, INFORMATION SEEKING AND INFORMATION USE

3.1 Introduction

This study sought to investigate the information needs and challenges of agricultural researchers and extension workers in Zimbabwe. This involved identifying the patterns of information seeking and use, and the sources available and how they are used. It also involved looking at potential sources of information that may not be known by the researchers and extension workers and how their availability could help to address their needs. This chapter addresses the concepts of information, information needs, information seeking and information use as outlined in the following objective:

a. To investigate the information needs and information seeking behaviour of agricultural researchers and extension workers in Zimbabwe

The above objective was addressed by answering the following research questions:

i. What are the information needs of agricultural researchers and extension workers in Zimbabwe?

ii. What are the information seeking behaviour patterns of agricultural researchers and extension workers in Zimbabwe?

According to Case (2007:41), "In order to discuss and study a concept, we first need to define it, in the process, we may identify and define other ideas that are related to (and sometimes derived from) the concept under study." In the case of information, 'knowledge', 'data', 'information behaviour', 'information seeking', 'information source' and 'information use' are among the terms that make up the concept of information.

3.2 Defining information

Fox (in Case, 2007:39) observes, "Information seems to be everywhere. We talk of it being encoded in the genes ... disseminated by media of communication ... exchanged in conversations ... contained in all sorts of things ... Libraries are overflowing with it, institutions are bogged down by it ... [yet] no one seems to know exactly what information is." Defining information has not been an easy task. Schrader (in Case, 2007:40) laments the multiplicity of vague, contradictory and sometimes bizarre notions of the term 'information'. Bogdan (in Hjørland, 1997:110) observes that the concept of information has been taken to mean: a measure of physical organisation (or decrease in entropy); a pattern of communication between source and receiver; a form of control and feedback; the probability of a message being transmitted over a communication channel; the content of a cognitive case; the meaning of a linguistic form; and/or the reduction of uncertainty. Hjørland (1997) observes that although these concepts of information are defined in various sciences, such as physics, communication theory, psychology, and so on, there seems to be no unique idea of information upon which these various concepts converge, and hence no proprietary theory of information.

Buckland (in Hjørland, 1997:110) suggests that: "The word information can be used about things, about processes and about knowledge, in which things can be informative, or in similar ways, anything might in some imaginable circumstances be informative." Buckland goes on to present information as: a tangible entity - information is viewed as a thing, as data, document or recorded knowledge; and as an intangible entity, information is viewed as knowledge. Tangible processes include information processing, data processing, document processing, and knowledge engineering. As an intangible entity, information as a process implies becoming informed. Ingwersen and Järvelin (in Tanni and Sormunen, 2008:895) propose that information is what results from the transformation of the author's knowledge structures into information objects, and something which, when perceived and interpreted, affects and transforms the interpreter's state of knowledge. Hjørland (1997:111) emphasizes that "the concept of information implies that informational objects should not be analysed and described only according to an objectivistic epistemology, that is, it is not sufficient to describe information according to universalistic principles, as permanent, inherent characteristics of knowledge". Instead, it (information) must be analysed, described and represented in information systems according to situational, pragmatic and domain specific principles.

Wilson (2006:659) acknowledges the challenges associated with defining information, pointing out that various definitions have been coined seeking to differentiate the concepts of data, information and knowledge, and lately, attempts have been made to single out the concept of information for information science. This Wilson attributes to the failure to appropriately use definitions to the level and purpose of investigations. Wilson (2006:659) thus postulates that the word 'information' is used, in the context of user studies research, to denote a physical entity or phenomenon (as in the case of questions relating to the number of books read in a period of time, the number of journals subscribed to, etc.); the channel of communication through which messages are transmitted (as when we speak of the incidence of oral versus written information); or the factual data, empirically determined and presented in a document or transmitted orally.

Kaniki (2003) addresses the concept of information by also looking at the related concepts of data, information and knowledge and their relationship in what he refers to as the Data Information Knowledge (DIK) pyramid. Kaniki (2003:3) defines data as "observable facts of a situation or the ingredients that make up an event, it is capable of interpretation within a peculiar context, and when contextualised, it is converted into information". Key to this definition is the emphasis on the usefulness of this data in decision making, question answering, and problem solving. According to Vickery and Vickery (in Kaniki, 2003:4), information is peculiar in that when [it] is transferred from source to recipient or seller to buyer, it remains available to both, but does not give the recipient the right of exclusive use although it does allow sharing the information with others, taking into account the various intellectual property rights laws and regulations such as copyrights; patents etc. Within the context of the DIK pyramid, knowledge is held by people and is derived when information is acquired and applied appropriately; it provides the person who has it with the ability, know-how and skills to make judgements and act upon a given problem (Kaniki, 2003:4; Hayes, 1993:5).

Dervin (1983) identifies three types of information regarding information seeking in the Sense Making theory: "Objective, external information is that which describes reality; Subjective, internal information represents our picture or cognitive map of reality; and sense making information reflects the procedures and behaviours that allow us to 'move' between external and internal information."

Wilson (2006) argues that challenges arise when there is a failure to distinguish between 'facts', 'advice', and 'opinion', attributing the multiple use of the term 'information' to researchers' failure to distinguish between these terms. In their study, Ikoja-Odongo and Mostert (2006:146) and Hayes (1993) likewise observe the "colloquial uses" and multiplicity of definitions of information across disciplines and also note the challenges that stem from the interchangeable use of the concepts of data, information and knowledge. McCreadie and Rice (1999:46-48) list four major assumptions about information:

- "Information as commodity/ resource, where information is seen as a physical commodity to be produced, purchased, etc.
- Information as data in the environment, where it is viewed to include readily available data from an individual's environment.
- Information as a representation of knowledge, where information is viewed as a representation of, or pointer to knowledge, in the form of printed documents, i.e. books, journals, etc.,
- Information as part of the communication process, in which meanings are seen to be inherently in people rather than in words. Information is perceived as the process by which an informant's cognitive structures are encoded and transmitted to an information seeker who perceives the coded message, interprets them and learns from them."

Gorry and Scott-Morton (in Ashill and Jobber, 2001:53) conceptualises information in a business environment and divides it into seven categories as follows:

i. Broad scope information: information that is broad in its representation

ii. Timely information: information that is received quickly and on time

iii. Current information: the age of the information and its appropriateness for decision making

iv. Aggregated information: refers to the degree of summarisation, for example the provision of raw marketing data to a variety of aggregations around periods of time and areas of responsibility such as products/ markets

v. Information accuracy: the correctness of the output information to sufficiently satisfy its intended use

vi. Personal information sources, which involves direct contact with other individuals (e.g. face-to-face conversations, telephone conversations, meetings, etc.)

vii. Impersonal information sources describe sources that are written in nature, such as computer generated reports and market research reports

According to Case (2007:40), "the characterisation of information as a difference implies a very broad definition for a common word that has been defined in several distinct ways, with virtually all other definitions implying more restrictions on meaning." Case further explains that various authors have used different words to define the term 'information' by including specific requirements, such as information must always be *true* or *useful,* or it must be *embodied* in a form or object, and that it must be *intentionally* transmitted, etc. However different the definitions of information described above, they all exhibit a convergence of similar terms like data, information and knowledge, and how it is useful in making decisions, judgements and articulating problems or challenges (Meadow and Yuan, 1997; Turner, 2010; Ikoja-Odongo and Mostert, 2006).

3.2.1 Information theories

Mattelart and Mattelart (1998:43) observe that, "The mathematical theory of communication played a crucial role in the transportation of models from the exact sciences to the communication field." The authors trace the development of the theory of communication back to Shannon's 1948 "Mathematical theory of communication" and Weiner's 1948 "Cybernetics or control and communication in the animal and machine". According to Shannon (1948:2), a communication system essentially consists of five parts:

i. *An information source,* which produces a message or sequence of messages to be communicated to the receiving terminal. The messages may be teletype, as in radio or telephone, or a function of time and other variables, as in television, three dimensional sound transmission, etc.

ii. *A transmitter,* which operates on the message in some way to produce a signal suitable for transmission over the channel.

iii. *The channel,* which is the medium used to transmit the signal from transmitter to receiver and may be a pair of wires, a band of radio frequencies, etc.

iv. *The receiver,* which typically performs the opposite operation to that of the transmitter, reconstructing the message from the signal.

v. *The destination,* being the person (or thing) for whom the message is intended.

The adoption of Shannon's communication model transcended disciplines. As explained by Mattelart and Mattelart (1998:43), the social sciences, using Shannon's model, adopted the assumption of the neutrality of the "transmitting" and "receiving" instances. In France, Abraham Moles positioned his theoretical project for "An ecology of communication" [i.e. science of the interaction of different species within a given field] under the banner of both Shannon's Mathematical theory and the analysis of Norbert Wiener.

Shannon's model faced challenges from the Palo Alto, a group of American scholars who argued that the Mathematical theory was for engineers, whereas communication should be studied by social scientists using their own model (Mattelart and Mattelart, 1998). The Palo Alto team tried to account for the overall process of interaction and not merely study a few variables in isolation by developing three hypotheses:

i. The essence of communication resides in relational and interactive processes (the elements themselves are less important than the relationship between elements)

ii. All human behaviour has communicative value (all actions in which people respond to each other or mutually apply each other's ideas, may be seen as part of a vast system of communication)

iii. Psychiatric disorders are a sign of disturbed communication between those who are ill and the people around them

The Palo Alto researchers, Mattelart and Mattelart (1998:52) explain, replaced the notion of isolated communication as a deliberate, conscious verbal act, with the idea of communication as an ongoing, social process involving a number of behavioural modes such as speech, gestures, facial expression, and the physical space between individuals. Benczur (2003) based his theory - "The evolution of human communication and the key effect of dramatic change in communication due to the very fast development of information technology" - on Shannon's information theory.

According to Case (2007:49), Shannon and Weaver's implied definition is useful to a limited extent, and he identifies five issues that present problems when using their (Shannon and Weaver's) theory as follows:

i. "Utility: does information, in order to be information, have to have some kind of effect, some sort of usefulness to humans? In particular, does information reduce uncertainty about something?

ii. Physicality: must information always take on some physical form such as a book, the sound waves of human speech, or a natural object that embodies some kind of data?

iii. Structure or process: must information be structured in some way? That is must it be composed of elements in fixed relations to one another, or in some way consist of a complex "whole" such as an image?

iv. Intentionality: when studying information, is it necessary to assume that someone (or something) intends to communicate it to another entity? Or is some information simply out there in the environment?

v. Truth: must information, in order to be information, be true? Is it proper to call something information if it is demonstrably false?"

3.3 Information needs

Vickery and Vickery (1992:17) provide a general view of information needs, observing that: "The citizen in his/her daily life, from time to time needs to know about the availability, quality, and cost of many things, for example consumer goods and services, health and welfare services, education and training facilities." For the daily running of a household, he/she may need practical information on functionalities like cooking, gardening, house maintenance, etc. Along with these requirements, Vickery and Vickery (1992) observe that the individual will want different types of general information to satisfy intellectual curiosity, and this might be information on current affairs, social and political events, legal matters, and financial matters. In order for these needs to be satisfied, the individual will consult various information sources (newspapers, television, etc.), retrieving information that matches/ addresses the query, depending on the needs (Vickery and Vickery, 1992; Choo, Detlor and Turnbull, 2000). How then do we define needs in the context of information behaviour?

According to Choo, Detlor and Turnbull (2000:3), information needs are frequently thought of in terms of a person's cognitive needs – gaps or anomalies in the state of knowledge or understanding that may be represented by questions or topics. Derr (1983:273) argues that an information need is a condition in which certain information contributes to the achievement of a genuine or legitimate information purpose, and that it [the information need] is a relationship which obtains between information and information purposes. Green (in Case, 2007:69) identifies four general conclusions about the concept of need:

i. A need is always instrumental, i.e. it involves reaching a desired goal, which may be to satisfy individual curiosity, or which may be based on some pre-existing need like passing an exam

ii. Needs are usually contestable, which make them differ from wants

iii. A need is related to the concept of necessity, in such a way as to carry more moral weight to the level of making a distinction between primary and secondary needs

iv. A need is not necessarily a state of mind and it is possible to be unaware of one's true needs

Individuals seek information because they experience a need, which is a feeling of an inadequate state of knowledge, referred to by Belkin (1980:135) as an Anomalous State of Knowledge (ASK). Rosenfeld and Morville (2002:28) observe that information needs can vary widely, and each type of information need causes users to exhibit specific information seeking behaviour. According to Chowdhury (2004:194) and Ikoja-Odongo and Mostert (2006:147), an information need may arise when an individual recognises that his or her current state of knowledge is insufficient to cope with the task at hand, or to resolve conflicts, or to fill a void in some area of knowledge. From an information retrieval perspective, Chowdhury (2004:194) identifies the characteristics of an information need or needs as follows:

i. An information need is a relative concept that depends on numerous factors and does not remain constant but changes over a period of time

ii. Information needs vary from person to person, from job to job, subject to subject, organisation to organisation, etc.

iii. Information needs are largely dependent on the environment, for example the information needs of those in the academic environment may differ from those in business or industry

iv. Information needs often remain unexpressed or are poorly expressed

v. Information needs often change upon the receipt of some information

According to Hjørland (1997:159) and Kaniki (2003), a user's information needs may be influenced by education, economic status, geographical location, availability of information systems and services, awareness of the availability of information systems and services, research, personal role in social life, culture, recreation, or may be professionally oriented, and may be more or less conscious or acknowledged. Devadason and Lingham (1996) provide additional dimensions of influence as the use to which the information will be put and the legal and regulatory systems surrounding the user. Hjørland highlights the need to distinguish between the concept of need and the concept of demand, explaining that while the demand for documents in a library may be low because the library is inaccessible to the user, the user's information needs will exist nevertheless. Gudiksen (in Hjørland, 1997:160) stresses that 'need' should not be viewed statically, but as something that is produced; the goal of an information system should not only be to meet certain needs, but also to make it possible for users to develop their needs. For example, users cannot acknowledge their need for certain documents (subjects) until they are aware of the existence of the documents.

Taylor (1968:182) describes a cognitive approach whereby the information need progresses in a relatively independent fashion inside the head of the user, developing continuously and going through four phases or levels of question formation. These are:

i. Visceral need: is the actual but unexpressed need for information. It may be a simple unclear sort of dissatisfaction, which changes in quality, and concreteness as information is added.

ii. Conscious need or conscious awareness of an ill-defined area or indecision. It is the mental description of the need.

iii. Formalised need: is the formal statement of the need. The individual can form a rational and qualified statement of his question.

iv. Compromised need: a representation of the inquirer's need within the constraints of a system and its files.

Hjørland (1997:165) is critical of Taylor's theory, arguing that the four phases confuse two different things: the development of the knowledge of the primary problem, and the change in the information need as a consequence of this primary development. Hjørland (1997:172) further argues that the formulation of information needs is, "in addition to conceptualisations of the objects under study, based upon realistic or unrealistic assumptions of the structure of the knowledge base that is being searched and upon assumptions of an epistemological nature". Wilson (2006:665), however, is of the view that when we speak of users' information needs, "we should not have in mind a concept of a fundamental, innate, cognitive or emotional need for information, but a concept of information (facts, data, opinion, advice) as a means towards an end of satisfying such fundamental needs."

Information needs have been characterised differently in various studies, but conceptually share a common denominator. Devadason and Lingham (1996) refer to three types of needs: expressed or articulated needs, unexpressed needs, which the user is aware of but does not like to express; and delitescent or dormant needs, which the user is unaware of. Whereas Hjørland (1997) raises issues of subjectivity and objectivity in dealing with information needs, Kebede and Rorissa (2008) argue that there should be a model that captures the essence of the information needs of end-users as a combination of 'content' and 'non-content' needs (e.g. those related to information resources and end-users' skills).

Dervin and Nilan (1986:10-12) reviewed post 1978 literature on information, observing that most studies left the terms 'information needs' and 'information use' undefined, rather implying that by knowing how users use or might use systems, one knows what their needs are or might be. By focusing on what the studies seemed to imply to be evidence of a need, Dervin and Nilan (1986) suggest that it becomes possible to extract six different approaches to 'information needs assessment', and these are:

i. The demand or system/ resource approach

   This measures the extent to which different kinds of sources, media, systems, documents, materials or channels are used.

ii. The awareness approach

   These measurements focus on determining respondent awareness of current services. Need is implied when areas of awareness are deemed lower than they ought to be.

iii. The likes-dislikes approach

These measurements focus on determining the degree to which people are satisfied or dissatisfied with different aspects of a service. Those aspects that satisfy are seen to indicate a need for more service, while those that do not satisfy are usually seen to indicate a need for system improvement.

iv. The priorities approach

In these measurements, respondents are asked to indicate what they would like the information to be like. Activities or characteristics that are highly prioritised point to the need for the development of the service.

v. The community profile approach

In these measurements, demographic and environmental profiles of a community are developed. These profiles are then used to infer programme development needs.

vi. The interests, activities, and group membership approach

In these measurements, respondents are asked to detail their interests, activities and group membership. Extrapolations are then made from the data to infer programme development needs.

Dervin and Nilan (1986:11) have argued that most of these approaches are inhibited by system definitions of what needs are, and they are limited to examining behaviour primarily within the context of user interactions with systems.

Devadason and Lingham (1996) have also argued that "the effectiveness of an information system depends on the extent to which the system's characteristics are in accordance with the user's environment and situation and on how much the potential of the system is willing and able to make use of the services provided in the information system". Likewise, Dervin and Nilan, Devadason and Lingham (1996) call for the careful identification, analysis and classification of the 'real' information needs of users (including all potential users and non users) as an essential basis for the planning, implementation and operation of information systems. They identify some of the challenges of information needs identification as follows:

- The same information is perceived by different users differently as the answer to their information need
- Researchers require original documents whereas planners need digests of points of view or opinions
- Information is put to different uses by different groups of people
- A need is satisfied by having access to the identified information in a particular package, form, and at a suitable time
- The flow of information through channels of communication is complex and adds to the complexity of identifying information needs
- Individual preferences and behavioural aspects add a further dimension

Choo, Detlor and Turnbull (2000:3) suggest that in order to understand and analyse information needs, we need to examine not only cognitive needs, but also affective needs and situational dimensions.

3.4 Information seeking

Kuhlthau (1991:361) describes information seeking as "the user's constructive activity of finding meaning from information in order to extend his or her state of knowledge on a particular topic". In order to understand the context in which people seek information, Kuhlthau (1999:10) argues that it is important to first comprehend the underlying concepts of information seeking as this offers opportunities for developing a foundational theoretical framework which is essential for designing information systems and services that respond to users' needs. Kuhlthau (1999:13-17) identifies the underlying concepts as follows:

a. **Process**. Information seeking is not only about locating sources and finding facts to answer questions and solve problems, but also a complex inquiry process that involves learning from a diverse range of inconsistent and incompatible sources and can have important implications on the way systems and services are designed. Conceptual strategies which may be developed for application in the design of more responsive systems and services include: continuing, charting, composing, collaborating and conversing. These conceptual strategies highlight the constructive process in information seeking.

b. **Constructive process of information seeking**. The concepts involved in this process include: acting and reflecting, feeling and formulating, predicting and choosing, and interpreting and creating. These sequences or stages enable the person to construct/ develop a new understanding based on the information encountered while searching for information.

c. **Uncertainty**. Uncertainty is considered to be a natural, essential characteristic of information seeking (as opposed to the *reduction* of uncertainty as the primary objective of information seeking). It incorporates the user's perspective of information seeking, and can only be considered in context. It is context that reveals the relationship between uncertainty, confidence, uniqueness, redundancy, stance and interest, and their implications on the theoretical framework.

d. **Complexity**. Complexity is essential in understanding the experiences of uncertainty in the information seeking process, the argument being that it is an individual's perception of the complexity of a task that determines his/her experiences of process and degree of uncertainty. Task complexity, which is relatively new, is an important concept for understanding why and when the stages of the information search process are experienced by users in contrast to information seeking which is considered to be a more straightforward source-location and question-answering undertaking.

e. **The concept of enough**. Enough relates to seeking meaning in a quantity of information by determining what one needs to know and by formulating a perspective on which to build. The concept of enough may be applied at every stage of the process, e.g. incorporating the ability to recognise an information need, to explore information on a general topic, to formulate a specific focus, etc.

According to Hjørland (1997:137), the goal of information seeking is to identify potential knowledge, data, information, or raw material that will contribute to the theoretical or empirical development of a field or to the solution of a practical problem. Kingrey (2002) postulates that information seeking serves as an umbrella overarching a set of related concepts and issues that involve the search for, and retrieval, recognition, and application of meaningful content; in other words the content is accessed, used and synthesised into personal knowledge. Kingrey further explains that the search may be explicit or implicit; the retrieval may be the result of specific strategies or serendipity; the resulting information may be embraced or rejected; the entire experience may be carried through to a logical conclusion or aborted in midstream; and there may be a million other potential results. Kingrey (2002: np) thus suggests that information seeking should be viewed as a "cognitive exercise, as a social and cultural exchange, as discrete strategies applied when confronted with uncertainty, and a basic condition of humanity in which individuals exist".

Case (2007:5) describes information seeking as a "conscious effort to acquire information in response to a need or gap in one's knowledge". This observation implies that the individual realises that they have a need which drives them to seek information. Case (2007:80) further observes that most accounts of empirical investigations do not attempt to provide a definition of information seeking, taking it for granted as 'what people do' in response to a need for information. Case, like Wilson (2006), argues that information seeking is more closely related to the concept of 'need' than it is to the concept of information itself. Zerbinos (in Case, 2007:80) observes that, "Information seeking takes place when a person has knowledge stored in long term memory that precipitates an interest in related information as well as the motivation to acquire it." Wilson (1999) highlights the concept of purpose in information seeking - "the purposive search for information" – while Marchionini and Johnson (in Case, 2007:80) propose problem oriented and restrictive approaches in defining the information seeking process, describing it as "a process in which humans purposefully engage in order to change their state of knowledge …" and "as the purposive acquisition of information from selected information sources."

According to Yoon and Nilan (1999:871), information seeking is “a dynamic process of a user making sense that involves cognitive behaviour at the level of individual perception and an associated communicative behaviour at the level of the social context when insight is sought via linguistic means from other sources”. Yoon and Nilan expound that the cognitive behaviour centres on the certainty and uncertainty aspects of a user’s perception in the information seeking situation, which can be described as what the user is aware of knowing and not knowing in a particular ‘need situation’. Certainty is considered to be what the user already knows in relation to his/her information need.

Bates (2003) proposes a four part integrated model of information seeking that conceptualises awareness, monitoring, browsing, and searching, as shown below.

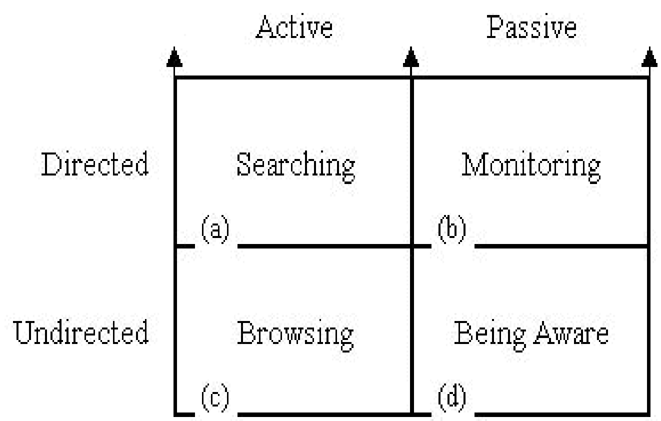

Figure 3.1: Modes of information seeking

Adapted from Bates (2003)

According to Bates (2003: np), awareness is everything we know and comes to us through passive undirected behaviour, as shown in (Figure 3.1, cell d). Monitoring is directed and passive. In monitoring (cell b), Bates suggests that as people, we maintain a back-of-the mind alertness of things that interest us and of answers to questions that we have. We do not feel such a pressing need that we engage in an active effort to gather the information that we are interested in. We may also have a question in mind and not act to find an answer, but notice when information comes along that is relevant to the question. Intentionally or unintentionally, we often arrange our physical and social environment in such a way as to provide the information we need, when we need it. Bates further observes that browsing (cell c) is the complementary opposite of monitoring, and here we have no special information need or interest, but actively expose ourselves to possibly novel information. This involves directed search-active attempts to answer questions or develop our understanding of a particular question or topic. Bates argues that the two passive models of information seeking – awareness and monitoring - almost certainly provide the vast majority of information for most people during their lives. Bates thus concludes that in terms of information seeking, people operate in two general modes, i.e. sampling and selecting (Figure 3.1, cells a & c), or passive absorption (cells b & d). When people know what information they want, they generally either search for it (cell a), or monitor environmental information for it (cell b). When they do not know what they want, they browse (cell c) or remain passively aware (cell d). Thus the natural propensities of human beings are to collect information passively through absorption from the environment, or actively through sampling and selection.

Wilson (2006:660) laments that although the concept of an 'information need' has been commented on by authors since the 60s (Menzel, 1960; Paisley, 1965) and throughout the 70s (Ford reviews, 1977), progress towards some theoretical understanding of the concept has been slow. Wilson acknowledges that this has been partly as a result of the failure to identify the context within which information needs are investigated. Wilson (2006) expresses concern about the definitional problems of 'information need' and the difficulty of separating the concepts of 'wants', 'expressed demand', and 'satisfied demand', among others. Wilson (2006) posits that the "user's life world" can be defined as the totality of experiences centred upon the individual as an information user …and is in contact with a variety of "information systems". The author hypothesises two subsystems of mediator and technology to illustrate the interaction between a living system and the information-searching subsystem. Although it is not comprehensive, the author suggests four possible search paths that:

- Identify search strategies by a user independent of any information system
- Identify search paths involving either a mediator or an information system's technology (manual file, computer file, etc.)

- Identify search strategies employed by a mediator to satisfy a user's demand for information
- Identify strategies employed by a sophisticated technology on behalf of either the user or the computer

Adopting the above search strategies relates more to investigating information seeking behaviour than to the user's need for information. This helps to answer the second challenge in the theoretical understanding of information needs, i.e.: What is intended by information needs research and what is expected of such research? Wilson (in Bawden, 2006:676) identifies three particular challenges in information research which follow the trend towards a more holistic view of information needs and users, as follows:

i. A move towards qualitative research as an alternative or complement to quantitative methods.

ii. A narrowing down of research focus for in-depth studies of well funded groups to determine the underlying factors of behaviour

iii. A widening of conceptual perspectives of user behaviour, going beyond purely 'information concepts' into other areas such as psychology and sociology

The term 'information needs' has, however, been deemed inappropriate to illustrate the process adequately. Kingrey (2002) proposed the term 'information behaviour' which she considers best to describe the relationship between information needs and users. Wilson (2006:664) concedes that it may be advisable to remove the term 'information needs' from our professional vocabulary and speak instead of "information seeking towards the satisfaction of needs". Case (2007:82) considers 'information behaviour' to be better suited to characterising the broad range of human behaviour related to information. Case (2007) suggests that the definitions provided above emphasise purposive activity, which metamorphoses into the term 'information behaviour'. Information behaviour is defined by Wilson (1999:249) as those activities a person may engage in when identifying his or her own needs for information, searching for such information in any way, and using or transferring that information.

3.5 Information seeking behaviour

Fatima and Ahmad (2008:141) conceptualises information seeking behaviour as a broad term that encapsulates a set of actions that an individual takes to express information needs, seek information, evaluate and select information, and finally use this information to satisfy his/her information needs. Majid, Anwar and Eisenschitz (2000:146) define information seeking behaviour as a "broad term encompassing the ways individuals articulate their information needs and seek, evaluate, select, and use the needed information". According to Wilson (1999:251), information seeking behaviour stems from the recognition of some need as perceived by the user, who consequently makes demands on formal systems such as libraries, information centres, online services, or people in order to satisfy the perceived need. Njoku (2004) provides a responsive definition by describing information seeking behaviour as the pattern of response to an information need by a person or group of persons. Njoku (2004:302) points out that information seeking behaviour and use are influenced by the information needs (which are determined by the individual's socio-economic status and their surrounding environment) combined with the goals for which the information is sought, the methods available for meeting the needs, and the information seeker's personality traits (intelligence/creativity, pragmatism/idealism, etc.). Chowdhury (2004) also defines information seeking behaviour as the pattern of using information systems and centres that is dependent on factors closely related to the personal characteristics and traits of users and factors dependent on the information centre and information system concerned.

According to Case (2007:5), information behaviour "encompasses information seeking as well as the totality of other unintentional or passive behaviours (such as glimpsing or encountering information), as well as purposive behaviours that do not involve seeking, such as avoiding information". Timmers and Glas (2009:50) add to this definition, observing that information seeking behaviour is also tied to actions of people in any circumstance for which information is being sought to aid, for example solving economical or technical problems.

According to Talja (2000: np), information seeking behaviour results from a response to an information need, and differences in information seeking behaviour have been explained mainly as follows: i) Differences in the cognitive skills, knowledge states and motivation of individuals, ii) Differences in the educational levels and socio-economic circumstances of social groups, and iii) Differences in the problem situations or subject areas that trigger information seeking.

3.5.1 Information seeking behaviour models

A model may be described as a "framework for thinking about a problem and may evolve into a statement of the relationships among theoretical propositions" (Wilson, 1999:250). The author observes that most models in the general field of information behaviour are of the former variety, i.e. "framework for thinking". They are statements, often in the form of diagrams, which attempt to describe an information-seeking activity, the causes and consequences of that activity, and/or the relationships between stages in information seeking behaviour. According to Morehead and Rouse (1982), a lot of earlier research on information seeking behaviour inclined towards describing human abilities and limitations in information seeking as affected by various task parameters. Aina (2004:11), on the other hand, argues that many models of information seeking have been developed with the aim of improving information access to users.

Fisher, Erdelez and McKechnie (2005) articulated seventy two (72) theories of information behaviour, from Nahl's *Affection Load* to Turnbull's *World Wide Web Information Seeking Behaviour*. The researcher' guide covers well established and proposed conceptual frameworks that one may use to study different aspects of human behaviour. This section details six models of information behaviour. Reference has already been made to the theories and frameworks of Dervin and Nilan (1986), Kuhlthau (1991), Taylor (1968), Bates (2003), and Choo, Detlor and Turnbull (2004), among others.

3.5.1.1 Wilson's Model of Information Behaviour

According to Wilson (1997:552), an analysis of literature on information-seeking behaviour must be based on some general model of what might be called 'information behaviour'. Wilson's Model of Information Behaviour is a variation of Wilson's 1981 model (discussed next) that aims to show the various stages that occur in information seeking behaviour. Wilson (1999:251) posits that information-seeking behaviour begins with a need as perceived by the user, who in order to satisfy that need, makes demands on formal and/or informal information sources or services which ultimately result in success or failure to find relevant information.

Wilson's Model of Information Behaviour

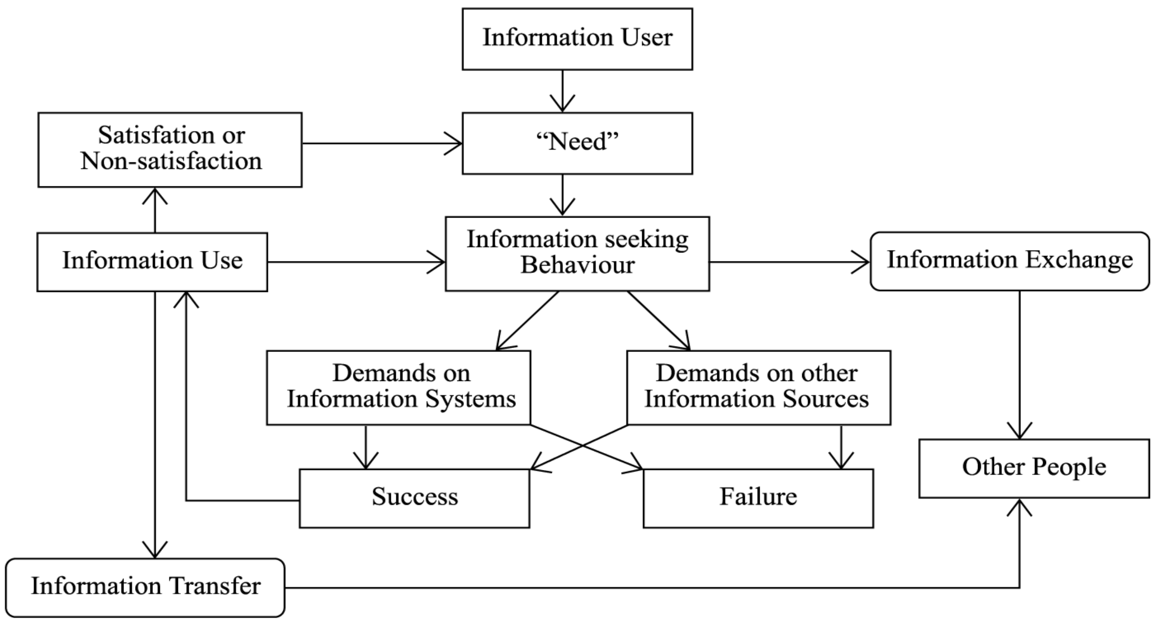

Figure 3.2: Wilson's Model of Information Behaviour

Source: Wilson, T.D. 1999. Information behaviour models. *Journal of Documentation,* 55:3:251

Wilson also shows that part of information seeking behaviour may involve other people through information exchange, and that information that is believed to be useful may be passed to other people as well as being used by the person him/herself.

3.5.1.2 Wilson (1981)

Wilson's 1981 model is based on two propositions: firstly, that an information need is not a primary need but a secondary need that arises from needs of a more basic kind and secondly that in the effort to discover information to satisfy a need, the information seeker is likely to encounter different kinds of challenges/ obstacles (Wilson, 1999:252). Wilson defines basic needs as physiological, cognitive, or affective, and the context of any of these needs may be the person him/herself, their social role, or the surrounding environment (political, economical, technological, etc.). These contexts could also act as obstacles that hamper the information search process.

3.5.1.3 Krikelas (1983)

Krikelas (in Henefer and Fulton, 2005:226) suggests that it is the individual user who defines for himself or herself what information is, but at the same time acknowledges that if one accepts this view of information, research would be left stuck with questions of how one can study the internal processes of an individual who is reducing uncertainty. Krikelas therefore contends that observing information seeking behaviour in isolation will not provide reliable data, but must be accompanied by a clear understanding of the purpose behind the behaviour. Henefer and Fulton (2005:226) and Case (2007:126) observe that in order to accommodate the possible range of reasons affecting information behaviour, Krikelas presents three information activities as the foundation to his model, namely information gathering, information seeking, and information giving. These activities are distinguished by adopting a two-tiered analysis of immediate information needs and differed information needs, where information seeking is seen as a response to what the individual perceives to be an immediate need, and information gathering is seen as a response to a range of needs/ differed needs (Henefer & Fulton, 2005; Ikoja-Odongo and Mostert, 2006).

Zaborowski (2008:17) criticizes Krikelas' model in that while it is a simple, one dimensional flowchart with no single part of the process encompassing the other, other models have demonstrated that information seeking is not a linear process, but one that requires information seekers to gather information, reassess, and seek additional information. Case (2007) argues that Krikelas' model is like a "library search model" and is also more "applicable to information seeking of students or professionals in some work oriented context".

3.5.1.4 Ellis (1989)

Ellis (1989:178) identified a pattern of information behaviour among social scientists that he classified into six generic features (as opposed to stages in other studies) as follows:

i. **Starting**. Typifies stages of the initial search for information, such as identifying references on topics, and may include books, indices and abstracts, online sources, etc.

ii. **Chaining**. This involves tracing (snowballing) references, citations, footnotes, or other forms of referential connection between materials or sources identified during the 'starting' feature. It involves identifying sources that refer to an original source.

iii. **Browsing**. Looking for information in areas of potential interest, e.g. scanning journal tables, references, etc.

iv. **Differentiation**. Using known differences of information sources as a way of filtering the amount of information obtained.

v. **Monitoring**. Keeping track of developments on a given topic or area by following particular sources regularly, e.g. newspapers.

vi. **Extracting.** This involves selectively identifying relevant material from information sources.

Meho and Tibbo (2003:571) propose accessing, networking, verifying, and information managing as additional features to Ellis' model. Wilson (1999) acknowledges that the strength of Ellis' model, as with Kuhlthau's, is based on empirical evidence from subsequent studies.

3.5.1.5 Kuhlthau (1991)

According to Kuhlthau (1991:361), the Information Search Process (ISP) model, "delves on the user's constructive activity of finding meaning from information in order to extend his or her state of knowledge on a particular problem or topic, and incorporates three realms: the affective (feelings), the cognitive (thoughts), and the physical (actions)". These realms manifest in each of the six stages of the ISP model. Kuhlthau (1999:366-368) typifies the six stages of the ISP as follows:

a. **Initiation**. This involves initial awareness of a lack of knowledge or understanding, coupled with feelings of uncertainty and incomprehension. The task at this stage is to merely recognise or identify the need for information.

b. **Selection**. The task is to identify and select the general topic to be investigated or the approach to be pursued. Feelings of uncertainty give way to optimism.

c. **Exploration** is characterised by feelings of confusion, uncertainty and doubt, which tend to increase with time. The task is to investigate information on a general topic in order to extend personal understanding.

d. **Formulation** is the turning point of the ISP when feelings of uncertainty diminish and confidence increases. The task is to develop a focus from the information encountered.

e. **Collection**. This is the stage at which interaction between the user and the information system functions most effectively and efficiently. The task is to gather information related to the topic of interest.

f. **Presentation**. A successful search brings relief and a sense of satisfaction and disappointment if no positive results are yielded.

According to Kuhlthau (1991:369), the model of the ISP provides an articulation of users' common experiences, which when shared by the user, the intermediary and the system, may provide a basis for interaction.

3.5.1.6 Dervin's Sense Making theory

According to Dervin (1998), the founding concepts of the Sense Making theory are time, space, movement, gaps, step-taking, situation, bridge, and outcome. Dervin (1983) posits that the core premises of sense making rests on two assumptions, firstly that "reality is neither complete nor constant but rather filled with fundamental and pervasive discontinuities or gaps" and secondly, that "information is not a thing that exists independent of and external to human beings but rather is a product of human observing". Dervin (1983) further observes that constraints to human observing are in four fold: the limitations on human physiology, the limitation of present time-space, the limitation of past time-space, and the limitation of future time-space. To this effect, Dervin (1983) concludes that "information seeking and use are posited as "constructing" activities--as personal creating of sense".

Wilson (1999) divides sense-making into four constituent elements:

- Time and space, which define the context in which information problems arise;

- A gap which identifies the difference between the contextual situation and the desired situation (e.g. uncertainty);
- An outcome, the result of a sense making process; and
- A bridge, which helps to close the gap between the situation and the outcome.

According to Case (2007:75), in the Sense Making theory, a search for information begins with questions directed at making sense of the situation; communication is central to the process of 'bridging the gap' to reach some kind of information or the desired help. The strategies employed are determined by the information seeker's conceptualization of both the gap and the bridge, and the answers, ideas, and resources obtained along the way. Wilson (1999) notes that the strength of Dervin's model lies partly in its methodological consequences, since in relation to information behaviour, it can lead to a pattern of questioning that can reveal the nature of a problem and the extent to which information serves to bridge the gap between uncertainty and confusion.

3.6 Information use

According to Choo, Detlor and Turnbull (2000:14) and Savolainen (2009:187), information use occurs when the recipient [of information] processes the information by engaging mental schemas and emotional responses within a larger social and cultural context, and the outcome is a change in the individual's state of knowledge (increased awareness, understanding of a situation), or capacity to act (solve a problem, make a decision, negotiate a position). Taylor (in Choo, Detlor and Turnbull, 2000:15-16) observes that the ways in which people use information may be summarized in just eight categories which are not mutually exclusive, so information used in one category may also address the needs of other categories. These are:

i. "**Enlightenment**: information is used to develop a context or to make sense of a situation, is used to answer questions like 'What are they? Are there similar situations?' etc.

ii. **Problem understanding**: information is used in a more specific way in developing a better comprehension of a particular problem

iii. **Instrumental**: information is used so that the individual knows what to do and how to do something; for example instruction is a common form of instrumental information

iv. **Factual**: information is used to determine the facts of a phenomenon or event to describe reality and its use is likely to depend on the actual and perceived quality (accuracy, reliability) of the information that is available

v. **Confirmational**: information is used to verify another piece of information and its use often involves the seeking of a second opinion

vi. **Projective**: information is used to predict what is likely to happen in future and takes the form of forecasts, estimates, and probabilities

vii. **Motivational**: information is used to initiate or sustain personal involvement in order to keep moving along in a particular course of action

viii. **Personal or political**: information is used to develop relationships; enhance status, reputation, and personal fulfilment."

Savolainen (2009:187) contends that information use is a generic concept that is frequently used but rarely explained in literature. Together with related expressions, these concepts tend to be employed as popular terms that generally refer to the ways in which people prefer and access information sources of various types. Savolainen (2009) sought to explain the process of information use by comparing the conceptualizations provided by the constructivists and the human information processing approach. The comparison bordered on major constituents of information use, phases of information use, and strategies of information use. Savolainen (2009) established that both approaches share the assumption that interpreting, relating, and comparing qualities of things are fundamental to the information use process.

The tripartite model of information in Figure 3.3 is concerned with the cognitive, affective, and situational dimensions.

Information Use Model

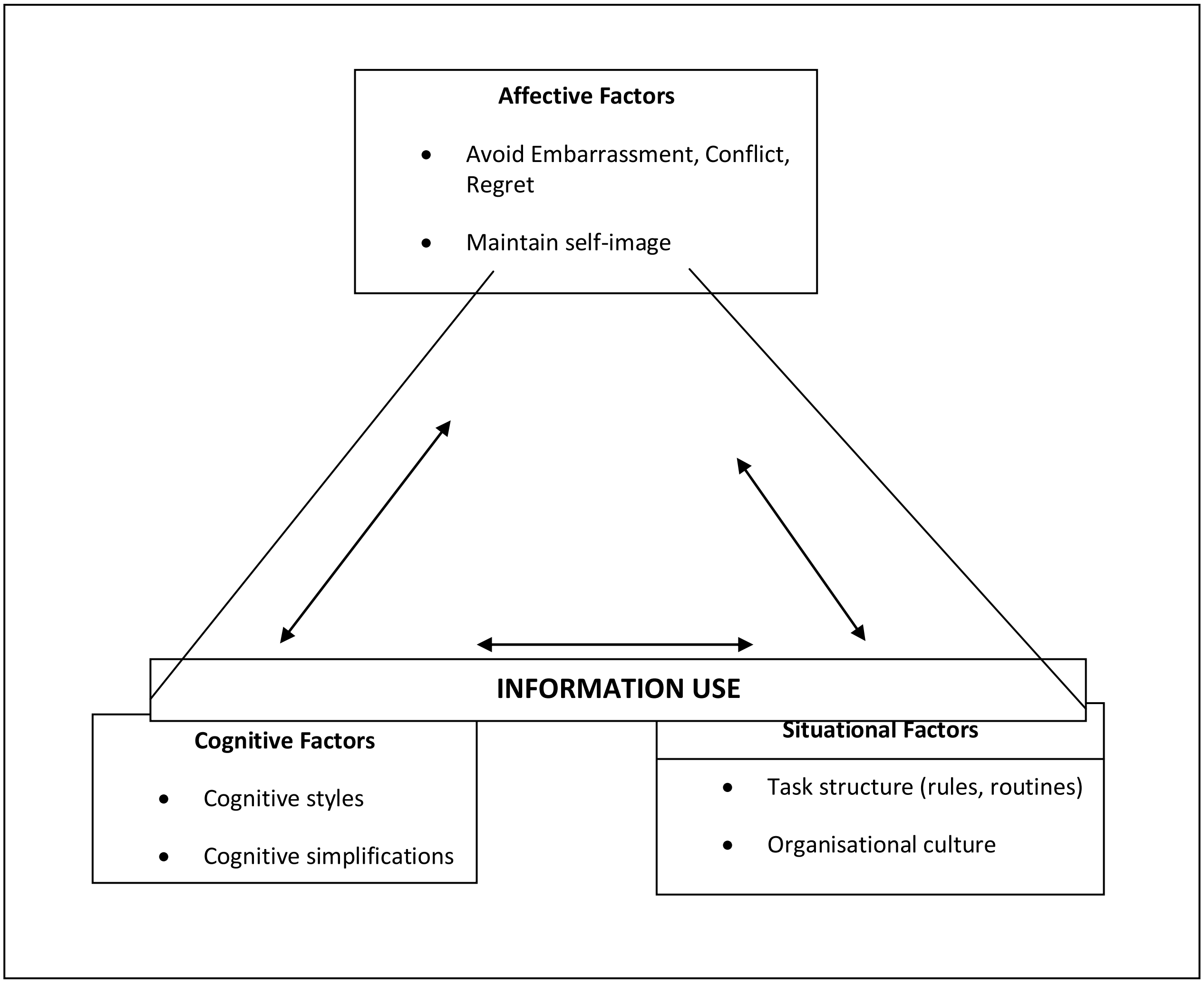

Figure 3.3 Tripartite model of information

Adapted from Choo, Detlor and Turnbull (2004)

Choo, Detlor and Turnbull (2004:16-21) explain the dimensions as follows:

a. ***Cognitive dimension***. At this level, the manner in which information is processed and utilised is influenced by an individual's cognitive style and preferences: "Personality types are analysed based on four pairs of traits which are: introversion versus extraversion, sensing versus intuition, thinking versus feeling, and judging versus perceiving."

b. ***Affective dimension***. Information is used selectively to avoid embarrassment, conflict or regret; maintain self image and enhance personal status or reputation, e.g. people avoid using information that arouses strong, negative emotions in others or themselves.

c. ***Situational dimension***. "Information use is determined by the extent to which rules and routines structure the task in which the information is utilised, for example, records and research policies define what information is documented and archived; information-handling rules define how information is to be routed and filtered; and planning rules define how information is used to decide about resource allocation, among other examples." Choo, Detlor and Turnbull (2004)

3.7 Concepts in relation to the study

This chapter elucidated the concepts of information, information needs, information seeking and information use, which are central to this study on the information needs of researchers and extension workers in Zimbabwe.

Beginning with the concept of information, the current study adopts the assumptions by MaCreadie and Rice (1999) and is cognizant of the ideas expressed by Wilson (2006), Dervin (in Case, 2007), Kaniki (2003), and Gory and Scott-Morton (2001) in their definitions of information and in the need to distinguish between different types of information.

MaCreadie and Rice (1999) view information as a product that is generated, distributed, purchased or sold and available in some format, whether in the form of print in books or journals, or in electronic format. Agricultural information is derived from both formal (research institutes and the extension system) and informal sources (public gatherings, colleagues and other indigenous derivations). Gorry and Scott-Morton (in Ashill and Jobber, 2001:53) stress the timeliness of information; information must be received quickly and on time if it is to be relevant to the recipient. This is relevant to this study given the scientific nature of agricultural information. It was observed earlier that farmers raised concerns about the inadequacy of the extension system in meeting their information needs on time.

Literature has shown that information needs can be examined from a cognitive, affective or situational perspective, with varying characteristics. The need begins within the individual, prompting him or her to consult information systems or individuals, which may result in success or failure. Belkin (1980) explains that individuals seek information because they experience a feeling of an inadequate state of knowledge. Researchers and extension workers have varying needs depending on their clientele and personal requirements, and they will consult different sources in order to fulfil their information needs. Chowdhury (2004:194) explains that information needs change with time and vary from person to person and from job to job and are largely dependent on the environment. This study sought to investigate, among other issues, the impact of the changing nature of agriculture (for example the land reform programme) and its impact on the work of researchers and extension workers.

Majid, Anwar & Eisenschitz (2000) identified knowledge about information needs and information seeking behaviour as crucial in helping scientists to effectively meet their information needs. Majid, Anwar & Eisenschitz (2000) also found that many studies have suggested that scientists rely heavily on informal and interpersonal information channels besides formal information communication sources. The authors observed that colleagues were preferred over other channels of information because they are considered to be familiar, reliable, and immediately accessible (proximity of source). Nair and Francis (1996:122) observe that the type of information and data required by users of an agricultural library and information system varies greatly according to the types of users and their horizon of activity. Researchers and extension workers require information for personal, work, and other purposes, and consult various sources of information, including colleagues. Extension workers' information needs and information seeking behaviour patterns reflect a professional orientation - whatever helps them do their job better. At the same time, it mirrors the needs of the clientele, i.e. farmers.

Information is communicated through some form of media, such as the radio, television, the internet, print sources like newspapers, etc. These sources, as discussed in Chapter two, are among the channels used to disseminate agricultural information to farmers. Personal information sources, such as face-to-face conversations, meetings, public gatherings and field days, also provide channels for generating as well as disseminating information, including agricultural information (Pazvakavambwa and Hakutangwi, 2006; Gorry and Scott-Morton in Ashill and Jobber, 2001; MaCreadie and Rice, 1999).

The information seeking behaviour models that were discussed in this chapter have demonstrated the various patterns and strategies that people apply in the information seeking process. The theories assume some level of literacy, either consciously or subconsciously, on the part of the person seeking information as demonstrated in the stages involved. While Bates (2003) and Kingrey (2002) focus on the concepts of searching, browsing and retrieval, Wilson (2006) highlights search strategies within an information system, whether manual or computerised. The models emphasise the importance of seeking information in response to a challenge or the need to solve a problem. Wilson (1999) points out that this places demand on formal information systems such as libraries, information centres and online services. Ellis' (1989) model is specific in that it highlights the features of a search process using defined information resources that are common to researchers and extension workers; colleagues, catalogues, indices and abstracts, citations, and browsing online are some of the sources and techniques that may be used. Ellis also highlights the importance of being kept up to date in a particular area by following particular sources, which in libraries may be achieved through the provision of selective dissemination of information (SDI) services.

Dervin (1998) highlights the importance of time and space as defining the context in which information problems arise. Krikelas' (1983) model is taunted as a "library search model", although like the other models, it does not mention assisted information retrieval – expert help (e.g. librarians). This is unusual considering that the information seeker may not be an expert and may therefore require assistance from experts in a given field. The models have also shown that although information seeking does not always yield positive results, the ultimate goal in the information seeking process is that the outcome changes the individual's state of knowledge through increased awareness and a better understanding of the situation (Taylor in Choo, Detlor and Turnbull, 2000).

3.8 Summary

This chapter discussed the concepts of information, information needs, information seeking and information use, and showed how they collectively fall within the nested model of information behaviour. Different models of information behaviour were explained to demonstrate the varying patterns of information seeking and use, with Wilson's Information Behaviour model (Figure 3.2) being favoured for this research. Wilson (1999) observes that models of information behaviour do not all attempt to describe the same set of phenomena or activities, and are complementary rather than in competition. The complementary role of the models demonstrates that information is relative and is sought by different people depending on circumstances, context, and the purpose for which the information is sought. The relationship between the concepts and the current study has also been shown, specifically how the information needs and information seeking behaviour of extension workers and researchers are affected by personal, work, and other environmental factors.

The next chapter presents the diffusion of innovation theory as applied in the study.

CHAPTER FOUR

DIFFUSION OF INNOVATION THEORY

4.1 Introduction

Asopa and Beye (1997:29) define agricultural development as a dynamic development process that implies a shift from traditional methods of production to new, scientific methods of production. This may involve new technological components, new crops, and/or even new farming systems. However, Asopa and Beye (1997) note that in order for farmers to adopt these new production technologies successfully, they must first learn about them and how to use them correctly. This chapter addresses agricultural research-extension systems/ linkages by looking at the communication and diffusion of agricultural innovations based on the theoretical framework of the Social Interaction model. The chapter seeks to address the following research objectives:

b. To examine the role played by agricultural researchers and extension workers in communicating agricultural information to the farmers;

d. To assess the role of agricultural researchers and extension stakeholders as potential uptake/dissemination pathways for agricultural technologies;

The chapter attempts to answer the following research questions:

i. What role do researchers and extension workers play in the dissemination of agricultural information to farmers?

ii. What means and processes are in place for managing information generated by the Ministry of Agriculture, Mechanisation and Irrigation Development's research and extension divisions and research institutes?

iii. What is the level of ICT development within the Ministry of Agriculture, Mechanisation and Irrigation Development's research and extension divisions and research institutes, and what is the impact on the generation and dissemination of agricultural information among researchers and extension workers?

iv. What is the significance of stakeholders' collaboration with the Ministry of Agriculture, Mechanisation and Irrigation Development's research and extension system, and what role do stakeholders play in the generation and dissemination of agricultural information?

Key issues emerging from the research questions include the generation and dissemination of technologies, and the impact of information and communication technologies and stakeholders on this process.

4.2 Models of research-extension linkage

Agricultural research findings are of little use if they are not adopted by farmers. Unfortunately, the only outcome of most research is an interesting article in a scientific journal or report which goes no further than library shelves because there is no effective research extension system or linkage in place (van den Ban and Hawkins, 1999:31). Havelock (in van den Ban and Hawkins, 1999:31-32) developed three models which are useful in analysing research-extension linkages. These are:

i. **The Research, Development and Diffusion model**. This model is often used in industry and involves four components, namely basic research, applied research, development, and diffusion.

ii. **The Social Interaction model**. This model stresses the diffusion of innovations and shows the importance of mass media in creating awareness. It assumes that innovations have been developed that may be profitable to large numbers of people. Research among farmers has played an important role in the development of this model. The role of extension in this model is to diffuse research findings among farmers with extension agents acting as experts who teach farmers new knowledge.

iii. **The Problem Solving model**. This model begins with the person with the problem rather than with research or innovation. The major role of this model is to help farmers clarify or identify exactly what their problem is and to find or develop the information required to solve it. Extension agents act more as guides and mentors who help farmers decide which way they would like to go.

This study adopts the Social Interaction model because of its applicability and appropriateness in enunciating the research extension linkage process. The diffusion of innovations is modelled on Rogers' Diffusion of Innovations theory. The communication and diffusion of new innovations is central to this study, and the model has been applied in related research. According to Asopa and Beye (1997:33), evolving new agricultural technology and its quick dissemination requires a series of integrated and communicating networked systems among concerned agencies. This requires three sub-systems:

i. A research system, responsible for generating and evolving new agricultural technology and innovations;

ii. A linking (extension) system, responsible for the transfer of new technology, facilitating the adoption of technology, and also reporting problems on the field to the research system (feedback); and

iii. The client system (farmers), the ultimate users of the technology.

4.3 Diffusion of Innovations theory: A background introduction

Rogers (1983:38) observes that "for several decades, research into the diffusion of innovations occurred in a series of independent intellectual enclaves, and each of the disciplinary cliques of diffusion researchers studied a different kind of innovation." For example, rural sociologists investigated the diffusion of agricultural innovations among farmers, while educational researchers studied the spread of new teaching ideas among school personnel. According to Wejnert (2002), although the study of diffusion of innovations began with Tarde's 1903 book, "The Law of Limitation", a more concerted development of this approach did not occur until forty years later when Ryan and Gross (1943) published results on the spread of hybrid corn use among Iowa farmers. Wejnert (2002) observes that since that study's publication, more than 4000 research papers have appeared on the diffusion of diverse innovations, such as agricultural practices, technologies, policy innovations and political reforms.

Rogers (1983:39) explains that by the mid-1960s, there was a trend towards collapsing the "paper curtains" between the diffusion research traditions, in other words a move towards a more unified and cross-disciplinary approach to diffusion research. According to Rogers, every diffusion scholar was fully aware of the parallel methodologies and results in other traditions by 1968, as evidenced in the computed index of cross tradition citations in each diffusion publication. Rogers (1983) identifies nine major diffusion research traditions, the oldest being anthropological diffusion. The others include: early sociology, rural sociology, education, public health and medical sociology, communication, marketing, geography, and general sociology. From these traditions, eight main types of diffusion research emerged as follows:

- Earliness of knowing about innovations
- Rate of adoption of different innovations in a social system
- Innovativeness
- Opinion leadership
- Who interacts with whom in diffusion networks
- Rate of adoption in different social systems
- Communication/ channel usage
- Consequences of the innovation

These form the basic components of this study and will be dealt with in relation to aspects of research extension linkage. Rogers (1983) and Wejnert (2002) conclude that all diffusion research traditions have now intellectually merged towards one invisible college, although diffusion studies are still conducted by scholars in a number of different disciplines.

4.4 Diffusion and adoption processes

Diffusion is the process by which an innovation is communicated through certain channels over time among members of a social system. It is a special type of communication where the messages are concerned with new ideas. It is the newness of the idea in the message content of communication that infuses diffusion with its special character (Rogers, 1983:5-6). Communication is viewed as the process through which people exchange meaning, for example, through the use of information (Leeuwis, 2004:27). Based on this definition, Rogers (1983:5) explains that communication is a process of convergence (or divergence) as two or more individuals exchange information in order to move towards each other (or apart) in the meanings that they ascribe to events. Diffusion of innovations refers to the spread of abstract ideas and concepts, technical information, and actual practices or objects within a social system, where the spread signifies the flow or movement from a source to an adopter, typically through communication and influence (Rogers, 1983). It is a social process via which subjectively perceived information about a new idea is communicated.

The diffusion of an innovation within a social system takes place through its adoption by individuals or groups. Adoption is the decision to make full use of an innovation as the best available course of action. An innovation diffuses within a social system through its adoption by members or groups, and the decision to adopt an innovation is in itself a process. Thus, the adoption process is a decision making process that goes through a number of cognitive stages before the individual can make the final decision to adopt an innovation (Rogers, 1983; van den Ban and Hawkins, 1996).

4.5 Four main elements in the Diffusion of Innovations theory

Rogers (1983) identifies four main elements in his Diffusion of Innovations theory, namely innovations, communication channels, time, and social systems.

4.5.1 Innovations

An innovation is an idea, method or object which is regarded as new by an individual or other unit of adoption, but which is not always a recent development or phenomenon. The perceived newness of the idea or innovation to the individual determines his or her reaction to it (van den Ban and Hawkins, 1996; Rogers, 1983). Van den Ban and Hawkins (1996) observe that a number of studies have analysed the relationship between characteristics of an innovation in production technology and its rate of adoption, mostly by using more or less objective judges or simply assuming that characteristics are perceived the same way. Greenhalgh (2005:83) notes that the attributes of innovations that influence adoption by individuals were of central concern to early sociologists. Greenhalgh (2005) and Rogers (1983) identify five characteristics of an innovation, namely relative advantage, compatibility, complexity, trialability, and observability.

4.5.1.1 Relative advantage

Rogers (1983) explains relative advantage to be the degree to which an innovation is perceived to be better that the idea it supersedes, noting that the greater the perceived relative advantage of an innovation, the more rapid its rate of adoption is going to be.

4.5.1.2 Compatibility

Rogers (1983) defines compatibility as the degree to which an innovation is perceived to be consistent with existing values, past experiences, and the current needs of potential adopters. The author notes that an idea that is not compatible with the prevailing values and norms of a social system will not be adopted as rapidly as an innovation that is compatible.

4.5.1.3 Complexity

Complexity is the degree to which an innovation is perceived to be difficult to understand and use (Rogers, 1983:15). The author observes that some innovations are readily understood by most members of a social system (e.g. the mobile phone), while others are more complicated and will be adopted more slowly (e.g. the computer).

4.5.1.4 Trialability

Trialability is the degree to which an innovation may be tried out or experimented with on a limited basis. New ideas that can be tried in the instalment plan will generally be adopted more quickly than innovations that are not divisible (Rogers, 1983:15). The author also observes that an innovation that can be tried out represents less uncertainty to individuals who are considering it for adoption.

4.5.1.5 Observabilty

Rogers (1983) defines observability as the degree to which the results of an innovation are visible to others. He observes that the easier it is for individuals to see the results of an innovation, the more likely they are to adopt.

4.5.2 Communication channels

Rogers (1983) defines communication as how participants create and share information with one another in order to reach a mutual understanding. He observes that the essence of the diffusion process is the exchange of information, which is when an individual communicates a new idea to another individual or group, and this process also involves the communication channel connecting the two units. Rogers (1983) explains that a communication channel is the means by which a message is conveyed from one individual to another. It greatly influences the conditions under which a source will or will not transmit an innovation to the recipient, and the effects of the transfer. He observes that mass media channels such as the radio, television and newspapers are often the most rapid and efficient means via which to inform an audience or potential adopters about the existence of an innovation. Leeuwis (2004:189) also articulates that through conventional mass media (e.g. newspapers, journals, leaflets, radio and television), a sender can reach many people from afar. However, interpersonal communication is considered more effective in persuading individuals to accept a new idea because of its interactive nature (face-to-face contact, group meetings, and so on) (Rogers, 1983; Leeuwis, 2004).

According to Rogers (1983:18), the results from most diffusion studies suggest that most individuals do not evaluate an innovation on the basis of scientific studies, although such objective evaluations are not entirely relevant. Instead, most people depend on the subjective evaluation of an innovation that is conveyed to them by others in close proximity who will have adopted the innovation. The dependence on the experience of peers, according to Rogers, points to the fact that more effective communication occurs when two or more individuals belong to the same group, live or work near each other, and share the same interests, also referred to as 'homophiles'. He notes that when they share common meanings, a mutual language (through culture or subculture), and are alike in personal and social characteristics, then the communication of new ideas is likely to have greater effects in terms of knowledge gain, attitude formation, and changes in overt behaviour. However, Rogers (1983) notes that one of the most distinctive problems in the communication of innovations is that the participants are usually quite heterophilous, i.e. a change agent for instance, is usually more technically competent than his clients.

4.5.3 Time

Rogers (1983) observes that time is an important element in the diffusion process and is involved in three ways: in the innovation-decision process, in the innovativeness of an individual, and in the innovation's rate of adoption.

4.5.3.1 The innovation-decision process

The innovation-decision process describes the stages through which an individual or other decision making unit passes from first knowledge of an innovation, to forming an attitude towards the innovation, to a decision to reject or adopt the innovation, to the implementation of the new idea and confirmation of this process. Van den Ban and Hawkins (1996) observe that these stages resemble the stages in the Normative Decision Making model that is often used to analyse the adoption process, i.e.: i) Awareness, ii) Interest, iii) Evaluation, iv) Trial, and v) Adoption. Rogers proposes different stages in the innovation-decision process:

a. Knowledge: occurs when an individual or the decision making unit is exposed to the existence of an innovation and gains some understanding of how it works

b. Persuasion: occurs when an individual or the decision making unit forms a favourable or unfavourable attitude towards an innovation

c. Decision: occurs when an individual or the decision making unit engages in activities that lead to the adoption or rejection of an innovation

d. Implementation: occurs when an individual or the decision making unit puts an innovation into use. Re-invention is most likely to occur at this stage

e. Confirmation: occurs when an individual or the decision making unit seeks reinforcement of an innovation-decision that has already been made, with the possibility of reversing earlier adopted decisions if exposed to conflicting messages about the innovation

f. Discontinuance: is a decision to reject an innovation after it had previously been adopted and may occur due to dissatisfaction with an innovation, or because an innovation has been superseded by an improved idea. This stage takes place during the confirmation phase

Rogers (1983) asserts that the innovation-decision process is an information-seeking and information-processing activity during which an individual obtains information in order to decrease uncertainty about the innovation.

4.5.3.2 Innovativeness and adopter categories

The second way in which time is involved in the diffusion process is the innovativeness of an individual or other unit of adoption. Rogers (1983) defines innovativeness as the degree to which an individual or other unit of adoption is relatively faster in adopting new ideas than other members of a system. An important finding from adoption research, as observed by Leeuwis (2004:131), is that innovations are not adopted by everyone at the same time or rate. Particular innovations are assimilated quickly by some and only taken up later by others, while some individuals never adopt them. More importantly, Leeuwis points to the pattern in adoption research with respect to the rate at which people adopt innovations; based on certain criteria, some individuals adopt early while others adopt late. In their research, Rogers (1983) and Leeuwis (2004) that adoption researchers typically classify people into five adopter categories, i.e. i) Innovators, ii) Early adopters, iii) Early majority, iv) Late majority, and v) Laggards.

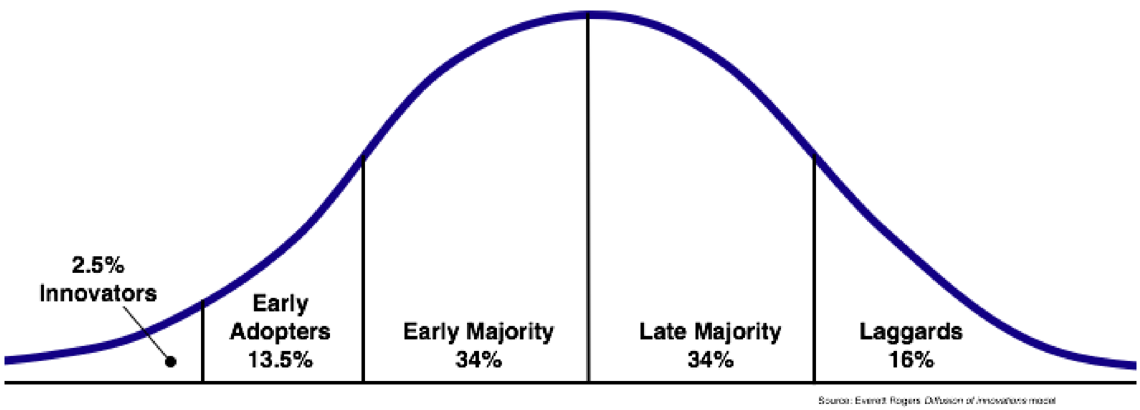

Figure 4.1: Rogers' adopter categories

Adapted from Rogers (1983), sourced from Wikimedia

Leeuwis (2004:131) explains that the percentages in Figure 4.1 above represent a standardised average of the percentages found in different studies.

4.5.3.2.1 Innovators: Venturesome

According to Rogers (1983:248), innovators are considered to be venturesome and eager to try new ideas. This leads them out of a local circle of peer networks into more cosmopolite social relationships. He observes that communication patterns and friendships in a circle of innovators are common, regardless of the distance between them. Innovators have other traits or prerequisites which may include the control of substantial financial resources to buffer against possible losses, and the ability to understand and apply complex technical knowledge. According to Rogers (1983), while an innovator may not command respect from other members of a social system, he/she plays an important role in the diffusion process by being the first to adopt a new idea from 'outside' the system. There are usually only a handful of innovators in any given social system.

4.5.3.2.2 Early adopters: Respectable

Rogers (1983) observes that early adopters are 'localites', in other words they are a more integrated part of the social system and have the greatest degree of opinion leadership in most social systems. Potential adopters 'check with' and look at early adopters for advice and information before using an innovation. Rogers explains that this adopter category is generally sought by change agents as a local missionary for speeding up the diffusion process. Due to the narrow gap between them and the average individual in terms of innovativeness, they serve as role models for other members of the social system. They are respected by their peers, and are the embodiment of the successful and discrete use of new ideas (Rogers, 1983:249). He observes that the role of early adopters is to decrease uncertainty about a new idea by adopting it and to convey a subjective opinion to peers who are in close proximity through interpersonal networks.

4.5.3.2.3 Early majority: Deliberate

The early majority adopts new ideas just before the average member of a social system. Individuals that fall into this group interact frequently with their peers but rarely hold leadership positions (Rogers, 1983). Rogers observes that their unique position between the very early and the relatively late adopters makes them an important link in the diffusion process. This category of adopters may deliberate for some time before completely adopting an innovation; hence their innovation decision period is relatively longer than those of innovators and early adopters.

4.5.3.2.4 Late majority: Sceptical

This group adopts new ideas just after the average members of a social system (Rogers, 1983:249). Adoption by this group may be the result of peer pressure (which is necessary to motivate adoption) or economic necessity. Rogers notes that innovations are approached with a sceptical and cautious attitude; the late majority does not adopt an innovation until most others in their social system have done so.

4.5.3.2.5 Laggards: Traditional

Laggards are the last in the social system to adopt an innovation and possess almost no opinion leadership (Rogers, 1983). Leeuwis (2004:134) observes that from the outset, use of the term 'laggard' expressed and/or reinforced the idea among researchers and change agents that individuals are somehow to blame for non-adoption due to their assumed 'resistance to change' or conservatism. Rogers (1983) explains that the point of reference for the laggard is the past, and decisions are often based on what has been done in previous generations, with individuals interacting with others who hold the same traditional values. Rogers also observes that when laggards finally adopt an innovation, it may already have been superseded by a more recent idea that is already being used by the innovators.

4.5.3.3 Rate of adoption

Rogers (1983) postulates that the rate of adoption is the third way in which the time dimension is involved in the diffusion of innovations. He defines the rate of adoption as the relative speed at which an innovation is taken up by members of a social system. Rogers observes that when the number of individuals adopting a new idea is plotted on a cumulative frequency basis over time, the resulting distribution is an S-shaped curve (see Figure 4.2).

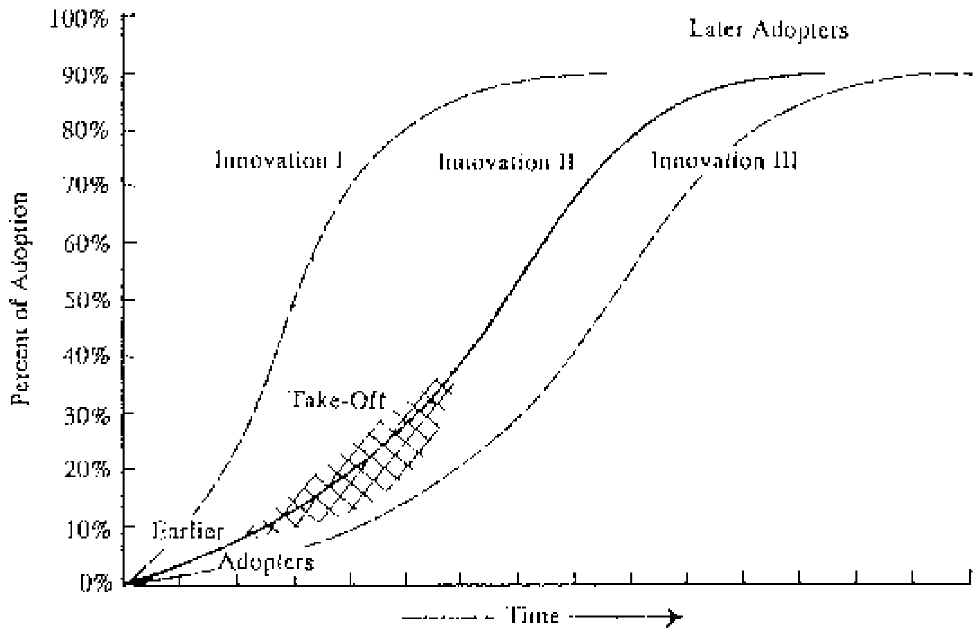

Figure 4.2: Rate of adoption

Diffusion is the process by which (1) an **Innovation** is (2) **Communicated** through certain **Channels** (3) over **Time** (4) among the members of a **Social System**
Adapted from Rogers (1995)

Rogers explains that at first, only a few individuals adopt the innovation in each time frame (year or month), i.e., the innovators. The diffusion curve begins to climb as more and more individuals adopt the innovation until saturation, signifying the end of the diffusion process. According to Rogers (1983:23), most innovations have an S-shaped rate of adoption; differences arise in the rate of adoption of the same innovation in different social systems.

4.5.4 Social system

The social system is the fourth main element in the diffusion of innovations. Rogers (1983:24) defines a social system as a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. He observes that the members or units of a social system may be individuals, informal groups, organizations and/or subsystems, with each unit in the system being distinct from other units. Rogers stresses the point that diffusion occurs within a social system and that the social structure affects diffusion in a number of ways. This leads to questions about how the structure affects diffusion, the effect of norms and diffusion, the role of opinion leaders and change agents, types of innovation decisions, and the consequences/ outcomes of the innovation, briefly discussed below.

4.5.4.1 Social structure and diffusion

Rogers (1983) defines structure as the patterned arrangement of units in a system. Structure helps to regularise and stabilise human behaviour in a social system, allowing one to predict behaviour and thereby decrease uncertainty. The hierarchical structure, which dictates from the top down to lower ranks, is an example. Besides formal structure, Rogers identifies informal structure which links system members (peers, groups) and determines who interacts with whom and under what circumstances. He further observes that the structure of a social system can facilitate or impede the diffusion of an innovation in a system, with individual innovativeness being affected by both individual characteristics and the nature of the social system to which the individual belongs.

4.5.4.2 System norms and diffusion

Norms are the established behavioural patterns of members of a social system. They define acceptable behaviour and serve as guides or standards for members of a social system (Rogers, 1983). The author observes that a system's norms can be a barrier to change and can operate at the level of a nation, religious community, an organization, or a local system such as a village.

4.5.4.3 Opinion leaders and change agents

Rogers (1983) posits that the most innovative member of a social system is often perceived to be a deviant and is accorded low status; hence his/her role in the diffusion process (especially persuading others about an innovation) is often limited. Leeuwis (2004:133), on the other hand, observes that there are opinion leaders who may stimulate or provide information and advice about innovations to many in the system. Opinion leadership is thus defined as the degree to which an individual is able to influence other individuals' attitudes and behaviour; it is earned and maintained by the individual's technical competence, social accessibility, and conformity to prevailing social norms (Rogers, 1983:28). He observes that opinion leaders are more exposed to all forms of external communication, are more cosmopolite, have a higher social status, are more innovative, and are at the centre of interpersonal communication networks. Rogers (1983:270) argues that in order to understand the nature of opinion leadership, it is important to be cognisant of the following factors: the various models of mass communication flow, such as the two-step flow; how homophily-heterophily affects the flow of communication; measures of opinion leaders; and characteristics of opinion leaders.

Katz and Lazarfeld in Rogers (1983) are accredited with developing the two-step model of mass communication which hypothesized that communication messages flow from a source via mass media channels to opinion leaders, who in turn pass them on to their followers. Homophily and heterophily, described in 4.5.2, confirm that when diffusion networks are homophilous, followers seek opinion leaders of higher socioeconomic status, with more education, greater mass media exposure, greater change agent contact, and more innovativeness. Rogers acknowledges that they may also act as barriers to the rapid flow of innovations within a social system, as similar people interact in socially horizontal patterns.

Rogers (1983:312) describes a change agent as an individual who influences clients' innovation decisions in a direction deemed desirable by a change agency. He observes that in most cases, a change agent seeks to secure the adoption of new ideas, but he or she may also attempt to slow down the diffusion process and prevent the adoption of ideas. Rogers (1983:343) identifies seven roles of change agents as:

- To develop a need for change on the part of clients (e.g. farmers)
- To establish an information-exchange relationship
- To diagnose their problems
- To create intent to change in the clients
- To translate this intent into action
- To stabilise adoption and prevent discontinuances

- To achieve a lasting relationship with the clients

Examples of change agents include teachers, consultants, agricultural extension workers, and sales persons, among others. Rogers observes that change agents provide a communication link between a resource system and a client system, noting that in order for this type of communication to be effective, the innovations must be selected to match the clients' needs and problems. He also advocates that feedback from the client system must flow through the change agent to the change agency so that it can make appropriate adjustments on the basis of previous successes or failures. Swanson and Rajalahti (2010:121) observe that traditionally, one of the weakest links between research and extension institutions is the lack of well trained and qualified subject matter specialists. These are important in articulating the needs of the farmers as well as disseminating innovations from the research system.

4.5.4.4 Types of innovation decisions

Rogers (1983) postulates that the social system has yet another important kind of influence on the diffusion of new ideas. Innovations can be adopted or rejected by individual members of a system or by the entire social system, which can decide to adopt or reject an innovation based on a collective or an authority decision. The decision to adopt or reject according to Rogers) falls into three categories:

i. Optional innovation-decision: choices to adopt or reject an innovation that are made by an individual, independent of decisions of other members of the social system.

ii. Collective innovation-decisions: choices to adopt or reject an innovation that are made via consensus of members of a system. All units of the system must usually conform to the system's decision once it is made.

iii. Authority innovation-decision: choices to adopt or reject an innovation are made by relatively few members of the social system who possess power, status, or technical expertise. The individual member has little or no influence on the innovation-decision as his or her role is to implement it. Authority decisions have the fastest rate of adoption.

Rogers concludes that the social system is involved directly in collective, authority and contingent innovation-decisions, and indirectly in optional innovation-decisions.

4.5.4.5 Outcomes of innovations

Rogers (1983) observes that a social system is involved in an innovation's outcomes or consequences because some occur at system level while others only affect the individual. He defines consequences or outcomes as the changes that occur to an individual or to a social system as a result of the adoption or rejection of an innovation, noting that it (the innovation) has little effect until it is distributed to members of a system and put to use by them. Rogers (1983:380-381) classifies consequences into three groups:

i. **Desirable versus undesirable consequences**. Desirable consequences are the functional effects that an innovation has on an individual or a social system, while undesirable consequences are the dysfunctional effects of an innovation on an individual or social system. The degree to which an innovation is desirable or undesirable is dependent on how the innovation affects the social system.

ii. **Direct versus indirect consequences**. These are the changes to an individual or social system that occur in immediate response to an innovation, while indirect consequences are changes that occur to an individual or social system as a result of direct consequences of an innovation.

iii. **Anticipated versus unanticipated consequences**. Anticipated consequences are changes caused by an innovation that are recognisedand intended by members of a social system. Unanticipated consequences are changes caused by an innovation that are neither intended nor recognised by members of a social system.

Rogers acknowledges that although classifying consequences or outcomes improves the understanding of them, consequences may be difficult to measure in a scientific and methodological manner.

4.6 Criticism of diffusion research

Practitioners have regarded the diffusion of innovations as a useful field of social science, with articles on diffusion research having appeared in the top journals of every discipline (Rogers, 2003:102). The author observes that due to its popularity over the last decades, the results of diffusion research have also been incorporated into textbooks across many academic disciplines. This popularity has been attributed to the following factors: the conceptual nature of the model, which bridges diverse disciplines and methodologies; diffusion research has a pragmatic appeal in getting research results utilised; diffusion research allows scholars to repackage their empirical findings as generalisations of a theoretical nature; and the research methodologies used are clear, data is not difficult to collect, and methods of analysis are clear (Rogers, 2003). But despite these enormous contributions to research, the diffusion model has not been without its shortcomings. According to Stephenson (2003), in acknowledging criticism to his theory, Rogers noted that the absence of critical viewpoints in the early development of the theory led to the challenges experienced in the long run.

Rogers (1983:92), Deshpande (1983), Haider and Kreps (2004) have identified four major criticisms of diffusion research, the first being its pro-innovation bias. The implication of most diffusion research is that an innovation should be diffused and adopted by all members of a social system, that it should be diffused more rapidly, and that the innovation should be neither re-invented nor rejected. Rogers (2003) points out that pro-innovation bias occurs when there is an economic reason to adopt an innovation and when it is being funded by an agency for change, for example when sponsors of a study already have an innovation in mind. Parallels can be drawn with a seed company which may 'forcibly' introduce a variety onto the market, not because of its performance, but because of the amount spent in producing the product.

In order to avoid shortcomings that might arise, it is essential that the innovation be tested on a small scale (pilot or on-field experiment/ demonstration) before full scale implementation. Criticism of pro-innovation bias has been that it does not take into account the fact that diffusion and adoption may fail because it was a bad idea to begin with. Ganzel (2007) and Stephenson (2003) observe that development/ diffusion agents tend to provide more assistance and hence information to their more innovative, educated, larger and wealthier clients as well as to information seeking clients who are most receptive and most likely to adopt the new idea(s). There is a tendency to be much more concerned with adopters than with resistors and this, Deshpande (1983) explains, ignores those who really need or need more help.

The second major criticism of diffusion research is the "individual blame bias", which is the "tendency to hold the individual responsible for his/her problems rather than the system in which he/she is part" (Rogers, 2003:118). According to Stephenson (2003), this means that the development agents are not blamed for their lack of response to the needs of the farmers (in this instance), but rather it is the individuals who fail to adopt an innovation who are blamed for lacking response. Deshpande (1983:330) indicates that this is the same as source bias, which is the tendency of diffusion research to side with the change agencies that promote innovations rather than with potential adopters. It suggests that laggards or late adopters are responsible for the failure to adopt without taking into account possible failures of the social system in the diffusion process. Critics maintain that companies, research institutes, and development agencies (extension) should respond to the needs of all farmers. Such bias could be overcome by changing the unit of analysis by focusing on diffusion networks rather than on individuals, and for researchers or extension workers to remain open to the cause of the problem, with all stakeholders taking responsibility in identifying the problem associated with the innovation (Rogers, 2003; Deshpande, 1983; Haider and Kreps, 2004).

Thirdly, there is the recall problem, and this may occur due to inaccuracies when respondents react to questions at the time of implementation. Deshpande (1983:330) charges that, "This problem is inherent in all recall data collection that relies on respondent memory for the date of adoption of the new idea or product." This is so because if self-report measures are used to determine exactly when adoption took place, subject recall of the exact time adoption took place may be questionable. The use of multiple data collection techniques as alternatives to the cross sectional survey design is one of the ways in which such bias could be eliminated (Rogers, 2003; Haider and Kreps, 2004).

Fourthly is the issue of equality in the diffusion process, as socio-economic gaps among members of a social system often widen due to the spread of new ideas. As Rogers (2003) explains, this problem arises due to researchers paying very little attention to the consequences or outcomes of an innovation. This criticism suggests that social gaps caused by factors such as income and education hinder diffusion and adoption and are not accounted for in diffusion research (Rogers, 2003). Gross (in Stephenson, 2003) indicates that non adopters are affected by the diffusion of innovations process, for example larger farmers may increase production as a result of adopting an innovation resulting in a decrease in the prices received by all farmers, meaning that small farmers get poorer. Van den Ban (1996:33) observes that the Diffusion of Innovations model has been for the known undesirable consequences of imposing innovations, ignoring the fact that farmers' knowledge and experience is an important resource for developing sound solutions to their problems. He asserts that this often creates mistrust in the social system as farmers do not readily accept recommendations based on research which has not been tested in their own environment.

4.7 The diffusion theory in relation to the study

The concept of linkage implies the communication and working relationship established between two or more organisations pursuing commonly shared objectives ideally through regular contact in order to improve productivity (Agbamu, 2000:1). Research-extension linkage thus refers to the interaction between agencies supporting the activities of research institutions and the users of the research output. A strong research and extension system is required in order to achieve a high standard of agricultural production. Research and extension cannot fulfil their mandates without each other; hence good communication, strong interaction, and effective collaboration are primary requisites (Asopa and Beye, 1997:5).

One of the most important functions of agricultural extension is to bridge the gap between research centres/ institutes or scientists and farmers for the communication and dissemination of agricultural research (Jones and Garforth, 1997). However, Jones and Sanyang (2009:141) argue that much of the problem with conventional agricultural research and extension lies with the process of generating and transferring technologies, and that much of the solutions lie with farmers' own capacities and participation in the research process.

Having detailed but not exhausted Rogers' (1983) Diffusion of Innovations theory and acknowledging its shortcomings highlighted above, this section examines how the theory relates to and is applied in the current study. In looking at the application of the diffusion theory, the study addresses the research extension system holistically by looking at the implications on research, implications on the extension system, and ultimately farmers' receptiveness to innovations. This is done through the application of the four main elements of the diffusion of innovations' process.

4.7.1. Innovations

Research generates new innovations, and these are transmitted by extension workers to the farmers for implementation. Agricultural research in Zimbabwe is undertaken by private and public institutions which are located in different agro-ecological zones across the country. As van den Ban (1996:102) observes, research is concerned with the following innovations:

i. New farming systems, such as a change from crop production to commercial horticulture or animal production. Mutangadura (1997: iii) found that the agricultural research and disciplinary priorities of smallholder farmers and commercial farmers were different, with smallholder priorities including agronomy, plant breeding, chemistry and soils, and commercial farming focusing on soybeans, roses, beef, wheat, and dairy, among other varieties. The current structure within the Ministry of Agriculture shows that research is conducted according to agro-ecological zones and by commodity type. Van den Ban (1996) provides an analogy whereby plant varieties are equated to hardware, and techniques for growing them to software. He observes that scientists who develop new hardware (seed varieties) in their research should take into account the access farmers have to resources in developing and using the software. Van den Ban (1996) argues that scientists often fail in this respect, for example they have developed many techniques for irrigated agriculture but not for rain-fed agriculture, although the vast majority of farmers have no access to irrigation.

Another dimension in farming systems involves new farming practices, for example in Zimbabwe, farmers have moved from rural areas to commercial agriculture following the land reform programme, some even practicing agriculture for the first time. This translates to new practices such as mechanization and the extensive use of herbicides, practices that are rare among subsistence farmers. Agricultural research has to be proactive in identifying methods that would address such groups of farmers. Examples include identifying and recommending farm equipment and chemicals to deal with specific weed types, and developing (through experimentation) new seed varieties that are appropriate for maximised production. According to Sunding and Zilberman (2000), the classification of innovations according to form is useful in considering policy questions and understanding the forces behind the generation and adoption of innovations. They categorise innovations into the following classes:

- Mechanical innovations - tractors and combine harvesters
- Biological innovations - new seed varieties
- Chemical innovations - fertilisers and pesticides
- Agronomic innovations -new management practices

ii. New methods to assist management decisions, such as soil testing, linear programming, or computerised expert systems. These may include biotechnological innovations and information innovations that rely mainly on computer technologies (Sunding and Zilberman, 2000). The use and application of information and communication technologies (ICTs) in the generation and communication of agricultural technologies has brought about changes in format and content as well as in the quality and quantity of information. Ajit (in Kiplangat, 2004) observes that the use of ICTs has great potential to improve and enhance the process of agricultural technology transfer and in turn improve productivity in agriculture.

iii. Social organizations, such as farmer unions and cooperatives. These are essential as they can form the basis of interaction/ contact for both research and extension systems.

Greenhalgh (2005) and Rogers (1983) identify five characteristics of an innovation and these are analyzed in relation to the study, namely relative advantage, compatibility, complexity, trialability and observability.

4.7.1.1 Relative advantage

Van den Ban (1996) observes that an innovation may enable the farmer to achieve goals in a better way or at a lower cost, and cites incentives as one way of motivating farmers to try an innovation. An example from Zimbabwe confirms this assertion. Newly resettled farmers were given incentives and subsidies to boost maize output (a staple diet), but when these were withdrawn, the innovations experienced very low farmer participation, failing to go beyond the trial phase.

4.7.1.2 Compatibility

Innovations that are not compatible with the norms of a social system are often difficult to adopt. Van den Ban (1996) suggests that farmers who witness large yield increases by growing improved wheat varieties are likely to be happy and accept improved rice varieties. Implications on research may include on-farm trials or a farming systems approach, where instead of an innovation being developed at a research station, it is actually tested in the farmer's environment with the participation of extension agents. Seed companies like SeedCo in Zimbabwe are working with farmers to produce commercial seed using this approach (SeedCo, 2010).

4.7.1.3 Complexity

Rogers (1983) and van den Ban (1996) observe that innovations often fail because of incorrect implementation, with some complex technologies requiring complementary adoption. Dairy cows with higher genetic potential, for example, will produce more milk only if they have food which is higher in protein and energy content. They will in fact produce less than indigenous cattle without this food. Innovations that require complementary adoption also require full comprehension which in turn requires properly disseminated information from the research system.

4.7.1.4 Trialability

Farmers will be more inclined to adopt an innovation which they have tried first on a small scale on their own farm, and which they find to perform better than an innovation they had to adopt immediately on a large scale (van den Ban, 1996:105). Innovations that fail initial tests may be discontinued as cost effective measures or sent back to the research station for improvement. Research extension workers play a pivotal role in this interaction.

4.7.1.5 Observability

Rogers (1998) asserts that the results of some ideas are easily observed and communicated to others, whereas some innovations are difficult to describe to others. Van den Ban (1996) agrees, noting that farmers learn a lot from observing and discussing their colleagues' experiences, their observations often being the catalyst of discussions. On-farm demonstrations and farmer-field schools are some of the methods researchers and extension workers use to showcase new innovations to farmers.

4.7.2 Communication channels

Traditionally, extension messages are based on farmers' experiences and/or agricultural research findings, and possible roles include helping, analyzing, deciding, informing, and monitoring (van den Ban, 1996). Rogers (1983:198) explains that communication channels are either interpersonal or mass media, and may originate from either local or cosmopolite sources. Leeuwis (2004) concurs with Rogers above but adds hybrid media as a third communication channel.

4.7.2.1 Mass media

Leeuwis (2004:190) categorises conventional media according to four dominant channels: i) Mainly textual, e.g. newspapers, farm journals, flyers, brochures, etc.; ii) Mainly auditory, e.g. radio, speech, songs, cassettes, storytelling, etc.; iii) Mainly visual, e.g. posters, drawings, slide shows; iv) and Combinations, e.g. audio visual, television, theatre, drama. These can reach large audiences rapidly, create knowledge and spread information, and lead to changes in weakly held attitudes.

4.7.2.2 Interpersonal channels

Leeuwis (2004:190) and Rogers (1983) observe that the basic forms of interpersonal communication are group meetings/ discussions and bilateral meetings/ discussions (face-to-face exchange between two or more individuals). These facilitate a two way exchange of information and persuade an individual to form an opinion or to change a strongly held belief or attitude. Characteristics include limited audiences, tailor-made content, and in-depth dialogue. Farmers can learn from each other's experiences, especially if they share similar problems.

4.7.2.3 Hybrid media (Information and communication technologies)

Information and communication technologies combine the functional properties of mass media and of interpersonal communication, potentially reaching many people in different places simultaneously when necessary (Leeuwis, 2004). Technologies that facilitate communication include Compact Disc-Read Only Memory (CD-ROM), Disc-Read-interactive (CD-i), videotext, expert systems, electronic conferencing, and the internet, to name a few. The internet alone encapsulates the World Wide Web (www), electronic mail (e-mail), newsgroups, social networking sites, chat rooms, and many other forms of efficient communication. ICTs provide mass storage that research systems may utilise for further referencing, for packaging information and innovations that extension workers can use, and for further dissemination to farmers. Library and information centres could also utilise ICTs in the collection and dissemination of agricultural information through access to databases. Open access initiatives have seen publishers making full text journal articles available online. The web enables research institutes to publicise their activities as well as draw awareness to ongoing innovations across different agro-ecological zones. Farmers as well as extension workers can also download research results from other agents, for example SeedCo and other chemical companies have information on their website that is readily used by other research institutes, including the government (SeedCo, 2010).

Swanson and Rajalahti (2010:123) observe that increasing bodies of knowledge and information and training materials are becoming available from the rapidly expanding global agricultural information system. The authors explain that agricultural extension systems would benefit greatly from having adequate ICT capacity which would enable electronic communication between extension staff, research staff, and with client groups. E-mail also facilitates communication internationally among researchers. This requires specific infrastructure, hardware and software, as well as adequate internet connectivity.

As shown in Pazvakavambwa and Hakutangwi (2006) above, use of the media is evident in the agricultural research and extension system in Zimbabwe, although it is yet to fully utilize minority languages and reach minority groups. Use of the media is particularly evident in radio and television programmes where research and extension specialists are invited to discussion panels that provide feedback to listeners'/ viewers' questions. Leeuwis (2004:119) argues that the way communication unfolds in a particular context is shaped partly by the nature of the relationship between those communicating. The author notes that when people (e.g. change agents and farmers) have positive experiences with each other, communication is likely to be smooth, while the opposite applies if there has been conflict.

4.7.3 Time

Arnon (1989:774) observes that after a new technique has been developed by agricultural research, its widespread adoption by farmers may be delayed for a period of time that may be long or short depending on the circumstances. This delay may be caused by: the time required by the research and extension systems before recommendation for adoption; the length of the diffusion process; the type of innovation; and interaction between the new inputs among other factors. As shown in Dervin (1983), the concept of time defines the context in which information problems arise and attainment of the desired situation or outcome. The diffusion of an innovation is a process that begins with generation and ends with implementation (or rejection).

4.7.3.1 Innovation-decision process

To reiterate, Rogers (1983) explains that the innovation-decision process is an information seeking and information processing activity whereby an individual obtains information in order to decrease uncertainty. Kuhlthau (1999), Hjørland (1997), Case (2007), Marchionini and Johnson (in Case, 2007) and Wilson (2006) describe the concept of information seeking as the user's constructive act of finding meaning from information in order to extend his or her state of knowledge on a particular topic. Researchers, extension workers and farmers all seek information at different stages of the diffusion process. Van den Ban (1996:98) identifies the stages as knowledge, persuasion, decision, implementation, and confirmation, pointing out that often, the research-extension-farmer communication process does not deal with one innovation, but with a package of innovations. He further argues that extension research has shown that different sources of information are important for first hearing about an innovation, and for making the final decision to adopt or reject the innovation. It is imperative that appropriate information is disseminated from research through extension if farmers are to adopt innovations. This may include supplementary handouts or flyers in the appropriate language and format, depending on the literacy levels of the recipients. Figure 4.3 illustrates the stages in the decision making process on which the Diffusion of Innovations theory is modelled.

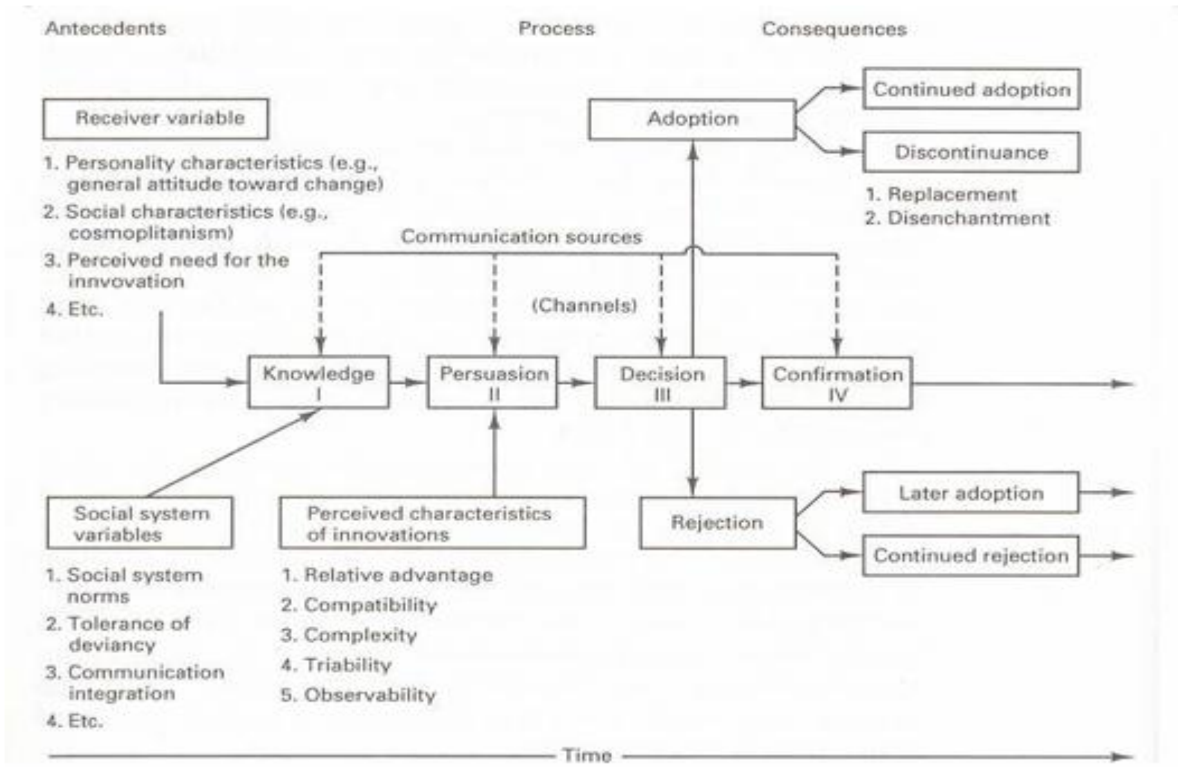

Figure 4.3: Diffusion of Innovations model

Source: Rogers (1995) Available: http://nnlm.gov/pnr/eval/rogers.html

Leeuwis (2004:131) argues that an important practical conclusion that ties to the stimulation of adoption is that people (in this case farmers) require and search for different kinds of information during each stage of the process. The information requirements evolve from:

a. Information clarifying the existence of tensions and problems addressed by the innovation or policy measure

b. Information about the availability of promising solutions

c. Information about relative advantages and disadvantages of alternative solutions

d. Feedback information from one's own or other people's practical solutions

e. Information reinforcing the adoption decision made

4.7.3.2 Innovativeness and adopter categories

Diffusion processes can substantially enhance the effect of extension and lead to rapid innovation in agriculture, but one cannot automatically expect that an innovation that is introduced to a system (e.g. farming) will diffuse to everybody and at the same rate - few farmers may immediately accept and put a new innovation into use; some farmers may take a long time to accept and use the innovation, and all farmers do not adopt at the same time (Roling, 1988:5; Rogers, 1983; van den Ban, 1996).

To reiterate, the land reform programme and the current agricultural system in Zimbabwe is characterized by farmers at different levels of experience on the one hand, and by an extension system that has to mediate new innovations to these groups of farmers on the other (Moyo, 2004; Mudhara, 2004). Some farmers, in particular new farmers, are having first time experiences growing crops like soybeans, tobacco, and sugar cane, and especially at commercial level. Within the different cropping systems (e.g. tobacco, soybean, and sugarcane systems) and different farmer levels (small, medium and large scale farmers) are different types of adopters. The research and extension system will have to adjust its diffusion mechanisms in order to address the different groups adequately. This can be achieved by way of identifying potential innovators, early adopters, the early majority, the late majority, and laggards. Doing so may help research and extension systems focus and prioritise on resources, given that the bulk of adopters (68%) fall in the early and late majority.

Rogers (1983:251) characterised the different groups of adopters, and this clearly shows that the level of education, farm sizes, number of extension contacts and investment risks shows a descending pattern as one moves from innovators to laggards, which invariably reflects their socioeconomic status. The laggards, regarded as traditionalists, are generally characterised as old and/or the least educated. The A1[6], A2[7] and communal area (CA)[8] in Zimbabwe tend to follow the above characterisation (Mudhara, 2004).

4.7.3.3 Rate of adoption

Leeuwis (2004) and Rogers (1983) observe that the rate of adoption is influenced by the perceived attributes of the innovation, type of innovation-decision, nature of communication channels, nature of social systems, and extent of change agents' promotion efforts. As with adoption categories, innovators (few individuals) will adopt an innovation at its inception, before the rest adopt. What lessons can be derived from the rate of adoption? For research, this may signal a successful innovation and for extension it may also indicate the advantages of disseminating methodologies.

4.7.4 Social systems

Agricultural researchers and extension workers within Zimbabwe's public sector fall under the Ministry of Agriculture, Mechanisation and Irrigation Development (MoAMID). The Ministry's structure was articulated in Section 2.2. Because this study addressed the research and extension system/ linkage, the ultimate users - the farmers - were discussed within the theoretical framework as their needs are reflective of the performances of both the research and extension systems in Zimbabwe.

4.7.4.1 The change agent

One of the most important functions of agricultural extension is to bridge the information divide between researchers/ scientists and farmers in the communication of agricultural research. Extension workers facilitate the flow of information from agricultural research systems (Department of Research and Specialist Services - DR&SS - and affiliate institutions, both private and public) to farmers and farmer groups (A1, A2 and CA). In order for an innovation to be accepted, it should be responsive to the needs of such groups and address their problems. Thus in order for the linkage/ system to be effective, a feedback mechanism that transmits from the bottom-up should be adopted as shown in Figure 4.4 below. The feedback mechanism recognizes the need for a direct line of communication from researchers to farmers, and vice versa from farmers to researchers.

[6] A1 represents newly resettled farmers in villages and self contained plots of about 5 hectares (2000-)
[7] A2 represents commercial farming land use meant to empower black indigenous farmers (2000-)
[8] CA represents the communal area, settlement patterns of pre-1980 which exist up to today

In Figure 4.4 below, the researcher modified the diagram to include the direct farmer-to-researcher and researcher-to-farmer linkage.

Feedback flow of communication

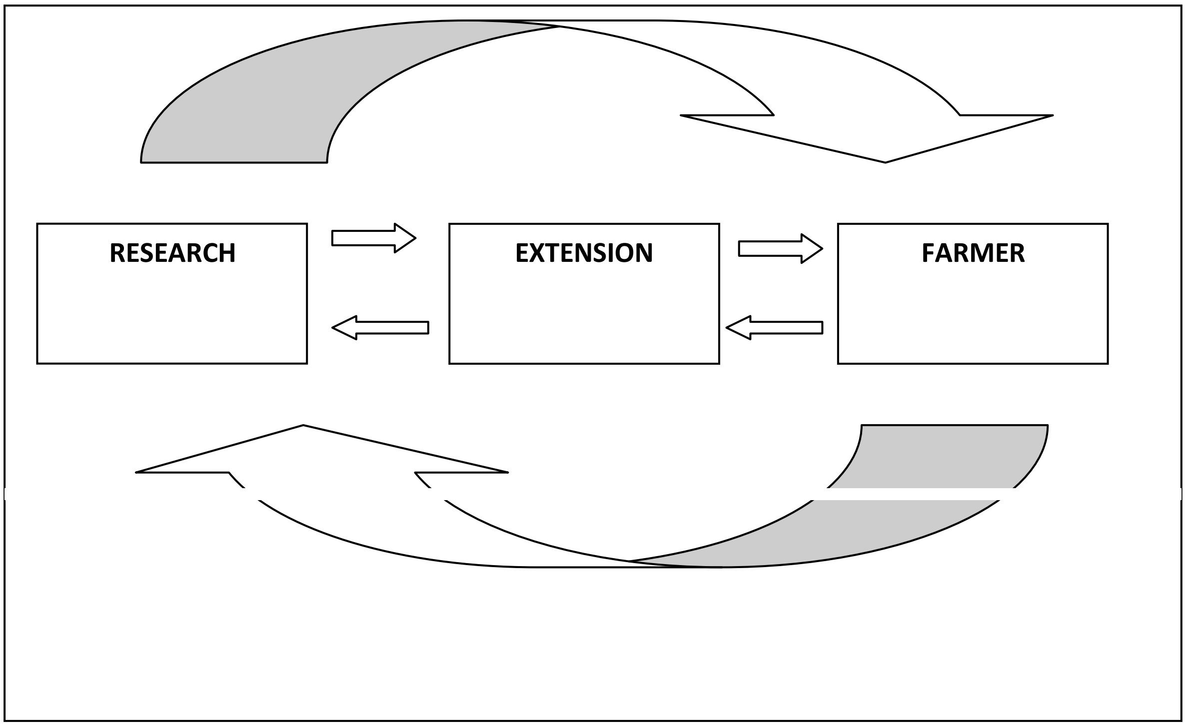

Figure 4.4: Feedback flow of communication

Adapted from McClure (1991) with modifications by the researcher

Abalu (2001) argues that in the 'top-down' or 'one way flow' of communication, farmers are treated as ignorant recipients of information rather than as knowledgeable partners in the technology transfer process. The feedback model incorporates mechanisms whereby responses and information from the farmers (client system) are transmitted up the hierarchical structure to the Head Office. Feedback in research and extension recognises the farmers' indigenous knowledge and the importance of integrating it in modern research. It engages farmers as participatory clients rather than as passive recipients of information or innovations.

4.8 Summary

Jones and Sanyang (2009:141) observe that "there has been recognition that the organisation of research extension itself was a major reason behind why science was failing to improve the livelihoods of poor people." This chapter outlined three research-extension linkage models by Havelock, and adopted his Social Interaction model. Rogers' Diffusion of Innovations theory was used as the theoretical framework of the study. A brief history of Rogers' theory was presented, highlighting the significance of the 1960s when a more unified and cross-disciplinary approach to diffusion research became evident.

The chapter addressed the Diffusion of Innovations theory by focusing on its four major elements, i.e. innovations, communication channels, time, and the social system, reflecting on their relevance to the study and focusing in particular on communication channels. The latter focused on traditional channels, i.e. mass media and interpersonal communication, with the added third dimension of hybrid media. The significance of information and communication technologies in generating and communicating research to farmers, points to the need to strengthen ICT capacity and infrastructure in both agricultural research and extension institutions. The role and qualities of change agents or extension workers and their relationship with opinion leaders as proxy agents for speeding up the diffusion process were also discussed. Change agents are seen as bridging the gap between agricultural research and farmers.

The next chapter provides perspectives on agricultural knowledge and information systems.

CHAPTER FIVE

PERSPECTIVES ON AGRICULTURAL KNOWLEDGE AND INFORMATION SYSTEMS (AKIS)

5.1 Introduction

This chapter expands on the contextual setting by giving a global perspective on issues pertaining to agricultural research and extension. These include: the changing nature of agricultural research and agricultural extension; agricultural information services; the role of ICTs; indigenous knowledge systems in agricultural research and extension; and partnering with private sector/ international organisations in Agricultural Knowledge and Information Systems for Rural Development (AKIS/ RD). In discussing information behaviour and the theoretical framework respectively, Chapters 3 and 4 have also presented related literature on these topics. The chapter addresses the following research objectives:

b. To examine the role played by agricultural researchers and extension workers in communicating agricultural information to farmers;

c. To investigate knowledge management systems within the Ministry of Agriculture's divisions and research institutes and find out the application and use of ICTs in the generation and dissemination of agricultural information;

d. To assess the role of agricultural researchers and extension stakeholders as potential uptake/dissemination pathways for agricultural technologies;

e. To examine the level of utilisation of indigenous agricultural knowledge by researchers and extension workers in the generation and dissemination of agricultural information;

f. To identify knowledge gaps, challenges, and constraints affecting the extension and dissemination of agricultural information

The chapter seeks to answer the following research questions:

b. What role do researchers and extension workers play in the dissemination of agricultural information to farmers?

c. What means and processes are in place for managing information generated by the Ministry of Agriculture, Mechanisation and Irrigation Development's research and extension divisions and research institutes?

d. What is the level of ICT development within the Ministry of Agriculture, Mechanisation and Irrigation Development's research and extension divisions and research institutes, and what is the impact of ICT on the generation and dissemination of agricultural information among researchers and extension workers?

e. What is the significance of stakeholders' collaboration with the Ministry of Agriculture, Mechanisation and Irrigation Development's research and extension systems and what role do stakeholders play in the generation and dissemination of agricultural information?

f. To what extent do researchers and extension workers utilize indigenous agricultural knowledge in the generation of agricultural information?

According to FAO/ the World Bank (2000:2), an Agricultural Knowledge and Information System (AKIS):

> ...links people and institutions together, to promote and enable mutual learning and generate, share and utilises agricultural-related technology, knowledge, skills and information. The system integrates farmers, agricultural educators, researchers and extensionists and the private sector (support and input services, traders) to harness knowledge and information from various sources for better farming and improved livelihoods.

Van den Ban and Hawkins (1996:25) define AKIS as:

> The persons, networks and institutions, and the interfaces and linkages between them, which engage in or manage the generation, transformation, transmission, storage, retrieval, integration, diffusion and utilisation of knowledge and

information, and which potentially work synergistically to improve the goodness of fit between knowledge, environment, and the technology used in agriculture.

These stakeholders generate technologies and information that affect farmers in many different ways.

5.2 Agricultural research

Alene and Coulibaly (2009:198), citing the Green Revolution of the 1960s and 70s, observe that agricultural research holds great potential for raising agricultural productivity. Agricultural research is carried out by both public and private sector institutions (discussed in Section 2.4), including agricultural universities or faculties of agriculture within universities, colleges of agriculture, ministries of agriculture departments or research institutes, national research councils, research foundations, and NGOs. The private sector may include farmers (consortia), seed companies, and other players within the input sector and the agribusiness sector. The public/ private sector dichotomy continues to influence the agricultural research process. According to Chema, Gilbert and Roseboom (2003:5), the demand for agricultural research in most African countries expanded after independence as the research focus shifted from a limited group of colonial export farmers (who occupied the best land), to including all farmers, including a very large group of predominantly indigenous subsistence farmers producing food crops under very diverse (and often harsh) agro-ecological conditions. As explained in chapter two, the land reform programme in Zimbabwe was initiated in order to address these inequalities.

In the 90s, Echeverria (1998:1) observed that globally, public funding for agricultural research had been growing at a slower rate than it had in the 70s and 80s. In many cases, it is still decreasing today. According to Janssen and Braunschweig (in Chema, Gilbert and Roseboom, 2003:4-7), the trends in the financing and organisation of agricultural research have been influenced by:

- Changes in the political and socio-economic context, e.g. market liberalisation.

- Changes in the demand for agricultural research services through continuous adaptation to the changing demands of new agricultural technologies and knowledge.
- Changes in research technologies, methodologies and approaches, e.g. ICTs and biotechnologies, and research collaboration between the public and private sectors and across disciplines.
- Changes in the institutional context at national level as well as regional collaboration in agricultural research.

Support for public research institutions is declining while an increasingly large portion of public support is taking on new forms, such as project-based or contract research (Echeverria, 1998:1). The consequences of this trend are discussed in this chapter.

5.2.1 Agricultural research funding

Many sub-Saharan African (SSA) countries inherited the colonial agricultural research system, which paid little attention to the challenges of subsistence farmers (Alene and Coulibaly, 2009:199). Research was heavily dependent on donor funding, targeting mainly large scale commercial farmers of export crops. With Zimbabwe's independence, the research mandate of both national and international agricultural research expanded considerably to directly address the needs of indigenous communities and small scale farmers (Alene and Coulibaly, 2009:199). Chema, Gilbert and Roseboom (2003:1) observe that the new reform agenda forced agricultural research to be more outward looking, client oriented, and impact driven. Research organisations were being urged to ensure that their knowledge and technology was being applied, preferably by resource-poor farmers in marginalised areas.

The study by Chema, Gilbert and Roseboom (2003:xii) reviews key issues and experiences in reforming agricultural research in Africa and observes the following major areas that dominate the National Agricultural Research System's (NARS's) agenda: the redefinition of the role of the government in agricultural research, including funding, priority setting and implementation; the decentralisation of agricultural research geographically and in terms of decision making; stakeholder participation and partnership; emerging funding instruments, e.g. co-financing; and the strengthening of ties between research agencies (national, regional and international) and between researchers, extension workers and farmers.

In the late 90s, Mutangadura (1997) looked at the research priority setting in the public sector in Zimbabwe and how it was affected by the Structural Adjustment Programme and severe budget constraints. The study found that research priorities differed between smallholder farmers and large scale commercial farmers, and according to agricultural produce**.** Echeverria (1998:1) likewise found that public research organisations were being faced with greater demands on their research capacity while simultaneously being caught in a vicious circle of tight budgets and lower research performance.

Contant (2001:183) asserts that priority setting is consistent with the country's agricultural policy, the research organisation's mission, and the research programme's objectives. Priority setting is often done in the context of limited resources, increasingly diverse research needs, external demands for greater transparency in resource allocation, and strengthening focus on client needs.

Contant (2001:191-192) provides the example of priority setting in Kenya with the Kenya Agricultural Research Institute (KARI), which is structured along three levels: institute (encompassing research stations and programmes), programme (national and regional), and project. KARI's priority setting process combines information on client constraints with expert opinions on the potential generation and adoption of new technologies, and data on climate, soils, populations, prices and production levels. Five steps are followed in synthesising and using the information in decision making and resource allocation, i.e.: compiling the information base; identifying programme research target zones and research themes; eliciting the potential for technology generation and adoption; ex ante estimation of research induced benefits; and establishing priorities with stakeholders.

Similar priority setting processes are being piloted within regional and production factor research programmes. The World Bank (2005:38) argues that the trend towards market liberalisation, the rise of supply chains, and the imposition of more rigid grades and standards have changed the role of the government in agriculture. Echeverria (1998:1) concurs, adding that the stagnation of public sector funding for agricultural research has been influenced by the perceived new, reduced role of the state; the movement of the agricultural sector towards a commercial agribusiness sector linked to global markets; and recommendations for more demand-driven mechanisms for allocating research funds. The World Bank (2005:38) notes that in many cases, the private sector has successfully replaced inefficient public or parastatal agencies as a supplier of essential private service.

According to Tabor (2001:11-12), planning processes exist to serve decision making, and as nations become more globally integrated, the focus of agricultural research planning changes involve: tracking globalisation trends, including innovations in communication, and ICTs that help to ease information exchange; and developing plans to integrate national agricultural R&D into global R&D systems in terms of policy. This could be achieved through the strategic acquisition and dissemination of regulatory and intellectual property rights information within the research community. Tabor concludes that national agricultural research providers have to respond to many more actors and be far more flexible and adept at positioning the domestic agricultural research effort to complement that which can be provided internationally.

5.3 Agricultural extension

Umrani and Jain (2010:1) observe that extension has evolved from its initial use in describing adult education programmes in England, to encompassing a wide range of communication and learning activities organised for rural people by professionals from different disciplines that include agriculture, health, and business, among others. According to the authors, the essence of agricultural extension is to facilitate interplay and nurture synergies within a total information system involving agricultural research, agricultural education, and a vast array of information-providing businesses. According to Foti et al. (2007:29), Encanto (2000) and van den Ban and Hawkins (1996:10), the aim of all agricultural extension endeavours is to transfer agricultural information that will enhance the productive capacity of farmers and improve their ability to deal with their problems and take advantage of new opportunities. Extension involves the conscious use of the communication of information to help people make sound decisions

In order for the above to be realised, the extension agents need to be well informed through relevant training so that they are able to articulate and attend to the farmers' constraints and challenges. Roling (1988:39-49) looks at extension by identifying the following common elements or conceptions:

- Extension is an intervention through which the change agent or extension worker formulates, implements, and evaluates objectives and strategies.
- Extension depends on communication as an instrument to induce change through the transfer of information.
- Extension effectiveness depends on the willingness of people to be persuaded, and is not an instrument which can force people to do things against their will.
- Extension as an instrument is usually deployed in institutions, e.g. in government departments, voluntary agencies, commercial companies, member associations, etc.

Van den Ban and Hawkins (1996:9) explain that agricultural extension agents supply information about agricultural policies and the reasons for them, and endeavour to stimulate certain developments considered to be desirable. An example would be encouraging farmers to guard against issues like environmental pollution through the proper use of pesticides. According to van den Ban (1999:145), one of the roles of an extension organisation is to contribute to the development of agriculture in their area by helping farmers to be timely aware of the changes in their environment which offer new opportunities for agricultural development but which also cause threats. Van den Ban (1999) further explains that choosing the goals of an extension programme includes judgement on which kinds of developments in agriculture are possible and sustainable and which are not, for example with respect to new technologies.

Peterson (1997:24) asserts that agricultural research organisations are extension's closest institutional partners in technological generation and transfer. For this reason, Peterson notes that the way research is structured and organised and the planning and management of research-extension linkages can either limit or enhance extension's effectiveness. In reviewing literature on extension, the researcher acknowledges the overlap in most areas, mainly due to the fact that the extension system links technology generation with the end-users, who are mostly farmers. Topics that come to the fore include poverty alleviation and issues of funding, planning, and globalisation. Swanson and Rajalahti (2010:7) caution that as governments consider how to strengthen their extension systems in order to achieve their national agricultural development objectives, they need to consider how these different extension functions relate directly to their overall goals, as show in Figure 5.1.

Key Extension Service Functions

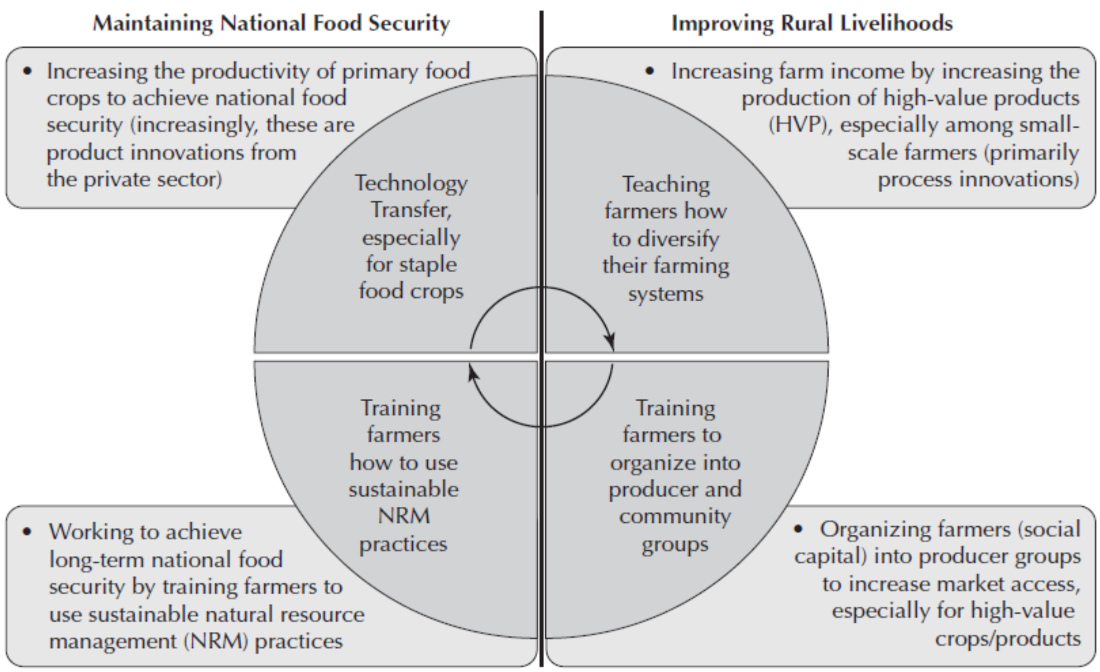

Figure 5.1: Key extension functions vis-a-vis national agricultural development goals

Adapted from Swanson and Rajalahti (2010:7)

Swanson and Rajalahti (2010:7-12) conceptualises four key objectives of extension, namely: transferring new agricultural technologies; capacitating farmers and providing solutions suitable for their location or agro-ecological zones/ conditions; organising and empowering farmers by building social capital within rural communities**,** providing timely information, and collaborating with organizations (e.g. in research and training farmers to use sustainable natural resource management practices.

5.3.1 The changing nature of agricultural extension: Funding

Contado (1997:112) contends that the most difficult and challenging policy issue facing extension is securing a stable source of funding given the ongoing trend of budget cuts by governments. Foti et al (2007:29) opine that governments (representing the public sector) have traditionally taken a dominant role in providing agricultural extension services because of the important contribution of extension to agricultural development. However, Foti et al (2007) also note that escalating budget deficits in many developing countries and in several cases, problems of poor governance of public sector programmes, have increasingly redirected attention towards making extension more cost effective and appropriate to farmers' needs. Saliu and Age (2009:160) note that public agricultural extension services are becoming too expensive to finance in some developing countries due to donor fatigue, hence the need to consider or find alternative methods of funding. Umrani and Jain (2010:66) suggest that the concept of demand-driven services is linked to a paradigm shift in public sector reform towards responsive governance, which emphasizes the need to make service provision accountable to users and to promote transparency. Donors usually consider this among other factors when appropriating funds for new projects or renewing existing ones.

Umrani and Jain (2010:67) observe that agricultural extension is characterised by various market failures that affect both the supply side and the demand side of advisory services, acknowledging, however, that the public sector and the third sector (NGOs) have traditionally played a major role in financing and providing extension services. Umali and Schwartz (in Foti et al., 2007:29) stress that a central objective in a private fee-for-service extension system is getting the right message to the right individual or group by creating a demand-driven extension service system that is cost effective, efficient and of high quality. In terms of alternative options for the funding and delivery of agricultural extension, Rivera and Cary (1997:206) observe that where the public sector provides extension services, alternative funding arrangements include: general tax-based public funding, commodity-based tax funding, fee-based public funding, and contract-based commercialisation of public services. Van den Ban and Hawkins (1996:256) propose that farmers can contribute to the cost of privatised extension services through: i) Paying a fee for each visit an extension agent makes to their farm; ii) A levy to be charged on certain agricultural products from agricultural research and extension; iii) Cost can be met from membership fees paid to farmers' organisations; and iv) The extension service can receive a specified portion of the extra income a farmer earns as a result of advice from extension agents.

Swanson and Rajalahti (2010:49) argue that recouping the full cost of extension and advisory services from small scale farmers would be difficult and unlikely to succeed, especially for "public goods". They argue that the goal of recovering the full costs of extension through a fee-for-service strategy appears to have little chance of succeeding in developing countries once public sector financing ends. Saliu and Age (2009:173) conclude that the provision of completely free-of-charge services to meet the different needs of all categories of farmers is gradually becoming unrealistic due to scarce financial resources and global economic changes. At the same time, privatising extension services may not yield the expected dividend of effective and efficient technology and agricultural information dissemination to farmers.

5.3.2 The changing nature of agricultural extension: Privatisation

Rivera and Cary (1997:203) note that when agricultural extension is discussed, the term 'privatisation' is used in the broadest sense of introducing or increasing private sector participation, which does not necessarily imply a transfer of designated state-owned assets to the private sector. They explain that in fact, various cost recovery, commercialisation, and other so-called privatisation alternatives have been adopted to improve agricultural extension. Swanson and Rajalahti (2010:36) are of the view that as the agricultural extension system becomes more diverse, there is a need to assess whether public, private, and civic organisations have a comparative advantage in carrying out different types of extension and advisory services. Swanson and Rajalahti (2010:72) indicate that such extension functions would include: technical advisory services to all types of farmers; helping small-scale farmers increase their farm income through crop diversity; helping organise farmers into producer groups; and improving the farm management and marketing skills of farmers. They recognise that specific advisory services, such as technology transfer, will be increasingly privatised as the agricultural sector becomes more commercialised.

Rivera and Cary (1997:203), and Umali and Schwartz (in Foti et al., 2007:29) suggest that the high cost of sustaining public sector extension systems, and hence the move towards privatisation, is to an extent influenced by the strong global trend towards market liberalisation and the transition from planned to market economies. Saliu and Age (2009:162) reiterate that options would be to reduce public expenditure on extension, charge for government extension services, shift the burden of associated cost to private organisations, or completely privatise extension services.

Schwartz (in Foti et al., 2007:29) opines that the commercialisation of traditionally publicly provided agricultural extension services raises several related issues, namely:

- Will fee-for-service systems necessarily lead to greater efficiency and equity?
- What are the social and income distribution implications of commercialisation in terms of access to the services by small-scale farmers and the rural poor?
- Will farmers be willing to pay for the extension services?

In light of the above, Rivera and Cary (1997:203) and Wesseler and Brinkman (2002:4) observe that while the commercialisation approach makes the extension service more responsive to client needs and changing economic and social conditions, it is not without implications. Implications include a decline in the exchange of agricultural information and a diminished emphasis on information for the public good, and a tendency to cater for large-scale farmers at the expense of small-scale farmers. Rivera (2000:36) acknowledges that in a privatised system, the farmer is more likely to effectively utilise advice since they will pay for it. The detriment is that it may hamper the free flow of information. Government extension agents often contribute to farm magazines and radio programmes for free; with privatisation, they may be inclined to charge, and farmers may not be willing to share what they paid for. Rivera (2000:36) notes that privatisation shifts agricultural knowledge from being a “public good” to a “private good” with subsequent cost and property rights implications. This would impact negatively on resource poor farmers.

5.4 Agricultural information services

According to Mundy and Sultan (in Wesseler and Brinkman, 2002:3), information, be it scientific, technical, economic, social, etc., is a basic element of any development activity and must be available and accessible to all. Information is useful only if it is communicated, circulated among users with appropriate facilities, and exchanged. Budak and Yurdakul (2004:215) assert that the quality, capability, and performance of farmers in agriculture are fundamental indicators of the level of the agricultural sector's efficiency, productivity, development and sustainability; hence information and organisation in the agricultural sector must assume greater importance.

Agboola (in Oduwole and Okorie, 2010:11) observes that information plays a key role in agricultural development and its effective communication would help to facilitate mutual understanding between farmers, agricultural scientists, and extension workers. Oduwole and Okorie (2010:11) share this view, observing that the method of communication of agricultural information is crucial towards enabling farmers to make informed decisions. Timeliness also adds value in this respect. Akbar (in Islam and Hasan, 2009:538), while analysing the situation in Bangladesh, observes that the flow of information to and from rural communities is an essential pre-condition for its development towards the eradication of widespread poverty. Akbar asserts that: "Information and communication technologies (ICTs) greatly facilitate the flow of information and knowledge, offering the socially marginalised and unaware community unprecedented opportunities to attain their entitlements." Islam and Hasan (2009:538) concur, observing that knowledge and information centres and tele-centres have been established in rural areas in order to provide information to marginalised and rural communities and to reduce technological discrimination and the digital divide between urban and rural areas. In addition to these, information kiosks, libraries, and information centres have also been established to provide information in other sectors.

5.4.1 Stakeholders and their information needs

Wesseler and Brinkman (2002:5-8) looked at ways of bridging the information divide between farmers, researchers, policy-makers, and development agents. They identified four categories and the information needs of each group as follows:

- *Farmers*. Their information needs relate to the production, processing, and marketing of farm products, including prices and other mandatory requirements. Factors affecting their access and utilisation include: illiteracy, farmers' inability to evaluate their own information needs, and poor communication networks and infrastructure.

- *Decision makers*. Ministries of agriculture represent the public sector and therefore need to understand their role in information provision, including institutional structures and the skills to ensure proper information management (e.g. supporting the efforts of institutional libraries and documentation services and those of agriculture-related ministries).

- *Development agents*. These include local state agencies (extension agents and administrators) or NGOs, whose information needs are relative to farmers and organisational needs at grassroots level. They need skills to acquire and present information without imposing it (includes repackaging).

- *Researchers*. Researchers collaborate with other partners in the framework of national agricultural research systems (NARS), which is when research centres, universities, NGOs, and farmer organisations join forces. Researchers need current information on current trends in their fields and related areas.

Studies by Kaniki (1995) and Aina (1991) found that farmers required information on fertilisers, pest and disease control, planting materials, and credit and loans. Aina (1991) established that in order of priority, the top information needs of extension officers were: the control of major pests; credit and cooperatives; proper handling of pesticides; marketing and field supervision programmes; and organising farmers' associations.

5.4.2 Agricultural information flow

Agricultural information is a product of both research and extension systems. Information as an input of research includes the different sources that are accessed from libraries, personal collections, ICTs, etc. As an output, it is characterised by scientific publications and knowledge. This is communicated to farmers through extension systems. Kizilaslan (2006) and Reddy (2008) observe that agricultural information is considered an essential input to agricultural education, research and development, and extension. Potential beneficiaries include policy makers, planners, students and researchers, among other groups. Reddy (2008), notes that information is generated by institutions such as colleges, universities, experimental stations, and national and international research institutes. As shown in Figure 5.2, several public and private agencies at some point generate agricultural information which filters down to the different user groups or benefactors.

The flow of agricultural information

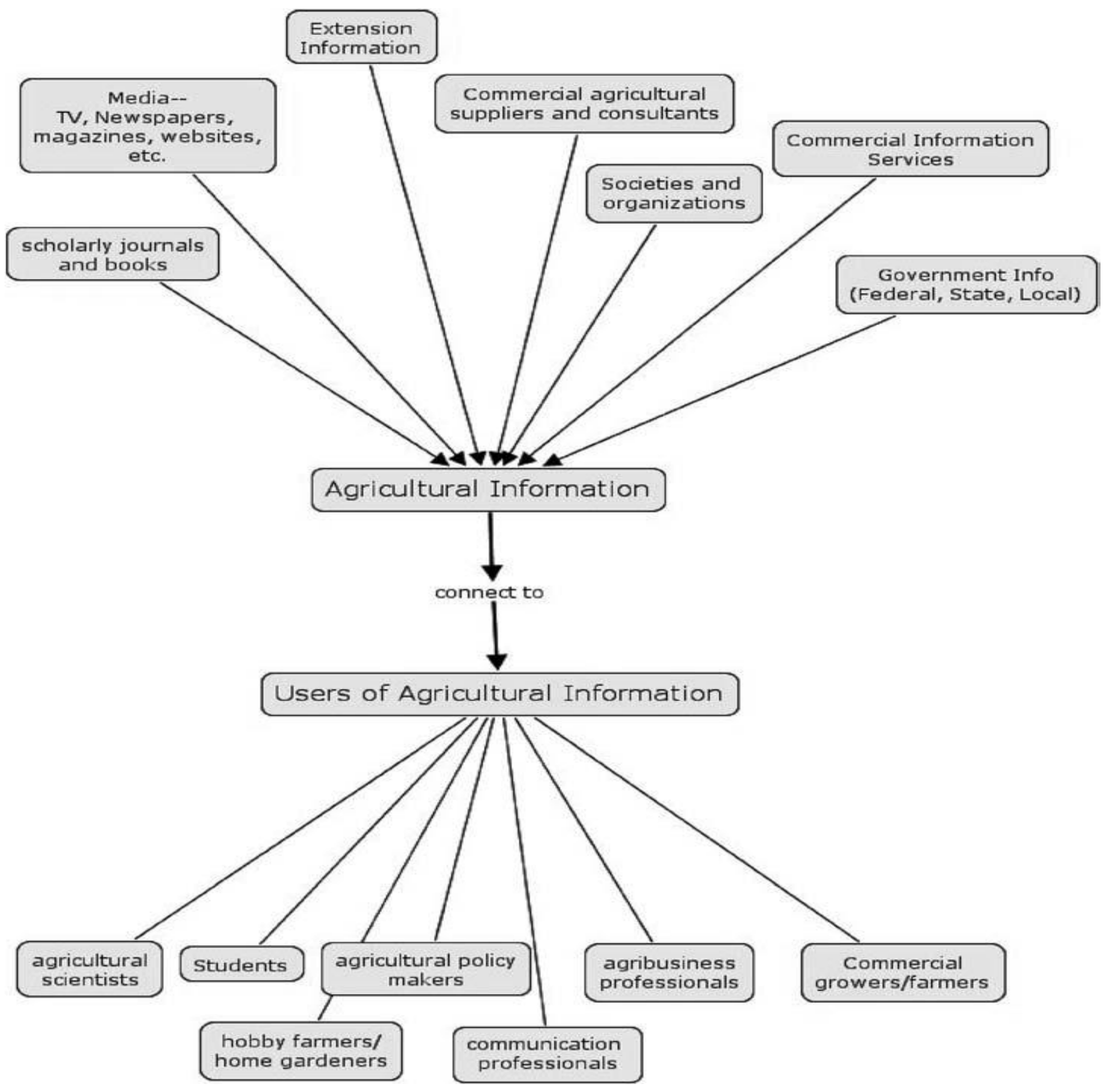

Figure 5.2: The flow of agricultural information

Adapted from Kizilaslan (2006)

Reddy (2008:2) and Kizilaslan (2006) also observe that traditional communication systems reflect a one-way flow of information, and the feedback is subtle. Information retrieval systems recognise the need for a two-way flow of communication with feedback, while in scientific information transfer; there are multiple participants with cross-communication between them. Agricultural information systems consist of four independent, interrelated components, namely development, documentation, dissemination, and diffusion of information (Reddy, 2008). Wolf, Just and Zilberman (2001:124) recognise that there are three functional levels of information systems, i.e.: end-users, who include decision makers in agricultural business; intermediaries, who may be analysts and advisors engaged in collecting and adding value to data and information in order to service a variety of decision-support needs of end-users; and primary producers, organisations engaged in data collection and economic research.

Majid and Eisenschitz (2000:146) looked at the information needs and information seeking behaviour of agricultural scientists in Malaysia, and found that there was an equal emphasis on both formal and informal sources of communication. Formal channels of communication were mainly books or journals, while informal communication included personal interaction through telephone calls, letters, e-mail, and conversations in meetings and conferences. Reddy (2008) likewise observes that formal and informal channels of communication are extensively used to interact with fellow scientists, editors, publishers, librarians, change agents and end-users. By observing the preferences of the different user groups, libraries are also better placed to provide relevant collections. Majid and Eisenschitz (2000:146) confirm this notion, observing that the majority of the agricultural scientists in their study perceived primary sources of information, particularly research and review articles, as more important in providing current information on scientific developments.

5.4.3 Channels used in agricultural information dissemination

According to Rivera (2000:31), the changing nature of agricultural information and the new global ideology are significantly shaping extension's development. Both the public sector's agricultural extension education institutions and the private sector's technology transfer activities have been affected. Rivera argues that agricultural information is changing in terms of content, the means by which it is transferred (format), and its marketability as a 'commodity'. Wesseler and Brinkman (2002:3) suggest that when scientists discover a new technology (e.g. a new crop variety), they must make sure that farmers know about it, and must also train extension staff, promote the technology on the radio, provide technical information in the form of brochures, and plant on demonstration plots so that farmers can see the variety growing.

Rivera, Qamar and Mwandemere (2005:38) indicate that mass media, computers, and their related technologies have become indispensible in administration and collaboration in organisations and institutions, and in the gathering, analysis and dissemination of information. FAO (2000:2) note that before mass media such as the radio and television, information used to be disseminated in paper-based form, meaning that it had to be physically brought to the user. New media and technologies have more recently been used for dissemination because they have the ability to reach wider audiences and are in some instances interactive. Encanto (2000) looked at the flow of information and information needs in the Philippines' national extension system and established that the radio was an important source of extension information. Extension workers and farmers received regular agricultural news from eight radio channels. The radio was favoured because most farmers owned or had access to a portable radio set which they could carry everywhere. Encanto (2000) also noted that information was broadcast regularly and in the local dialects for easy understanding.

5.4.4 Challenges facing agricultural information service provision

According to Thapisa (1997:197), agricultural information provision in the Southern African Development Community (SADC) region is characterized by inadequately developed and poorly stocked libraries and documentation centres. Aina (1991) commented on the perennial challenge of skilled library personnel, arguing that in order for agricultural librarians to function effectively in the provision of information to user populations, they need to possess skills in agricultural information handling. Thapisa (1997) and Asopa and Beye (1997:15-16) highlight the shortage of qualified and trained information professionals and lack of clarity about the status of library staff working in agricultural information services, particularly in the structure of agricultural information services, as well as not taking advantage of opportunities for information exchange. Other factors include lack of basic equipment, such as computers and internet access, to provide adequate, modern agricultural information services, and lack of adequate reading and storage space in libraries and documentation centres. The lack of funds has also grossly affected the development of agricultural libraries and documentation centres and their capacity to sustain subscriptions to scientific journals and collection development in developing countries.

Kizilaslan (2006:498) opines that agricultural information professionals must support agriculture by managing and improving access to a proliferating and increasingly complex array of information in a climate of shrinking resources. Thapisa (1997:199) argued that in order to develop an appropriate agricultural information delivery service in the respective SADC countries, there is a need to first establish an agricultural information policy in each country. The proliferation of ICTs and the advent of the open source initiative provide some relief to information professionals.

Dulle, Lwehabura, Mulimila and Matovelo (2001:190) suggest that access to timely and relevant information and the proper recording and organisation of information are key issues in the effectiveness of any research system. Their study revealed that the majority of agricultural researchers felt that information provision by many agricultural libraries in Tanzania was inadequate. Among the challenges faced by libraries were: lack of comprehensive journal collections; lack of up-to-date information; lack of information technology facilities (internet, CD-ROMs); inadequate funding; poor information access skills; and book mutilation, among other factors. Due to the poor collections, Dulle, Lwehabura, Mulimila and Matovelo (2001:190) found that the respondents (researchers) resorted to libraries outside the country or international organisations like ICRAF to address their information needs.

Asopa and Beye (1997:16) likewise observed that agricultural scientists in most developing countries are greatly disadvantaged in terms of the scientific information available to them, and where local information services are weak, these scientists see themselves cut off from developments in their own disciplines. A significant number therefore seek to emigrate to countries where they can more readily advance in their work and careers. Contrary to the above observations, Aina (1991) found that extension officers rarely used libraries as a source of agricultural information and relied mainly on their supervisors and colleagues, and occasionally on salesmen from agro-based industries.

5.5 Information and communication technologies in agriculture

Marker, McNamara and Wallace (2002:4) define ICTs as technologies that facilitate communication and the processing and transmission of information electronically. This includes the full range of 'old' and 'new' ICTs, from the radio and television, to telephones (fixed and mobile), computers and the internet. Mittal, Gandhi and Triphathi (2010:228) argue that any ICT intervention that improves the livelihoods of poor rural families is likely to have a significant impact (direct and indirect) on enhancing agricultural production, marketing, and post-harvest activities. Services that can be derived from using ICTs include: online information services; communication between researchers, extension (knowledge) workers and farmers; updates on current market information; weather forecasting; input suppliers; credit availability, etc. The management of information can also be enhanced through the creation of databases that detail resources. Websites can provide a platform for researchers and extension workers to access the latest information and also to obtain feedback from farmers.

5.5.1. Mobile phones

The ITU World Telecommunication or ICT Indicators database (2010) estimated that by the end of 2010, there would be 5.3 billion mobile cellular subscriptions worldwide, and access to mobile networks would be available to 90% of the world population, with 80% of the population living in rural areas. They further predicted that in the developing world, mobile cellular penetration rates would reach 68%, with the penetration rate in Africa expected to reach 41%. In 2009, Maritz (2009) observed that the number of Africa's mobile phone users was already higher than the United States.

What are the implications of mobile communication on agriculture? Dey, Newman and Prendergast (2011:47) suggest that in order to improve the contribution of mobile telephony and other forms of ICT to rural development, it is necessary for large mobile telephone operators and ordinary development workers to understand how groups, such as rural farmers, might effectively use mobile telephony and integrate it into their lives. Their study revealed that the social, occupational, and psychological benefits derived from mobile phone usage motivated the farmers to use and appropriate it through innovative use and adaptation despite language barriers, illiteracy, unfamiliar English terminology, translation challenges into local languages, and financial limitations (Dey, Newman and Prendergast 2011:47)

Mittal, Gandhi and Triphathi (2010:3) addressed the socio-economic impact of mobile phones on Indian agriculture, finding that information and communication technology (ICT) and mobile-enabled agricultural services act as instruments that deliver extension services and help to raise awareness amongst farmers. In terms of government investment in mobile telephony for rural communities, Mittal, Gandhi and Triphathi (2010:4) observed that the Chinese government invested US$1.13 billion in establishing mobile infrastructure for about 26,000 villages over the years through the state owned Mobile China to enable farmers to keep track of weather conditions or forecasts and product prices. Muto and Yamano (2008) found that the expansion of mobile phone networks and increase in mobile-density in Uganda has enabled higher market participation by farmers who produce perishable crops and who are located in remote areas, and helped them achieve higher prices by reducing the information asymmetry that existed between them and traders.

5.5.2 Challenges of ICT in agricultural extension and research

The application of ICTs for rural development must overcome significant challenges despite their numerous benefits if properly implemented. Munyua (2000) and Kalusopa (2005) attribute the challenges experienced in implementing rural ICT projects to lack of proper policies coupled with rigid regulations and high telecommunication tariffs and duty on equipment. Kalusopa (2005), for example, observed that the Zambian government's lack of involvement in the development of strategies for ICTs and the absence of a national IT co-ordination centre resulted in the duplication of efforts among three ministries in the country. Munyua (2000), Kumar (2005), and Kalusopa (2005) add that telecommunication costs and poor telecommunications and electricity infrastructure (such as low bandwidth for basic internet access) remain strong deterrents to access and utilisation. Kumar (2005:46) proposes that the cost of establishing such communication technology infrastructure and centres can be shared by the private and public sectors. There is also a severe shortage of material in local languages; the information available through ICTs is mostly in English, which most rural communities cannot read or write.

Mittal, Gandhi and Triphathi (2010:236), and Munyua (2000) also highlight the issue of gender bias, noting that women significantly lag behind men in their access to and use of ICTs, particularly in rural areas where women are likely to be the furthest removed from development opportunities. They also allege that when new technologies are introduced, they are seen as the domain of men, and women have therefore often been sidelined or left out of ICT-related initiatives. Illiteracy also makes the acquisition of basic ICT skills difficult. In order to enhance the development of ICT skills, Mittal, Gandhi and Triphathi (2010:236) and Munyua (2000) recommend the need to invest in training and advisory services for information intermediaries, telecentre staff, frontline workers, and women's groups. Focus should be on developing skills on how to use ICTs through practical and participatory approaches.

Kumar (2005:46) observes that farmers sometimes become suspicious or fearful that they may lose their traditional methods of farming through the adoption of ICTs. There is a need to win the confidence of these farmers, and make them aware of the benefits of ICT in agriculture (Ali and Kumar, 2010). In order to achieve this, Umrani and Jain (2010:231) suggest that as brokers between communication technologies and farmers, extension agents must be able to examine the appropriateness of various ICTs; their accessibility in rural and remote areas; and how to best reconcile costs and benefits. Extension agents must ensure that ICT access is gender sensitive and covers a diversity of cultures, languages, social strata and age groups.

5.6 Indigenous knowledge in agricultural research and extension

Warren (1991) and Tikai and Kama (2004:65) view indigenous knowledge (IK) as local knowledge that is unique to a given culture or society that has been developed overtime, mainly through the accumulation of experiences and an intimate understanding of the environment. The CTA Dossiers (2010) expands this to mean the sum total of the knowledge and skills which people in a particular geographic area possess and which enables them to get the most out of their environment. Most of this knowledge and these skills have been passed from earlier generations, but each new generation adapts and adds to this body of knowledge following changing circumstances and environmental conditions. Warren (1991) compares IK to the international knowledge system of universities, research institutes and private firms, and views IK to be the basis of local-level decision making in the areas of agriculture, healthcare, animal husbandry and traditional veterinary medicine, food preparation, postharvest preparation and preservation, natural resources management, and education, among others.

Dakora (1996:109) observes that since its inception in the Nile more than ten thousand years ago, agriculture has undergone considerable changes and presently incorporates both ‘traditional farming’ and mechanized agriculture. The evolution and continued co-existence of both systems of production indicates their collective importance in meeting the food needs of the growing human population. Dakora (1996:110) and Akullo et al. (2007:2) argue that for centuries, farmers have planned agricultural production and conserved natural resources with the instruments of indigenous knowledge (IK). Akullo et al. (2007:2) explain that IK is stored in people’s memories and activities; it is expressed in stories, songs, folklore, proverbs, dance, myths, cultural values, beliefs, rituals, community laws, local languages and taxonomy, agricultural practices, equipment, materials, plant species and animal breeds.

Various studies have been carried out on the role of indigenous knowledge systems and agriculture in Africa, Asia and the Pacific. Tikai and Kama (2004) looked at indigenous knowledge and its role in sustainable agriculture in Samoa, and found that it is still used to address issues such as managing soil fertility, pest control and diseases, weed control, soil preparation, planting materials, harvesting, and the storage of indigenous crops and animals. The study concluded that indigenous knowledge should be recorded and used to devise innovative research for agricultural researchers, extension workers, and development workers. IK was also recognised as important in addressing sustainable food security and the conservation of a variety of plants and animals.

Akullo et al. (2007) investigated indigenous agricultural practices using local knowledge by researchers in Uganda. The study revealed that IK was used by all categories of farmers, and to a large extent, agricultural research improves on already existing techniques - mulching, fallowing, and crop rotation fall under both indigenous and modern techniques of soil conservation and fertility improvement. Examples showed that farmers used concoctions such as ash, goat droppings and water as insecticide to control pests and diseases, ash to protect beans, and in some superstitious beliefs, farmers plant 'lab-lab' around their farms to prevent night dancers from intruding on their gardens (Akullo et al., 2007:6). Fenta (2009:3) found that in Ethiopia, the IK techniques still practiced include soil fertility and conservation, traditional waterways and stone terraces, crop rotation, and manuring. Indigenous pest control technologies consist of spraying animal urine, dusting seeds with ash and pepper, mixing animal urine and donkey waste, and cutting and burning infected plants.

Rajasekaran, Martin and Warren (1994) looked at a framework for incorporating indigenous knowledge systems into agricultural extension in India, identifying local people, including farmers, landless labourers, women, rural artisans and cattle rearers, as custodians of indigenous knowledge systems. Rajasekaran, Martin and Warren (1994:29) concluded that incorporating IK into agricultural extension education programmes would develop an understanding of the *emic* perspectives of local people while bridging the communication gap between insiders and outsiders. It would also recognize the accomplishments of local farmers and increase their participation in integrating, utilizing, and disseminating what already exists. Fenta (2009:3) observes that in Ethiopia, the absence of an effective linkage between indigenous knowledge and conventional knowledge has been identified as one of the major barriers to the development of agriculture in general and of agricultural research and extension systems in particular.

Rao and Ramana (2007) looked at indigenous knowledge practices among primitive tribal groups of Andhra Pradesh, concluding that there was an urgent need to document the existing indigenous knowledge of these primitive tribal groups and evaluate their value for bio-diversity conservation. Denucci and Fre (2003:1) observe that despite the plight of nomadic herders, pastoral systems have received little or no attention from researchers and extension services. Denucci and Fre (2003:30) argue that a reconsideration of pastoral indigenous knowledge and information systems (ethno-veterinary medicine) could be helpful in tailoring new extension services aimed at pastoralists in their special circumstances. For diffusion of extension messages, they suggest the radio as the most appropriate medium given its wide availability in rural communities.

5.7 Collaboration: the private sector and international organisations in AKIS/ RD

According to Farrington (1997:213), many observers have suggested that agricultural and rural development strategies would benefit from increased collaboration between government departments and non-governmental organisations. The Editorial/ Food Policy (2000:379) suggested that increased agricultural productivity between the 1970s and 2000 could largely be attributed to the development and dissemination of new agricultural technologies generated principally through partnerships between national and international agricultural research systems. Reddy (2008:4) observes that publicly funded agricultural research is going through a serious crisis almost everywhere due to declining budgets and also because scientific projects have been carried out in a ways that limited opportunities for interaction with farmers and private enterprises.

New approaches point to increased private sector participation in the fields of biotechnology and information technology in agriculture. Non-governmental organisations (NGOs) are striving to relate the real problems of farmers to the academic perspectives of scientists, and this is influencing the modalities of providing extension services to resource-poor farmers. Swanson and Rajalahti (2010:51) postulate that as part of the development process, agricultural extension and advisory systems will become increasingly pluralistic as the private sector increasingly provides technical advisory services to farmers, in particular services related to the sale and purchase of production inputs.

5.7.1 The role of international organisations

5.7.1.1 Extension

In their frustration with the current performance of public extension services, Swanson and Rajalahti (2010:51) note that donor agencies have started shifting more project resources to NGOs and other service providers that have an immediate and positive impact on the rural poor. Umrani and Jain (2010:75) likewise observe that an important strategy that is being used to address state (public sector) failures in agricultural extension is to involve NGOs, farmers' organisations, and private sector agencies in the management and execution of extension services. The role of the private sector (for example seed, fertiliser and other agricultural companies) in extension has been linked to the marketing or promotion of their products. For example, as noted in Chapter two, SeedCo employs qualified agronomists who are also salespersons, and are hence able to perform the dual tasks of extension and marketing. NGOs are also employing qualified agricultural personnel as part of their extension outreach programmes (see 2.6). However, Swanson and Rajalahti (2010:130) caution that although private sector firms and/or NGOs can achieve more rapid progress in establishing and providing extension services to different types of farmers, there are long term sustainability issues, particularly with respect to funding. They argue that it is more effective to strengthen and transform existing agricultural extension organisations by solving their primary organisational and resource problems rather than implementing new programmes that will not be sustainable in the long run.

5.7.1.2 Research

The Consultative Group on International Agricultural Research (CGIAR) - a global partnership that unites 15 organisations engaged in research for sustainable development - was established to lead, coordinate and support the international centres/ organisations that are part of the group (CGIAR, 2011). According to Renkow and Byerlee (2010:391), one of the core missions of CGIAR is growth in agricultural productivity. Renkow and Byerlee (2010:400) observe that CGIAR's research contributions to genetic improvement, pest management, natural resources management and policy development, have on average yielded a strongly positive impact relative to investment. This is despite challenges such as time constraints on the funding of projects and/or research that is conducted by researchers who are not based in the country/ area under investigation.

The UK Department of International Development (DFID) is one of the founding members of CGIAR and provides continued, unrestricted core funding to all the 15 centres and challenge programmes (DFID, 2011). The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is another example from CGIAR that has contributed towards research and information generation, and is one of several international centres based in Zimbabwe. According to Dar and Twomlow (2007:407), studies by ICRISAT and other institutions have identified key challenges in adoption by small-holder farmers, and these include: the poor research-extension-farmer linkage; the need to strengthen capacities of institutions and farmers' organisations to support agricultural production systems; poor information flow; lack of communication on rural development issues; and the need to integrate a gender perspective in agricultural research and training.

5.7.1.3 Information provision

International research organisations play an important role in information documentation and dissemination. As shown in the Kenyan study by Owino (2000:15), ICRAF, ILRI, ICIPE, for example, all maintain comprehensive libraries that provide information to national institutions and individuals. These organisations also facilitate access to global information databases and those of other international organisations like the World Bank, FAO, UNEP, etc. International organisations also facilitate low cost subscriptions to information databases for targeted developing countries.

The Information Training and Outreach Centre for Africa (ITOCA) (2011) in conjunction with Cornell University, led by the Food and Agricultural Organisation of the United Nations (FAO), World Health Organisation (WHO) facilitates access and usage training to databases like Access to Global Online Research in Agriculture (AGORA), whose goal is to increase the quality and effectiveness of agricultural research and training in low income countries. This affords researchers, policy makers, students and extension workers quality, relevant, and timely access to information via the internet. The Essential Electronic Agricultural Library (TEEAL) is a version of AGORA that is available on

CD-ROM and external hard-drive for those without internet access. The United Nations Environmental Programme (UNEP) coordinates the database, Online Access Research in the Environment (OARE), which enables developing countries to freely access one of the world's largest collections of environmental sciences. Another recent initiative for developing countries is Plant Resources for Tropical Africa (PROTA), which is a non-profit organisation that intends to synthesize the dispersed information on approximately 7,000 useful plants in tropical Africa, and to provide wide access to the information through web databases (internet based), books, CD-ROMs, and other special products (PROTA, 2011).

The Technical Centre for Agricultural and Rural Cooperation (CTA), through its Information Services and Dissemination Department, produces and distributes print and electronic publications (including Spore) and provides a range of information services. Its core activities are aimed at increasing the availability of agricultural and rural development information and increasing the awareness of information sources (CTA, 2011). Information is distributed through a variety of channels and projects are usually done in conjunction with other organisations, for example Cornell University and the TEEAL initiative.

International organisations and the private sector play a complementary role in extension and the diffusion of research and new technologies to rural communities, thus contributing to hunger and poverty alleviation. The role of the public sector has been grossly affected by poor funding from governments and this has seen NGOs and the private sector assuming some of the governments' responsibilities through donor funding.

5.8. Related studies

Various studies have been carried out on agricultural knowledge and information systems, and these have been consistently referred to in the present and preceding chapters. To reiterate, AKIS integrates farmers, agricultural educators, researchers and extension workers in harnessing information and knowledge for increased agricultural production. Studies have either addressed AKIS in its entirety or have focused on selected aspects.

FAO (2000) provides strategic guidelines for integrating education, research and extension into AKIS, emphasising in particular the role of farmers as participants rather than mere recipients of agricultural innovations. Rivera, Qamar and Mwandemere (2005) conducted a comparative review of ten country studies on AKIS in order to gain an insight into the operation of these systems and how governments were striving to integrate them. The study concluded that the globalisation issues affecting agriculture (markets, international trade, information and communication technologies, etc.) are reflective of the rapid and innovative changes affecting the world. Public and private sector collaboration in the areas of research and extension was identified as one of the ways to boost agricultural finance through investments, although it was necessary for governments to provide incentives and other favourable conditions.

Rees et al. (2000) conducted an AKIS field study on four selected districts in Kenya, focusing on the implications for technology dissemination and development. The study established that the major sources of knowledge of smallholder farmers were local (family, neighbours, etc.), and informal sources included churches and chiefs' 'barazas' (community meetings). Ndungu, Nkonge and Rees (2000) looked at AKIS in disseminating soil management technologies in Kenya, and concluded that the Ministry of Agriculture and other government departments were the main sources of agricultural information in that country, ahead of NGOs.

Studies that have addressed ICTs in agriculture include Kiplang'at (1999; 2004), who looked at the diffusion of ICTs in communicating agricultural information among agricultural researchers and extension workers in Kenya. Dulle et al. (2002) addressed the application of information technology for research among researchers in Tanzania, while Kalusopa (2005) looked at the challenges of utilizing ICTs for small scale farmers in Zambia. The above studies on ICTs all found that the infrastructure was not developed enough to support proper information dissemination, and in all cases, this was attributed to poor funding from the government. The studies also revealed that the facilities that were available were not being fully utilised, particularly in the case of Tanzania.

Several studies have been conducted on AKIS in Tanzania. Manda (2002) looked at information and agricultural development in Tanzania by evaluating the relationship between the flow of information and the pace and process of agricultural change in rural Tanzania. As with Kiplang'at above, Manda (2002) applied Rogers' Diffusion of Innovations model to guide the study. Dulle (2000) looked at extension approaches in disseminating agricultural information to extension workers. Among the findings of this study were the preferred sources of information, which were identified as personal collections, conferences and workshops, and reading newspapers. Contact with researchers and the use of libraries were found to be very unpopular with extension workers.

Lwoga (2011), Lwoga, Ngulube and Stilwell (2010) looked at knowledge management approaches in managing indigenous agricultural knowledge, and established that IK is acquired and shared spontaneously in groups/ communities and is subject to loss, hence knowledge management models should be used to manage and integrate IK with other systems. ICTs were found to influence and contribute to such processes. Bagnall-Oakeley et al. (2004) focused on farmers' indigenous agricultural knowledge and information systems and their implications on contracted research and extension systems. The study analysed farmers' information networks (where and how they got information), type of information, delivery preferences, and frequency of use of information services. The study found that farmers had a number of information requirements, and information was acquired through both formal and informal sources that also acted as channels of transmission, including churches, other farmers and the media.

5.9 Implications for the current study

The reviewed literature demonstrated the influence of globalisation on the agricultural landscape and how this has impacted on national systems. Lack of policies that respond to these changes and point to new directions affects how institutions respond to these changes.

Changes in agricultural research technologies and methodologies imply that research approaches have become multidisciplinary and multi-institutional. This requires us to recognise the role of other institutions, including NGOs and private sector organisations. Collaborative research promotes the sharing of resources and facilities through staff exchange and publication. Public sector institutions could be major beneficiaries in such partnerships as they tend to have fewer resources compared to the private sector and international research institutes such as SeedCo, CIMMYT and INCRISAT. Although private sector institutions and NGOs are not part of this study, it was believed that their influence would emerge in the responses of public sector personnel.

The role of extension services has also evolved in response to various influences of globalisation. The private sector - through the marketing of inputs - and NGOs are now performing extension functions, and this has implications on the targeted end-users. With this trend, there is the possibility that roles will be duplicated, e.g. targeting the same farmer or clientele, hence there is a need for collaboration among stakeholders. However, challenges may also arise as private companies' main focus is marketing, whereas public sector extension is a public good.

Literature has also demonstrated that agricultural information is acquired from and distributed through a variety of sources. These range from public meetings, conferences, seminars, radio, television, etc., and different users will have different preferences depending on the messages that are being conveyed and their literacy levels. For example, Dulle (2000) found that among extension workers, contact with researchers and the use of libraries were very unpopular. The impact of ICTs in extension means that access and the dissemination of agricultural information has assumed new dimensions and formats (mobile phones, the internet, etc.) to which farmers, researchers, and extension workers have to respond, if they have not already.

Funding is one of the main problems affecting research, extension, and the dissemination of agricultural information. It has negatively affected the resource base of most public sector institutions' infrastructure capacity, and is contributing to high employee turnover. Privatization and charging for research and extension services are some of the proposed or already implemented ways of raising revenue by governments.

5.10 Summary

Wesseler and Brinkman (2002:4) describe how the "preachy" extension agent, the "ivory tower" researcher, the "status-conscious" bureaucrat, and the poorly organized library eliminate the possibility that users (farmers) will be able to get the information that they need. Agricultural extension and research organisations, like most other disciplines and institutions, are not immune to the various developments taking place around them (Umrani and Jain, 2010:193). This chapter has focused on agricultural research and extension and the impact of globalisation and liberalisation. Particular focus has been placed on funding and privatisation and how these are changing the face of research and extension systems. The chapter has also addressed agricultural information services by looking at the different stakeholders and their information needs, the flow of agricultural information, the channels of communication, and the challenges in agricultural information provision.

The chapter also endeavoured to address the role of ICTs in agriculture, bringing in the 'new' concept of mobile phones and the challenges facing their application. IKS was also discussed within the context of research and technology dissemination and the implications of ICTs. The last part of this chapter looked at the role of NGOs and international organisations in enhancing agricultural research, extension, and information dissemination.

In reviewing literature for this chapter, the researcher was cognisant of the fact that the preceding chapters addressed related aspects of the different subjects covered, and tried to avoid any repetition.

The next chapter provides the research methodology of the study.

CHAPTER SIX

RESEARCH METHODOLOGY

6.1 Introduction

This chapter presents the study's research design and methodology, research instruments, and sampling and data analysis techniques. According to Leedy and Ormrod (2010:2), research is a systematic process of collecting, analysing, and interpreting information (data) in order to increase our understanding of a phenomenon of interest. Welman, Kruger and Mitchell (2005:2) define research as "the process of obtaining scientific knowledge by means of various objective methods and procedures." 'Objective' in their definition indicates that these methods and procedures do not rely on personal feelings or opinions, and that specific methods are used at each stage of the research process.

According to Kumar (2005:7), in order for a process to be called research, it is imperative that it has the following characteristics:

- **Control**. This implies that in exploring causality in the relationship between two variables (cause-effect relationships); the researcher must set the study in a way that minimises the effects of other factors that could affect the relationship. Because one cannot control external factors in the social sciences, an attempt is often made to quantify them.

- **Rigour**. The researcher must be scrupulous in ensuring that the procedures that are followed in finding answers to questions are relevant, appropriate and justified.

- **Systematic**. This implies that the procedures adopted in undertaking an investigation follow a logical sequence, i.e. different steps cannot be taken haphazardly.

- **Valid and verifiable**. This implies that whatever the researcher concludes on the basis of research findings is correct and can be verified by the researcher and others.

- **Empirical**. This means that any conclusions drawn are based on hard evidence gathered from information collected from real-life experiences, experiments, or observations.

- **Critical**. The process adopted and the procedures used must be able to withstand critical scrutiny.

Kumar (2000) acknowledges that these characteristics vary markedly between the physical and the social sciences, and within the social sciences.

6.2 Research methodology

Leedy and Ormrod (2010:6) explain that the basic framework underlying and unifying any research project is its methodology. Research methodology directs the whole endeavour; it controls the study, dictates how the data is acquired, arranges the data in logical sequences, sets up an approach for refining and synthesizing the data, suggests a manner in which the meanings that lie below the surface of the data become manifest, and finally yields one or more conclusions or series of conclusions that lead to an expansion of knowledge. According to Leedy and Ormrod (2010:6), research methodology has two primary functions:

i. To dictate and control the acquisition of data

ii. To collate data after its acquisition and extract meaning from it

Welman, Kruger and Mitchell (2005:2) explain that while research methodology considers and explains the logic behind research methods and techniques, it has a much wider scope than research methods (such as opinion polls), which in turn have a wider scope than research techniques. Creswell and Clarke (2007:5) view methodology in relation to the philosophical framework and the fundamental assumptions of a research project, i.e. a framework that relates to the entire process of a research project.

6.3 Research paradigm

Gephart (1999) observes that there has been considerable interest over the years in the role of philosophical assumptions and paradigms in conducting research. Kumar (2005) identifies two main paradigms that form research in the social sciences, namely the positivist and naturalistic approaches, but other researchers focus on three main paradigms in social research. Neuman (2011:80) explains that these three approaches are based on a major re-evaluation of social science that began in the 1960s. Neuman (2011:81) and Gephart (1999) identify the three approaches as:

i. Positivist social science

Positivism emphasises the discovery of causal laws, careful empirical observations, and value free research (Neuman, 2011:81). Gephart (1999) expounds that positivism assumes an objective world which scientific methods can more or less readily represent and measure, and seeks to predict and explain causal relations among key variables. Welman, Kruger and Mitchell (2005) assert that positivism adopts a quantitative approach.

ii. Interpretive social science

The interpretive approach emphasizes meaningful social action, socially constructed meaning, and value relativism (Neuman, 2011:87). It assumes that the purpose of social science is to understand social meaning in context, and that humans are interacting social beings who create and reinforce shared meaning. Gephart (1999) observes that 'interpretivists' assume that knowledge and meaning are acts of interpretation; hence there is no objective knowledge that is independent of thinking, reasoning humans. Gephart (1999) lists the research methods used in the interpretive approach as ethnography, observation, and interviews, among others.

iii. Critical social science

According to Neuman (2011:95), critical social science researchers conduct research in order to critique and transform social relations and empower people, particularly less powerful people, by revealing the underlying sources of social relations. Gephart (1999) explains that the goal of critical theory is to uncover hidden interests, expose contradictions, enable more informed consciousness, and displace ideology with scientific insight. Gephart (1999) and Neuman (2011) indicate that research methods in critical theory include field research, historical analysis, and dialectical analysis.

Gephart (1999) observes that positivist concerns to uncover truths and facts using experimental or survey methods have been challenged by interpretivists who assert that these methods impose a view of the world on subjects rather than capturing, describing, and understanding their world views. The author further observes that assessment in interpretive research differs from positivist theory assessment in that positivists seek rigor using statistical criteria and the concepts of reliability and validity to assess the quality of quantitative findings. Willis (2007:91) argues that while positivist research is conducted in an objective way and using objective methods, critical theory research is often subjective and conducted with emotion and ideological bias in the "real world".

Leedy and Ormrod (2010:94) observe that quantitative (positivist school) and qualitative (interpretive school) approaches involve similar processes, such as the formation of one or more hypotheses, review of related literature, and collection and analysis of data. However these processes are often combined and carried out in different ways, leading to distinctively different research methods. Neuman (2011:181) observes that in both styles, data is an empirical representation of concepts while measurement links data to concepts. However, differences in the styles of research and the types of data mean that they approach the measurement process differently. In other words, according to Creswell and Clarke (2007:29), both paradigms address the same elements in the process of research, but differ in how researchers implement each step. They assert that these differences are not opposites, but can be viewed as differences on a continuum.

This study applied both qualitative and quantitative research methodologies, referred to as triangulation. Neuman (2011:149) explains that triangulation is often used by quantitative and qualitative social researchers because it allows them to view a phenomenon from several different angles.

6.3.1 Qualitative research

According to Fox and Bayat (2007:7) and Green (2005:46), qualitative research is the predominant paradigm of research in the social sciences. They observe that qualitative research methods are designed to scientifically explain events, people, and matters pertaining to [people and events] and do not depend on numerical data, although qualitative research may also make use of quantitative methods and techniques. Leedy and Ormrod (2010:95) and Devlin (2006) expound that qualitative research involves looking at characteristics or qualities that cannot be easily reduced to numerical values. Leedy and Ormrod (2010:95) observe that while qualitative researchers seek a better understanding of complex situations, the qualitative research process is more ‘holistic’ and ‘emergent’, with the specific focus, design, measurement instruments (e.g. interviews) and interpretations developing and being modified during the process. Likewise Willis (2007:196) explains that qualitative research typically does not operate within strict technical guidelines and is not based on pre-specified methods and detailed hypotheses that will rigidly guide the scholar throughout the study. Neuman (2011:158) observes that qualitative researchers remain open to the unexpected, are willing to change the direction or focus of a research project, and may abandon original research questions in the middle of the research. Willis (2007) and Burns (2000) argue that technical criteria in a qualitative study are simply not as important as they are in positivist research.

Fox and Bayat (2007:65) explain that the criteria for selecting a qualitative research design are often derived from the following: perspective favoured by a particular researcher, the expertise of the researcher, nature of the research problem, and the audience for whom the research is intended. Leedy and Ormrod (2010:137), Fox and Bayat (2007:69) and Neuman (2011) identify the following qualitative methodologies: biographical, case studies, ethnography, grounded theory, phenomenology, and content analysis. This study employed content analysis and interviews as research instruments under the qualitative approach.

6.3.2 Quantitative research

Fox and Bayat (2007:7) observe that quantitative research is concerned with things that can be counted, and one of its principal characteristics is the use of statistics to process and explain data and to summarise findings. Creswell (in Leedy, 1997:104) defines quantitative research as an enquiry into a social or human problem based on testing a theory that is summarised or divided into variables, measured numerically, and analysed using statistical procedures in order to determine whether the predictive generalisation is true. Leedy and Ormrod (2010:94) describe quantitative research as looking at the amounts or quantities of one or more variables of interest. They explain that quantitative researchers seek explanations and predictions that they can generalise onto other persons and places, the intent being to establish, confirm, or validate relationships and to develop generalisations that contribute to existing theories. Leedy and Ormrod (2010:95) are of the view that quantitative studies represent the mainstream approach to research, with carefully structured guidelines for conducting them. Unlike the grounded theory, concepts, variables, hypotheses and methods of measurement tend to be defined before the study begins and remain unchanged throughout the study.

According to Miller (2003:237) and Neuman (2011:151), most quantitative researchers' approach to the social sciences is positivist, the argument being that data is numerate, and it is possible to measure and describe social phenomena numerically. Leedy and Ormrod (2010:96) and Neuman (2011:179) argue that all research requires logical reasoning. They observe that quantitative researchers treat measurement as a distinct step in the research process that occurs prior to data collection, with its own specific terminology and techniques**.** Quantitative researchers tend to rely heavily on deductive reasoning, beginning with certain premises or abstract ideas (e.g. hypotheses, theories) and then drawing logical conclusions from them.

6.3.2.1 Survey research

Research strategies commonly fall into five major categories, namely experimental, survey, archival analysis, historical or case study (see Table 6.1 below). Each method has its own logic and provides an alternative way of collecting and analysing empirical evidence (Leedy and Ormrod, 2010; Neuman, 2011; Miller, 2003; Walliman, 2005).

Table 6. 1 Research Strategies

Strategy	Form of research question	Requires control over behaviour or events	Focuses on contemporary events
Experimental	How, why, what if?	Yes	Yes
Survey	Who, what, where, how many, how much?	No	Yes
Archival analysis	Who, what, where, how many, how much?	No	Yes/No
Historical	How, why?	No	No
Case study	How, why?	No	Yes

Source: Yin (1994:6)

The study employed the survey research method in order to collect data on the information needs and challenges of agricultural researchers and extension workers in Zimbabwe. Leedy and Ormrod (2010:187), Zikmund (2003:175) and Welman, Kruger and Mitchell (2005:152) explain that survey research involves acquiring information about one or more groups of people (their characteristics, opinions, attitudes, previous experiences) by asking them questions and recording their answers. According to Frankfort-Nachmias and Nachmias (1996:245) and Neuman (2011:272), the survey method is the most important data collection method in the social sciences and related fields as it is used extensively to collect information on numerous subjects of research. Babbie (2008:270) agrees that survey research is probably the best method available to a social researcher who is interested in collecting original data in order to describe and measure attitudes and orientations in a large population. Babbie (2008:271) observes that surveys may be used for descriptive, explanatory and exploratory purposes, especially where individuals are units of analysis. Leedy and Ormrod (2010:187) articulate that in a survey, the researcher poses a series of questions to willing participants; summarises their responses with percentages, frequency counts, or more sophisticated statistical indexes; and draws inferences about a particular population from the responses of the sample.

Neuman (2011:273) emphasises that although categories overlap, the following can be determined using a survey: behaviour, attitudes/ beliefs/ opinions, characteristics, expectations, self-classification, and knowledge. Zikmund (2003:175) explains that the type of information gathered in surveys varies considerably depending on a survey's objectives. Zikmund further observes that most surveys have multiple objectives, pointing out that although it has been suggested that surveys are conducted to quantify certain factual information, certain aspects of surveys may also be qualitative. According to Taylor, Sinha and Ghoshal (2006:37), surveys are often classified as either analytical or descriptive, where the concern of analytical surveys is to explore associations between variables, while descriptive surveys, such as opinion polls and consumer research, are concerned with fact finding.

Leedy and Ormrod (2010:187) emphasise that by drawing conclusions from one transitory of data, we may extrapolate about the state of affairs over a longer period of time. Neuman (2011:43) explains that in survey research, researchers use written questionnaires or formal interviews to gather information about the backgrounds, behaviours, beliefs and attitudes of a large number of people. He observes that often, researchers select the people for a survey using random sampling so that they can legitimately generalise information from the sample onto a larger population. Fox and Bayat (2007:87) observe that in a survey, data is primarily collected using pre-formulated questions arranged in a pre-determined sequence in a structured questionnaire. Neuman (2011:43) notes that survey data is typically summarised in charts, graphs, or tables, and analysed using statistics.

6.4. Study area and population

This section is concerned with where the study was carried out and the objects investigated. Welman, Kruger and Mitchell (2005:52) and Neuman (2011:224) define a population as the total collection of all units of analysis about which the researcher wishes to make specific conclusions. Fox and Bayat (2007:144) and Taylor, Sinha and Ghoshal (2006:40) define the target population as the totality of the respondents who would meet the researcher's criteria. They assert that the population has to be determined carefully as the research sample will be drawn from it.

The target population consisted of all the agricultural researchers and extension workers within the public sector falling under the Department of Research and Specialist Services (DR&SS) and the Department of Agricultural Technical and Extension Services (AGRITEX) of the Ministry of Agriculture, Mechanisation and Irrigation Development (MoAMID) in Zimbabwe. The study also looked at the agricultural information services provided by personnel in the Central Library and agricultural research institute libraries.

6.5. Sampling

According to Burns (2000:83), the major task in sampling is to select a sample from the defined population using an appropriate technique that ensures the sample is representative of the population and, as far as possible, not biased in any way. The purpose of sampling is to be able to make generalisations about a population based on a scientifically selected subset of the population (Rea and Parker, 2005:115). Bhattacharyya (2003:78) observes that while the ideal solution in determining the true or actual values of the different parameters of a population would be to take into account the entire population, this is often not feasible due to cost, time, labour and other constraints. Sampling is considerably more economic. There are basically two types of sampling methods: probability and non-probability sampling methods. This study applied both sampling techniques.

6.5.1. Probability sampling

In probability sampling, each unit of the population has the probability of being selected as a unit of the sample. It is a method of selection where all the items in the population have a calculable probability of being selected (Sinha and Ghoshal, 2006:44; Panneerselvam, 2004:193). This probability varies and is dependent on the method of probability sampling. Leedy and Ormrod (2010:205) expound that in probability sampling, the researcher can specify in advance that each segment of the population will be represented in the sample. They assert that this is the distinguishing characteristic that sets it apart from non-probability sampling. Rea and Parker (2005:157) list two characteristics of probability samples:

i. The probability of selection is equal for all members of the population and at all stages of the selection process

ii. Sampling is conducted with elements of the sample selected independently of one another (one at a time)

Neuman (2011:227), Panneerselvam (2004:192), Kothari (2004:62-66), Zikmund (2003:368), Bhattacharyya (2003:76), and Leedy and Ormrod (2010:205) identify five probability sampling methods, briefly outlined below:

- Simple random sampling

  In simple random sampling, a researcher creates a sampling frame and uses a pure random process to select cases, ensuring the inclusion of each and every sample of the population so that each sampling element will have an equal chance of being selected.

- Systematic sampling

This is a special kind of random sampling in which the selection of the first unit of the sample from the population is based on randomisation, and the remaining units of the sample are selected from the population at fixed intervals of ***n***, where ***n*** is the sample size.

- Stratified sampling

Under stratified sampling, the population is divided into several sub-populations (called 'strata') that are individually more homogeneous than the total population, and the items are selected from each stratum to constitute a sample. Members within each stratum have similar attributes but the members between strata have dissimilar attributes. With stratified sampling, the aim is to use prior knowledge of the population to select relatively homogeneous strata.

- Cluster sampling

In cluster sampling, the total population is divided into a number of relatively small sub-divisions which are themselves clusters of still smaller units and then some of these clusters are randomly selected for inclusion into the overall sample. With cluster sampling, it is desirable for each cluster to be a microcosm of the entire population so that the full variability of the population is captured.

- Multi-stage sampling

The need for multi-stage sampling arises from economic considerations when the geographical area to be covered is very extensive and travel costs need to be minimised. This technique employs more than one stage to sample the population and helps in the design of a smaller sampling frame which will make a study practicable in terms of cost and time.

The probability sampling techniques employed in this study were random, stratified, and cluster sampling. The researchers were placed into sub-populations (strata) according to divisions/ areas of research and research institutes in the DR&SS, i.e.: Livestock and Pastures Research, Crops Research, and Research Services. Simple random sampling was then used to draw a sample from the Research Services division. There was no sampling of researchers from the other divisions (Livestock and Pastures Research and Crops Research) as the numbers were considered to be too low. Extension workers were drawn from the Department of Agricultural Technical and Extension Services (AGRITEX)'s two divisions, namely the Technical and Field divisions. In the extension staff category, simple random sampling was used to select extension staff from Mashonaland Central province, where the clusters followed the already defined district setup.

6.5.2. Non-probability sampling

Kothari (2004:59) explains that non-probability sampling is a sampling procedure which does not afford any basis for estimating the probability that each item in the population has of being included in the sample. Without such quality, the researcher cannot analyse the sample in the context of normal distribution (Rea and Parker, 2005:172). In other words, in non-probability sampling, units of analysis in the population do not each have an equal chance or do not have a chance of being included in the sample (Fox and Bayat, 2007:58). Neuman (2011:220), Kothari (2004:59), Leedy and Ormrod (2010:211-213), Panneerselvam (2004:200), and Taylor, Sinha and Ghoshal (2006:48) highlight convenience sampling, quota sampling, snowball sampling, and purposive or judgemental sampling as non-probability sampling techniques.

- Convenience sampling

This technique takes units that are readily available - the researcher may select anyone he/she happens to identify.

- Quota sampling

The researcher first identifies relevant categories of cases or people, then decides how many to get in each category.

- Snowball sampling

Initially, a certain number of sampling units is randomly selected, and later, additional sampling units are selected based on a referral process.

- Purposive sampling

The researcher uses a wide range of methods to locate all possible cases of a highly specific and difficult to reach population.

Purposive sampling was used in order to investigate different categories of staff with extension workers being drawn AGRITEX's Technical and Field divisions. The sampled populations were provincial, district and ward/village extension officers, the different researcher categories, policy makers, and other key informants.

6.6. Sample Size

Saslow (1982:412) and Kumar (2011:194) define the sample size as the number of individuals included in a study from whom the required information is obtained. The size of the sample has an indirect effect on the degree of accuracy desired in research and this necessitates that the sample size be carefully chosen to ensure that there are sufficient participants to meet all the conditions of the study (Ramadass and Aruni 2009:15; Graziano and Raulin 2004:336).

6.6.1. Researchers

The category of researchers was drawn from the three divisions of the DR&SS, namely:

i. The Division of Animal and Pastures Research's four institutes;

ii. The Division of Crop Research's six institutes; and

iii. The Division of Research Services' seven institutes.

The research institutes are distributed in different agro-ecological zones across Zimbabwe, with headquarters at the Ministry's DR&SS offices in Harare (Figure 2.2). Most institutes under the Research Services division are housed in the DR&SS offices in Harare. Researchers at the head offices were also targeted.

The target population for researchers, excluding research technicians, was initially set at 34 heads or chief research officers and 153 research officers. When a final check was done before the distribution of the questionnaires, it became evident that the numbers were less, attributed mostly to staff movement. For example, research officers who were chief researchers or heads of institutes were in acting capacity on a rotational basis. In the Biometrics institute for example, initial figures were 2 head or chief research officers and

6 research officers, but on the ground there was one head or chief research officer and one research officer. A final sample of 111 research officers (including chief/ senior and sectional heads) from DR&SS's research institutes distributed across the five agro-ecological zones was targeted, which included researchers at the head office. The participation of the directors of the three divisions, namely Crops Research, Livestock and Pastures Research, and Research Services, brought the total number of researchers to one-hundred and fourteen (114).

6.6.2. Extension workers

Zimbabwe is administratively divided into ten provinces of which two - Harare and Bulawayo - are urban, and sixty districts. In investigating the information needs of extension workers, the study focused on eight provinces excluding the urban provinces of Harare and Bulawayo, i.e. Matebeleland South, Matebeleland North, Midlands, Mashonaland West, Mashonaland Central, Mashonaland East, Manicaland, and Masvingo provinces. Extension workers were drawn from the Department of Agricultural Technical and Extension Services (AGRITEX)'s two divisions, namely the Technical and Field divisions (shown in Figure 2.3).

The Technical field consists of subject matter specialists at head offices and provincial offices. The Field division is an extension setup that follows a national, provincial, district and ward structure, reporting to the head offices at the Ministry's offices in Harare. The extension workers' population included all the extension workers at all 8 of the provincial and 60 district levels, but not at ward/village level because of the large number of village/ ward extension workers in the country. The decision was made by the researcher to focus on Mashonaland Central Province for village/ward extension workers or officers, where purposive sampling ensured that all seven districts were represented. Random sampling was then conducted in the different wards. Extension personnel/ subject specialists from the Field division based at the Ministry's head and provincial offices were also included in the population.

By sampling Mashonaland Central for village data, the study hoped to draw a generalisation of the national village data. As shown in the study by Foti, Nyakudya, Moyo and Chikuvire (2007:30), Mashonaland Central province is made up of areas of varied agricultural potential ranging from agro-ecological region II to region V, and was therefore believed to be representative in terms of agricultural practices. Zimbabwe's agro-ecological zones range from region I-V, as shown in Chapters one and two. In summary, the following provinces and districts were targeted:

- Manicaland Province: seven (7) districts
- Mashonaland Central Province: seven (7) districts plus wards
- Mashonaland East Province: nine (9) districts
- Mashonaland West Province: seven (7) districts
- Masvingo Province: seven (7) districts
- Matebeleland North Province: seven (7) districts
- Matabeleland South Province: six (6) districts
- Midlands Province: eight (8) districts

The target population for the Technical Division was thirty one (31) chief agricultural specialists and senior agricultural specialists drawn from the Departments of Crop Production, Training, Agronomy, Horticulture, and Agribusiness and Marketing.

From the Field division, the target population consisted of eight (8) provincial extension officers and sixty (60) district extension officers (including 7 from Mashonaland Central Province). Additional Ward/ village extension workers from fourteen districts (14) were randomly selected to provide field experiences, although this category was extensively investigated in Mashonaland Central Province. The study also looked at ninety-one (91) subject matter specialists in the 8 provinces, including those stationed at the Head Office.

The categories of agricultural extension officers, agricultural extension supervisors and AGRITEX workers drawn from Mashonaland Central Province to constitute a representative sample of agro-regions II-V were as follows:

a) Province

- Provincial AGRITEX Officer (1)

- AGRITEX Specialists/ Seniors /Principals (4)
- AGRITEX Extension Supervisor (1)

b) Districts

- District AGRITEX Officers (7)
- AGRITEX Officers/ Seniors/ Principals (23)
- AGRITEX Extension Supervisors (39)
- AGRITEX Workers/ Officers (55); 10% of 551 workers in Mashonaland Central Province. Purposive sampling was applied so that each of the seven districts in the province was represented while random sampling was applied on extension workers in each district.

The total target population for extension workers in the study was three hundred and eighteen (318). The two directors (Technical and Field) were included in the interviews and hence did not complete the questionnaire.

6.7 Data collection instruments

While deciding about the method of data collection, Kothari (2004:95) maintains that the researcher should keep in mind two types of data, i.e. primary and secondary data. Kothari explains that primary data refers to data that is collected afresh or for the first time, and thus happens to be original in character, while secondary data is data that has already been collected by someone else and has already been passed through the statistical process. Zikmund (2003:72) adds that because there are many research techniques, there are many methods of data collection. Respondents may participate by filling in a questionnaire or by interacting with an interviewer, among other methods. Kothari (2004:95) further observes that the researcher would first have to decide which sort of data he/she will be using (thus collecting) for his/her study, and accordingly he/she will have to select the appropriate method of data collection. Bhattacharyya (2003:51) cautions that because the quality of the results gained from data depends on the quality of the information collected, it is important for a sound investigative process to be enshrined to ensure that the data is highly representative and unbiased. This study used a questionnaire, interviews, observation, and the content analysis of existing records as its data collection techniques.

6.7.1 The questionnaire

According to Gray (2009:337), in a questionnaire, people respond to the same set of questions in a predetermined order. It is generally agreed that it is the most widely used survey data collection technique. Taylor, Sinha and Ghoshal (2006:6) further observe that questionnaires take many forms and may be designed to elicit quantitative and/or qualitative data. Gillham (in Gray, 2009:338) opines that the popularity of the questionnaire is based on its inherent advantages, which are:

- Savings in terms of money and time because they can be sent to thousands of respondents at relatively little cost.
- The inflow of data is quick and from many people.
- Respondents can complete the questionnaire at a time and place that suits them.
- Data analysis of close-ended questions is relatively simple and questions can be coded quickly.
- Respondents' anonymity can be assured, although in small surveys it may not be difficult for the researcher to recognise the responses of individuals.
- There is lack of interview bias.

6.7.1.1 Questionnaire design and construction

According to Panneerselvam (2004:23), the success of the survey depends on the strength of the questionnaire used. A questionnaire consists of a set of well formulated questions to probe and obtain responses from respondents. The researcher weaves questions together so that they flow smoothly (Neuman, 2011:277). The researcher also includes introductory remarks and instructions for clarification, and measures each variable with one or more survey questions. Grays (2009:340) notes that while the overall content, style and structure of the questionnaire must satisfy the respondent, each individual question must stand on its own merits. According to Rea and Parker (2005:30), at the heart of survey research is the questionnaire development process, and key considerations in this process include the placement of questions within the survey instrument and their format in terms of the method of implementation (telephone, mail, web-based intercepts, or in-person interviews). Neuman (2011), Rea and Parker (2005), Gray (2009), Dawson (2009), and Leady and Ormrod (2010) highlight factors to avoid when constructing individual questions as follows:

i. Prejudicial language: avoid language that contains sexist, racist or other discriminatory stereotypes.

ii. Imprecision: avoid vague phrases such as ‘average’ regularly since they are likely to be interpreted differently by the respondents.

iii. Questionnaires should be clear, neat and easy to follow.

iv. Sensitive questions: it is recommended that questions that deal with sensitive issues such as ethnicity, religion, income, etc., be placed at the end of the questionnaire.

v. Double questions should be avoided because they are impossible to answer.

vi. Assumptive questions: avoid questions that make assumptions about people’s beliefs or behaviour.

Dawson (2009:89) explains that once a researcher has chosen the questionnaire for data collection, the next step is to decide whether to construct closed-ended or open-ended questions, or both. Gray (2009) explains that open-ended questions are designed to tap into more detailed perceptions and attitudes than is possible with close-ended questions, and they usually generate qualitative data. Rea and Parker (2005:42) and Dawson (2009:30-31) expand on these three basic types of questionnaire:

- *Closed-ended questionnaire*

Most questions in this questionnaire have closed-ended response choices with a fixed list of alternative responses to choose from for each question. This type of questionnaire is used to generate statistics in quantitative research.

- *Open ended questionnaire*

  Open-ended questionnaires are used in qualitative research, although some researchers will quantify the answers at the data analysis stage. There are no predetermined answers or responses to select from; rather there are blank sections for respondents to fill in their answers. Questions usually seek opinions.

- *Combination of both*

  Most researchers tend to use a combination of both open- and closed-ended questions. Many questionnaires begin with closed-ended questions and end with a section of open-ended questions in order to obtain more detailed responses.

The study used a questionnaire with structured and open-ended questions in order to enable respondents to provide additional remarks, thus generating both quantitative and qualitative responses.

According to Rea and Parker (2005:46), the questionnaire should be as concise as possible while still covering the subject matter required for the study. Neuman (2011:292) opines that researchers prefer long questionnaires because they are more cost effective, but concedes that there is no absolute proper length; this depends on the survey format and on the respondents' characteristics.

6.7.1.2 Questionnaire administration

In the case of extension workers, the questionnaires were distributed in person to the respondents at the provincial and district offices. They were then either collected, in person, sent by post directly to the researcher, or returned to the provincial offices which then contacted or posted them to the researcher. In some instances, the researcher had to make more than one trip to collect the questionnaires as they were being returned in small quantities. For the AGRITEX Head Office, the questionnaires were distributed through the Ministry's Human Resources Department.

The questionnaires for researchers was again distributed in person because it was necessary for the researcher to also interview the librarians, particularly at the research institutes, as well as conduct observations on the status of the libraries. In Mashonaland Central Province, some of the questionnaire was returned through the provincial offices during the monthly meetings. From the 111 questionnaires distributed to researchers, 60 were returned, a return rate of 54%. Four were discarded as they had errors. Usable returns therefore amounted to 56.

6.7.2 The interview

According to Gray (2009:369), an interview is a conversation between people with one person acting as researcher. Leedy and Ormrod (2010:148) opine that interviews can yield a great deal of useful information, and citing Silverman, they note that the researcher can ask questions relating to any of the following:

- Facts (e.g. biographical information)
- People's beliefs and perspectives about the facts
- Feelings
- Motives
- Present and past behaviours
- Standards of behaviour (e.g. what people think should be done in certain situations)
- Conscious reasons for actions or feelings (e.g. why people think certain behaviours are desirable or undesirable)

Gray (2009:369) observes that there are a number of situations in which the interview is the most practical research technique. These include: where the objective of the research is to examine feelings or attitudes of a category of respondents, or where it is likely that people enjoy talking about their work rather that filling in questionnaires. Gray (2009:373-374) notes that there different types of interviews and the choice is largely dependent on the aims and objectives of the research. For example, Gray explains that where semi-structured interviews are used, the researcher can probe for more detailed responses as the respondents may be asked to explain or clarify their responses. Leedy and Ormrod (2010:188) also observe that interviews are quite often open-ended in qualitative research studies and are fairly structured in survey research. Gray identifies five categories of interviews, namely: structured interviews; semi-structured interviews; non-directive interviews; focused interviews; and informal conversational interviews.

i. **Structured interviews**. Structured interviews are used to collect data for quantitative analysis. The researcher uses pre-planned questionnaires and a standard set of questions - the same questions are posed to all the respondents and responses are recorded by the interviewer on a standardised interview schedule (Leedy and Ormrod, 2010:188; Gray, 2009:373)

ii. **Semi-structured interviews.** Semi-structured interviews are often used in qualitative analysis. In a semi-structured interview, the researcher may follow the standard questions with one or more individually tailored questions. Semi-structured interviews allow the researcher to ask the respondent for further views and opinions where it is desirable for respondents to expand on their answers. The order of questions may change depending on the direction the interview takes (Leedy and Ormrod, 2010:188; Gray, 2009:373; Neuman, 2011:407)

iii. **Non-directive interviews**. These are used to explore an issue or topic in depth and questions are generally not pre-planned. The format of the interview allows respondents to talk freely about the subject (Gray, 2009:373)

iv. **Focused interviews**. The focused interview is based on the respondents' subjective responses to a known situation. The interviewer will have prior knowledge of this situation and is thus able to keep the respondents within the theme of the interview (Gray, 2009:373-374).

v. **Informal conversational interviews.** The informal conversational interview relies on the spontaneous generation of questions as the interview progresses. It employs an open-ended format and is flexible in terms of what path the interview will take. Its major drawback is that the interviewer may begin to influence the course and direction of the interview (Gray, 2009:374).

Leedy and Ormrod (2010:188) observe that survey research typically employs face-to-face interviews or telephonic interviews. Face-to-face interviews have the distinct advantage of enabling the researcher to establish a bond with potential respondents and therefore gain their cooperation. Leedy and Ormrod contend that while such interviews yield the highest response rate, the time and expenses involved may be insurmountable if the interviewees reside far from each other.

Interviews were conducted with key informants in order to get a national and policy-based perspective on the subject under investigation. The interviewees were: AGRITEX: Director – Field Services and Director – Technical Services; and DR&SS: Deputy Director - Crops Research, Deputy Director - Research Services, and Director - Livestock and Pastures Research. The study employed both structured and semi-structured interviews.

6.7.3 Existing statistics and records

According to Neuman (2011:45), in existing statistics research, a researcher locates a source of previously collected information, often in the form of government reports or previously conducted surveys. Information is available in statistical documents (books, reports, etc.), published compilations that are available in libraries, and in computerised documents (Neuman, 2011:331). Rea and Parker (2005:5) observe that certain data may already exist that can serve to satisfy the research requirements of a particular study, which is why every researcher should first investigate existing sources of information to take advantage of information that has already been collected. According to Gray (2009:497), "for quantitative researchers, secondary analysis can involve the use of both documents and official statistics while for qualitative researchers, secondary analysis primarily involves the analysis of another researcher's qualitative data and documents." Existing official documents such as annual reports and policy documents were consulted in this instance.

6.7.4 Content analysis

Content analysis involves the description and analysis of text in order to represent its content and can be undertaken quantitatively, qualitatively, or using both and text can be from books, documents and articles (Miller, 2003). Leedy and Ormrod (2010:108) define content analysis as "a detailed and systematic examination of the contents of a particular body of material in an attempt to identify patterns, themes, or biases within that material." Devlin (2006:196-198) and Dawson (2009:122) observe that qualitative data that may require content analysis typically involves participants' written answers to one or more questions in narrative style. Devlin (2006) and Dawson (2009) identify the steps in content analysis and summarise them as follows:

i. Reading through all of the written responses or transcripts

ii. Creating a condensed list of responses

iii. Creating a list of categories (no more than six or seven)

iv. Developing an operational definition for each category

v. Conducting inter-rater reliability analysis on a sample of each category

Devlin (2006) explains that inter-rater reliability is the process of convincing other people about the validity of these categories by reading and categorising the written statements. Dawson (2009:122) notes that content analysis can be used for open-ended questions which have been added to questionnaires in large quantitative surveys, thus enabling the researcher to quantify the answers. Content analysis in this study was used to analyse the qualitative data from the interviews and responses to the open-ended questions in the questionnaires.

6.7.5 Observation

According to Graziano and Raulin (2004:136) "The central phase of any research project is the observation or data-gathering phase". Observation is a technique that involves systematically, purposefully selecting, watching, listening and recording an interaction or phenomenon as it takes place (Kumar, 2011:140) Ramadass and Aruni (2009:32), Walliman (2006:95) explain that observation techniques can be part of both qualitative and quantitative research in which data can be collected by manual, mechanical, electrical or electronic means. Kumar (2011:142) observes that "the selection of methods depends upon the purpose of the observation, and the way an observation is made determines whether it is a quantitative or qualitative study." Kumar (2011:142) further observes that "Narrative and descriptive recording is mainly used in qualitative research, while for quantitative study, an observation is recorded in categorical form or on a numerical scale.

According to Ramadass and Aruni (2009:71) observations can be made on objects, for example the absence or presence of certain facilities or structure, state of cleanliness, etc. The observation method was used in the study in order to complement the data collected from questionnaires and interviews, in particular the state of libraries and other facilities within the research institutes. The observation schedule for libraries addressed the following:

a) physical location

b) size, lighting

c) shelving and sitting space

d) office space

e) library guides

f) availability of computers and other ICTs

g) collection outlook and usage (browse date stamps)

Leedy and Ormrod (2010:147) point out that drawbacks can arise because the researcher (particularly the novice) will not always know what things are most important to look for. Nieuwenhuis (in Maree 2007:84) warns that before one uses observation as a data gathering techniques, the purpose and focus of the observation must be clearly defined in order to articulate what exactly will be observed.

6.8 Pilot study

According to Fox and Bayat (2007:102), a pilot study is a trial run of an investigation that is conducted on a small scale to determine whether the research design and methodology are relative and effective. This pre-test helps to determine whether a research instrument is adequately designed to capture the required data from the respondents. Leedy and Ormrod (2010:111) observe that although the pilot study may take some time initially, it may ultimately save the researcher time by helping him/her to identify which approaches will and will not be effective in finding solutions to the overall research problem. According to Rea and Parker (2005:31), a pre-test of the draft questionnaire assesses critical factors such as the following:

- *Questionnaire clarity*: Will respondents understand the questions? Are the response choices sufficiently clear to elicit the desired information? Any ambiguities may confuse the respondents, leading to undesired information.

- *Questionnaire comprehensiveness*: Are the questions and response choices sufficiently comprehensive to cover a reasonably complete range of alternatives? Questions may be irrelevant, repetitive or incomplete, in which case they will need to be revised.

- *Questionnaire acceptability*: Unacceptability may result from excessive questionnaire length or undue consideration for ethical and moral standards, e.g. questions that are perceived to invade the privacy of respondents.

6.8.1 Validity and reliability of survey instruments

According to Leedy and Ormrod (2010:91), measurement instruments provide the basis on which the entire research effort rests. They argue that the researcher should clearly identify the nature of the measurement instruments they use, describe each instrument in explicit and concrete terms, and describe the method of scoring responses. Leedy and Ormrod add that the researcher should provide evidence that the instruments have a reasonable degree of validity and reliability.

6.8.1.1 Validity

The validity of a measurement instrument is the extent to which the instrument measures what it is intended to measure (Leedy and Ormrod, 2010:29; Gray, 2009:155). To achieve validity, the subject area of the research instrument and operationally defined subject areas must match exactly. Validity refers to how well the operational and conceptual definitions mesh with each other; in other words it addresses the question of how well the social reality being measured through research matches with the constructs researchers use to measure it (Gray, 2009:155; Neuman, 2011:188). Mason (2002:39) explains that valid research means that you are observing, identifying or 'measuring' what you say you are, and the concepts can be identified, observed, or 'measured' in the way you say they can. Gray (2009:155-158), Neuman (2011:192-194), and Leedy and Ormrod (2010:92) identify four types of validity as follows:

- *Face validity*. The extent to which, on the surface, an instrument looks like it is measuring a particular characteristic.

- *Content validity* is associated with validating the content of a test or examination. It is often considered when a researcher wants to assess people's achievement in some area.

- *Criterion validity* is the extent to which the results of an assessment instrument correlate with another, presumably related measure. If answers about the new and established measures are highly correlated, then it is usually assumed that the new measure possesses criterion validity.

- *Construct validity* is the extent to which an instrument measures a characteristic that cannot be directly observed but is assumed to exist based on patterns in people's behaviour. These patterns or traits have to be operationally defined before they can be measured.

6.8.1.2 Reliability

According to Black in Gray (2009:158), reliability is an indication of consistency between two measures of something, and measures could be: two separate instruments; two like halves of an instrument (e.g. two halves of a questionnaire); the same instrument applied on two occasions; and the same instrument administered by two different people. Leedy and Ormrod (2010:29) explain that reliability is the consistency with which a measuring instrument yields a certain result when the entity being measured has not changed. Mason (2002:39) emphasises the accuracy of research methods and techniques in producing data. Leedy and Ormrod (2010:93), Neuman (2011:189-190), and Gray (2009:159) identifies the following ways of measuring reliability:

- *Stability*. This measure the scores achieved on the same test on two separate occasions, assuming what is being measured does not itself change.
- *Equivalence* is the extent to which two different versions of the same instrument yield similar results.
- *Internal consistency* is the extent to which all of the items within a single instrument yield similar results. It measures the extent to which a test or questionnaire is homogenous in order for a reliability coefficient to be calculated.
- Inter-judge reliability. Compares the consistency of observations when more than one person is judging.

Leedy and Ormrod (2010:29) assert that both validity and reliability reflect the degree to which researchers may err in their measurements. They further stress that the different forms of validity and reliability are dependent on the nature of the research problem, the general methodology used to address the research problem, and the type of data that is collected.

A pilot study was carried out before the main study in order to test the validity and reliability of the research instruments. Modifications and changes to the questionnaire were done based on the outcome of the pilot. The questionnaire was pre-tested on researchers and extension staff from the Department of Livestock and Veterinary Services and lecturers at Mazowe Veterinary College and Kushinga-Phikelela Agricultural College. According to Rea and Parker (2005:32), the sample size for the pre-test is generally in the range of twenty to forty respondents. However for very large sample surveys, pre-tests may focus on a larger sample. Rea and Parker argue that at the pre-test stage, the main focus is not statistical accuracy, but feedback concerning the overall quality of the questionnaire.

6.9 Research procedure

The research procedure addresses the processes followed in the data collection process. Initial permission was sought from the Ministry through a letter to the Permanent Secretary, who in turn delegated the then Director of DR&SS to oversee the researcher's requirements. This was followed by visits to DR&SS and later to AGRITEX in order to meet the heads as well as gather related information for the study. The Director of AGRITEX then gave the researcher a letter of introduction to use during field research or at any point when information was sought from related departments. Permission was also sought from the Director of the Livestock and Veterinary Services Division to conduct a pilot study with the division's researchers and extension workers. Due to employee turnover in the Ministry of Agriculture, the researcher requested an updated staff establishment list (March 2011) to ascertain whether the study population had not changed in terms of numbers.

6.10 Data presentation and analysis

Data was presented and analysed based on the themes that were outlined in the questionnaire. Quantitative data was analysed using the Statistical Package of Social Sciences (SPSS) and Microsoft Excel for graphs and charts. According to Bailey (1994:389), statistics that are used to infer the truth or falsify a hypothesis are called inferential statistics, which is in contrast to descriptive statistics that do not seek to make any inference but merely provide a description of the sample data. Descriptive and inferential analysis procedures were applied.

Responses from the interviews and observation schedules were analysed using content analysis. The interview questions were mostly open-ended, providing the respondents with the opportunity to expand or elaborate on their responses. Analysis was done using common and recurring words and terms from the respondents' vocabulary.

6.11 Challenges encountered in the course of the study

The main challenge faced by the researcher was employee turnover at the Ministry's Head Offices. Within the DR&SS, the researcher initially wanted to minimize sampling due to the small number of researchers involved. At the time of distributing the questionnaires, the numbers had further dwindled due to staff movements and leave. The number of staff reported to be on study leave was high. It was also difficult to secure interview schedules because of staff commitments. Interviews had to be delayed to almost the time of data analysis. Staff availability was found to be a challenge in the case of both researchers and extension workers because data collection coincided with district, provincial and national agricultural shows. Across the different levels, people were out in the field preparing. This meant that in some cases, questionnaires were left together with instructions to whoever was available in the offices (sometimes office orderlies) for forwarding to the relevant officers. Some of these questionnaires got lost or misplaced and replacement questionnaires had to be sent or delivered.

The second biggest challenge was getting people to complete the questionnaire. This was compounded by the length of the questionnaire, which was unfortunately unavoidable. Several phone calls, reminders and visits were undertaken in order to get the respondents to act on the questionnaires. In some instances, they were reported lost and replacements were sent to no avail. Examples include the Chemistry and Soils institute and Plant Quarantine section to which four questionnaires were distributed - one was returned and three replacements sent three times to no avail. At the beginning of data analysis, Plant Quarantine was requesting replacement questionnaires for the fourth time. The researcher's persistence and patience was due to the specialised nature of some departments/divisions involved in the study. From the extension side, a classic case was when one district was demanding payment for completing two questionnaires.

6.12 Summary

This chapter discussed the research methodology**.** Qualitative and quantitative paradigms were adopted in the study. The survey research method was used to collect data from agricultural researchers and extension workers falling under the Ministry of Agriculture's AGRITEX Department and DR&SS and its related research institutes. The chapter detailed the study area and population, including DR&SS and its research institutes and AGRITEX's provincial and district structures. The study focused on Mashonaland Central Province for in-depth extension activities because it was considered representative of agro-zones II-V. The chapter also discussed the data collection instruments, which consisted of questionnaires, interviews, content analysis and review of existing statistics and records, and observation. The advantages of the questionnaire and its construction and administration were also highlighted and the pilot study and its purpose discussed. The pilot study was seen as a way to test the appropriateness and acceptability of the research instruments before applying them on a large scale.

The next chapter presents the analysis and interpretation of the data.

CHAPTER SEVEN

ANALYSIS AND INTERPRETATION OF DATA

7.1 Introduction

This chapter presents the data analysis and interpretation. The chapter addresses the study's objectives (a) – (g) as outlined in Chapter one. Data analysis is divided into three different sections based on the research instruments used, i.e.: i) Section one (7.2): data from the questionnaire that was administered to researchers and extension workers, (Appendix A); ii) Section two (7.3): responses from interviews covering data from the interview schedule with key informants as well as data from the interview schedule with librarians (Appendix B and C); and iii) Section three (7:4): data from the observation schedule of libraries (Appendix D). According to Neuman (2011:149) triangulation is used by qualitative and quantitative researchers as it is better to observe something from different angles. Leedy and Ormrod (2010:99) concur, adding that "Multiple sources of data are collected with the hope that they will all converge to support a particular hypothesis or theory." Data from the three instruments, while providing some overlap, thus complemented each other in terms of clarity and depth. For example, the interviews with key informants (given their seniority), were meant to give an insight into the policy issues as they related to agricultural research and extension, which would not have been adequately addressed in the questionnaires. The observation schedule of libraries helped the researcher in evaluating the status of libraries in terms of state of materials, physical structures, as well as availability of other resources. The sections are subdivided into specific themes where this is applicable.

7.2 Section one: Questionnaire responses

This section analyses the researchers and extension workers' responses to the questionnaire. The self administered questionnaire was distributed and collected in person, with a few returned by post. The questionnaire addressed all the research questions as outlined in Chapter one. Data was analysed according to themes, specifically: i) Personal data of the respondents, ii) Information needs and information seeking, iii) ICT access and utilisation, iv) Indigenous knowledge and agriculture, v)

Collaboration in research and extension, and v) Respondents' challenges and suggestions. A similar questionnaire was distributed to researchers and extension workers.

From the 111 questionnaires distributed to researchers, 60 were returned (a return rate of 54%). However, errors were identified in four of the questionnaires and they were discarded. Usable returns therefore amounted to 56. The total target population for extension workers in this study was three hundred and eighteen (318). Two directors (Technical and Field) and one deputy director were interviewed and were not required to complete the questionnaires. A total of one hundred and seventy two (172) copies of the questionnaire were completed by extension workers, hence a return rate of 54%.

7.2.1 Personal data of the respondents

This section required respondents to provide their demographic details, specifically their location, department, occupation (whether they were an extension worker or a researcher), designation/ position, experience, qualifications, age and gender.

7.2.1.1 Location of the respondents

The respondents were drawn from eight provinces as defined by the target population in the preceding chapters. Although Harare as a province was not included in the study, its appearance in Table 7.1 below shows respondents who were based at the Ministry's Head Office (AGRITEX of DR&SS) in Harare only**.**

Table 7.1: Distribution of respondents by province N=228

Province	**Number**	**Percent %**
Harare (Head Office for Agritex and DR&SS)	22	9.6
Mashonaland East	23	10.1
Mashonaland Central	100	43.9
Mashonaland West	17	7.5
Midlands	11	4.8
Manicaland	13	5.7
Matebeleland South	16	7
Matebeleland North	6	2.6
Masvingo	20	8.8
Total	**228**	**100**

Mashonaland Central Province produced the highest number of respondents because provincial and district extension officers/ supervisors and ward/ village extension workers from the province were included in the study. The total number of respondents also includes researchers from Mazowe, which is in Mashonaland Central. Provinces with research institutes also include: Mashonaland East, Mashonaland West, Manicaland, Matebeleland South, and Masvingo. Matebeleland North and Midlands do not have research institutes.

The number of districts which participated in the study was forty-four (44), from the projected sixty (60) participated in the study (a response rate of 73%). In terms of representation by research institute, 16 (94%) out of seventeen (17) institutes responded, although there were variations in responses per institute.

7.2.1.2 Department of the respondents

The respondents were asked about their department in order to separate the AGRITEX respondents from the respondents representing DR&SS. From a total of 228 respondents, 172 (75.4%) were from the AGRITEX department and 56 (24.6%) were from DR&SS.

7.2.1.3 Occupation of the respondents

The aim of this question was to establish or distinguish researchers from extension workers, which could also have been established in 7.2.1.2 above. This question was a precautionary measure, as there was the possibility of some respondents identifying themselves more with the occupation than with the department. The question was also necessary because it highlighted the broad category which formed the basis of cross tabulating data. This is not to be confused with the actual designations or positions, discussed below (7.2.1.4). As in 7.2.1.2, the results indicated that from a total of 228 respondents, 172 (75.4%) were extension workers and 56 (24.6%) were researchers.

7.2.1.4 Position or designation of respondents

The respondents were requested to indicate their position or designation within the research or extension system, which reflected their responsibilities.

Table 7.2: Designation of respondents

Extension workers N=172 and Researchers N=56

Designation	Agricultural Extension		Agricultural Research	
	N=172	%	N= 56	%
Director	1	0.6	-	-
Deputy Director	-	-	2	3.6
Chief Agricultural Specialist	1	0.6	-	-
Agricultural Specialist/Snr/Principal	15	8.7	14	25
Provincial Agritex Officer	6	3.5	-	-
District Agricultural Extension Officer	38	22	-	-
Agritex Officer/Snr Principal	30	17.4	-	-
Agritex Extension Supervisor	24	14	-	-
Agricultural Extension worker	51	29.7	-	-
Research officer	-	-	32	57.1
Senior Research officer	-	-	4	7.1
Chief Research officer	-	-	1	1.8
Principal Research officer	-	-	2	3.6
Head of Institute	-	-	1	1.8
Agritex Specialist/Snr/Principal	6	3.5	-	-
Total	**172**	**100**	**56**	**100**

Table 7.2 indicates that of the respondents who completed the questionnaire, one was a director from AGRITEX, and 2 were deputy directors who were based at research institutes. In the category of agricultural extension, only 6 (3.5%) provincial AGRITEX officers completed the questionnaires, although all the desired 8 provinces gave feedback, and this meant that other officers (e.g. provincial subject matter specialists) from the remaining 2 provinces provided responses. Likewise, 38 (22%) district agricultural extension officers completed the questionnaires although 44 districts participated in the study (see 7.2.1.1). Among extension personnel, there were 15 (8.7%) agricultural specialists up to principal level, 30 (17.4%) AGRITEX officers, and 24 (14%) AGRITEX extension supervisors from Mashonaland Central districts and those randomly selected from other districts. 51 (29.7%) agricultural extension workers represented the category of extension personnel at grassroots level, i.e. village/ward level, and they were selected from Mashonaland Central for reasons already alluded to in the methodology.

In the agricultural researcher's category, there were 2 deputy directors mentioned above in addition to 32 (57%) research officers, 14 (25%) agricultural specialists, 4 (7.1%)

senior research officers, 2 (3.6%) principal research officers, 1 (1.8%) chief research officer, and 1 (1.8%) head of Institute.

7.2.1.5 Experience as a researcher or extension worker

The respondents were requested to indicate the number of years they had worked as a researcher or extension worker (Table 7.3). The combined overall responses indicate that 93 (40.8) of the respondents had between 1-5 years experience, 64 (28.1%) had 6-10 years experience, 18 (7.9%) had 11-15 years, 20 (8.8%) had 16-20 years, 14 (6.1%) had 21-25 years, and 19 (8.3%) had more than twenty six years experience.

Table 7.3: Experience of respondents

Extension workers N=172 and Researchers N=56

	Agricultural Extension		Agricultural Research	
Number of years	N=172	%	N=56	%
1-5 years	64	37.2	29	51.8
6-10 years	45	26.2	19	33.9
11-15 years	17	9.9	1	1.8
16-20 years	19	11	1	1.8
21-25 years	10	5.8	4	7.1
26 years and above	17	9.9	2	3.6
Total	**172**	**100**	**56**	**100**

Table 7.3 above indicates that most respondents (researchers and extension workers) were recently employed, with 157 (68.9%) with less than 10 years experience.

7.2.1.6 Number of years in current position

This question required respondents to indicate the number of years they had worked in their current positions, taking into account that people change positions or get promoted. Overall, 151 (66.2%) of the respondents had been in their current positions for 1-5 years, followed by 50 (21.9%) with 6-10 years, 8 (3.5%) with 11-15 years, 11 (4.8%) with 16-20 years, 2 (0.9%) with 21-25 years, and 6 (2.6%) with 26 years or more. A breakdown is provided in Table 7.4 below

Table 7.4: Number of years in current position

Extension workers N=172 and Agricultural Researchers N=56

Number of years in current position	Agricultural Extension		Agricultural Research	
	N=172	%	N=56	%
1-5 years	112	65.1	39	69.6
6-10 years	35	20.3	15	26.8
11-15 years	8	4.7	-	-
16-20 years	9	5.2	2	3.6
21-25 years	2	1.2	-	-
26 years and above	6	3.5	-	-
Total	**172**	**100**	**56**	**100**

Table 7.4 shows that respondents (researchers and extension workers) were mainly concentrated in the 1-5 years category and the 6-10 years category. This suggests that most still held the positions that they had at entry level**.**

7.2.1.7 Qualifications of the respondents

This question asked the respondents about their educational level and qualifications, vis-à-vis their positions and responsibilities. The qualifications they could indicate were: certificate, diploma, bachelors, postgraduate diploma, Master's and Doctorate. Overall, 67 (29.4%) of the respondents had certificate level qualifications while 28 (12.3%) had diplomas, 104 (45.6%) had bachelors, 4 (1.8%) had postgraduate diplomas, 24 (10.5%) had Master's degrees, and 1 (0.4) had a Doctoral qualification. The analysis by category of respondents is provided in Table 7.5.

Table 7.5: Qualifications of respondents by category

Extension workers N=172 and Researchers N=56

	Agricultural Extension		Agricultural Research	
Qualification	N=172	%	N=56	%
Certificate	66	38.4	-	-
Diploma	24	14	5	8.9
Bachelors	67	39	37	66.1
Postgraduate diploma	3	1.7	1	1.8
Masters	12	7	12	21.4
DPhil/PhD	-	-	1	1.8
Total	**172**	**100**	**56**	**100**

The number of extension personnel with certificate qualifications represented frontline extension workers at ward and village level, while the results also showed that there were no researchers with certificate qualifications.

7.2.1.8 Age of respondents

This question aimed to ascertain the age distribution of the respondents. The overall responses indicated that 56 (24.6%) were between the ages of 20-29 years, 69 (30.3%) were between 30-39 years, 75 (32.9%) were 40-49, and 28 (12.3%) were 50 years and above. Table 7.6 shows the age distribution by respondent category.

Table 7.6: Age of respondents by category

Table 7.6 Extension workers N=172 and Researchers N=56

	Agricultural Extension workers		Agricultural Researchers	
Age (years)	N=172	%	N=56	%
20-29	34	19.8	22	39.3
30-39	50	29.1	19	33.9
40-49	62	36	13	23.2
50 plus	26	15.1	2	3.6
Total	**172**	**100**	**56**	**100**

The majority of extension workers (62; 36%) were in the 40 - 49 age group, followed by 50 (29.1%) in the 30 - 39 age category. For extension workers, the number of respondents increased with age (up to 49 years), while comparatively the number of respondents decreased with age among researchers. The majority of researchers (22; 39.3%) were in the 20-29 age group followed by those between 30-39 (19; 33.9%).

7.2.1.9 Gender composition

The respondents were required to indicate their gender. The study established that 152 (66.7%) of the respondents were male, while 76 (33.3%) were female. An analysis of the respondents by category (researchers or extension workers) revealed that 116 (67.4%) of the extension workers were male and 56 (32.6%) were female, and 36 (64.3%) of the researchers were male compared to 20 (35.7%) females.

7.2.2 Information needs and information seeking

Having established the characteristics of respondents in 7.2.1, this section sought to identify their information needs and information seeking behaviour by addressing the following: information requirements by type; interaction between researchers and extension workers; impact of the land reform programme on agricultural research and extension; communicating agricultural information to farmers; and library collection and services.

Part A: Information requirements and type

This section looked at the type of information that is sought, the reasons for seeking information, preference of sources and their importance and frequency of use, examples of the information sources used, and gender challenges in agricultural extension.

7.2.2.1 Type of information required by extension workers and researchers

The respondents were requested to indicate the type of information (subject content) that they required as researchers or extension workers. The responses are summarised in Table 7.7.

Table 7.7: Type of information required by researchers and extension workers

Extension workers N=172 and Researchers N=56

Type of information required	Agricultural Extension Worker		Agricultural Researcher	
	N	%	N	%
Soil fertility	48	28	19	34
Horticulture	33	19	34	61
Soil classification	68	40	30	54
Agricultural economics	51	30	31	55
Irrigation drainage	62	36	29	52
Plant breeding	103	60	28	50
Poultry	93	54	44	79
Plant pathology	92	53	27	48
Dairy farming	110	64	46	82
Plant disease and pest	42	24	24	43
Post-harvest technology	48	28	33	59
Animal health	96	56	45	80
Tobacco culture	46	27	54	96
Animal breeding	117	68	42	75
Agro forestry	73	42	38	68
Agronomy	39	23	22	39
Range management	120	70	35	63

Crop protection	38	22	23	41
Agricultural engineering	111	65	46	82
Farm mechanisation	84	49	40	71
Climate change	47	27	14	25
Policy development	97	56	27	48
Advisory information	61	35	19	34

*Table represents multiple responses

The type of information that was mostly required by extension workers was information on range management (120; 70%), followed by animal breeding (117; 68%) and agricultural engineering (111; 65%). Information on horticulture (33; 19%) and agronomy (39; 23%) was less popular among extension workers. In contrast, the type of information that was mostly required by researchers was information on tobacco culture 54 (96%), followed by dairy farming and agricultural engineering (46; 82% responses each). Information on climate change was less sought after (14; 25%). The responses indicate that while the information required by the two categories of respondents varied, it was relevant to their work activities.

7.2.2.2 Information seeking purposes

The respondents had to indicate what they used the information in 7.2.2.1 above for. Overall, the majority (172; 75.4%) indicated that they required information when assisting farmers. 139 (61%) when conducting research, 86 (37.7%) for general awareness, 80 (35.1%) when assisting extension workers, and 24 (10.5%) when assisting researchers. Table 7.8 below provides a summary of the findings according to the category of users.

Table 7.8: Information seeking purposes

Extension workers N=172 and Researchers N=56

Information seeking purposes	**Agricultural Extension Worker**		**Agricultural Researcher**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**
To conduct research	95	55.2	44	78.6	139	61
General awareness	73	42.4	13	23.2	86	37.7
When assisting extension workers	61	35.5	19	33.9	80	35.1
When assisting farmers	149	86.6	23	41.1	172	75.4
When assisting researchers	18	10.5	6	10.7	24	10.5

*Table denotes multiple responses

7.2.2.3 Primary source when in need of information

The respondents were asked to indicate whom they consulted first when they needed information. The majority (57; 25%) indicated that they first consulted the internet, followed by departmental collections (54; 23.7%), colleagues (46; 20.2%), personal collections (38; 16.7%), and the library (30; 13.2%). Data analysis according to respondent group showed that most extension workers (48; 27.9%) consulted departmental collections, while the majority of researchers (28; 50%) consulted the internet. The responses are shown in Table 7.9.

Table 7.9: Primary source when in need of information

Extension workers N=172 and Researchers N=56

Who or what do you consult first when in need of information?	Agricultural Extension Worker		Agricultural Researcher	
	N=172	%	N=56	%
Library	24	14	6	10.7
Internet	29	16	28	50.0
Colleagues	37	21	9	16.1
Personal collection	31	18	7	12.5
Departmental collection	48	27.9	6	10.7
Workshops & seminars	3	1.7	-	-
Total	**172**	**100**	**56**	**100**

7.2.2.4 Print and electronic sources

The respondents were asked to indicate what they would consult or choose first between print and electronic sources when in need of information. Print sources were selected by an overwhelming 175 (76.8%) of the respondents, while 53 (23.2%) indicated that they would use electronic sources first. The results point to issues of connectivity, as will be discussed in the next chapter.

The responses of extension workers indicate that 156 (90.7%) preferred print sources, with only 16 (9.3%) mentioning electronic sources. Responses for researchers show that the majority (37; 66.1%) preferred electronic sources, with 19 (33.9%) mentioning print sources.

7.2.2.5 Importance of information sources in keeping up-to-date

The respondents had to indicate the importance of different sources of information in keeping up-to-date with scientific developments in the respondents' related field. The respondents were provided with twenty-four options to choose from. The responses reveal that technical reports were considered to be very important by 164 (71.9%) of the respondents, specifically 126 (73%) of the extension workers and 38 (67.9%) of the researchers. This was followed by books (147: 64.5%), professional meetings/ workshops (146; 64%), and fact sheets and the internet (137; 60.1% each). 6 (3.5%) and 5 (2.9%) of the extension workers respectively did not find books and meetings/ workshops to be important. The internet was considered to be important/ very important by 56 (100%) of the researchers. Journals were considered to be important/ very important by researchers, with only 1(1.8%) not believing this to be the case. Consulting knowledgeable persons in the field or the supervisor was considered to be important/very important by 164 (95.3%) of the extension workers, as were face to face conversations/ discussions (159; 92.4% of extension workers), demonstrating the interactive nature of extension work. Table 7.10 below provides a detailed analysis of the information sources.

Table 7.10: Importance of various information sources

Extension workers N=172 and Researchers N=56

Information Resource	**Relative Importance**	**Agricultural extension worker**		**Agricultural Researcher**		**Total**	
		N	**%**	**N**	**%**	**N**	**%**
Journal articles	Very important	51	29.7	38	69.7	89	39
	Important	92	53.4	17	30.4	109	47.8
	Not important	29	16.9	1	1.8	30	13.2
Review articles	Very important	43	25	24	42.9	67	29.4
	Important	102	59.3	31	55.4	133	58.3
	Not important	27	15.7	1	1.8	28	12.3
Conference abstract and proceedings	Very important	41	23.8	22	39.3	63	27.6
	Important	85	49.4	31	55.4	116	50.9
	Not important	46	26.7	3	5.4	49	21.5
Books	Very important	123	71.5	24	42.9	147	64.5
	Important	43	25	29	51.8	72	31.6
	Not important	6	3.5	3	5.4	9	3.9
Professional meetings/ workshops	Very important	116	67.4	30	53.6	146	64
	Important	51	29.7	24	42.9	75	32.9
	Not important	5	2.9	2	3.6	7	3.1
Sources of contents /	Very important	38	22.1	6	10.7	44	19.3

contents pages	Important	93	54.1	35	62.5	128	56.1
	Not important	41	23.8	15	26.8	56	24.6
Indexing and abstracting journals	Very important	29	16.9	16	28.6	45	19.7
	Important	89	51.7	34	60.7	123	53.9
	Not important	54	31.4	6	10.7	60	26.3
Research reports/ patents	Very important	85	49.4	42	75	127	55.7
	Important	70	40.7	13	23.2	83	36.4
	Not important	17	9.9	1	1.8	18	7.9
Technical reports	Very important	126	73.3	38	67.9	164	71.9
	Important	39	22.7	15	26.8	54	23.2
	Not important	7	4.1	3	5.4	10	4.4
Fact sheets	Very important	121	70.3	16	28.6	137	60.1
	Important	40	23.3	30	53.7	70	30.7
	Not important	11	6.4	10	17.9	21	9.2
Pamphlets/ leaflets	Very important	101	58.7	13	23.2	114	50
	Important	62	36	34	60.7	96	42.1
	Not important	9	5.2	9	16.1	18	7.9
Internet sources	Very important	87	50.6	50	89.3	137	60.1
	Important	46	26.7	6	10.7	52	22.8
	Not important	39	22.7	-	-	39	17.1
Theses and dissertations	Very important	26	15.1	22	39.3	28	21.1
	Important	74	43	28	50	102	44.7
	Not important	72	41.9	6	10.7	78	34.2
Newsletters	Very important	51	29.7	16	28.6	67	29.4
	Important	98	57	34	60.7	132	57.9
	Not important	23	13.4	6	10.7	29	12.7
Library catalogue	Very important	49	28.5	7	12.5	56	24.6
	Important	80	46.5	36	64.3	116	50.9
	Not important	43	25	13	23.2	56	24.6
Face to face conversations/ discussions	Very important	100	58.1	24	42.9	124	54.4
	Important	59	34.3	31	55.4	90	39.5
	Not important	13	7.6	1	1.8	14	6.1
Email/ list serve/ discussion forums	Very important	45	26.2	19	33.9	64	28.1
	Important	81	47.1	30	53.6	111	48.7
	Not important	46	26.7	7	12.5	53	23.2
Librarian/ library staff	Very important	38	22.1	11	19.6	49	21.5
	Important	82	47.7	25	44.6	107	46.9
	Not important	52	30.2	20	35.7	72	31.6
Consult knowledgeable person in the field/ supervisor	Very important	101	58.7	31	55.4	132	57.9
	Important	63	36.6	22	39.3	85	37.3
	Not important	8	4.7	3	5.4	11	4.8

*Table indicates multiple responses

7.2.2.6 Frequency of use of information sources

Having identified the importance of information sources for research and extension purposes, the respondents were required to indicate how often they consulted the sources. Table 7.11 below provides a combined summary of the responses.

Table 7.11: Frequency of use of information sources

Extension workers N=172 and Researchers N=56

Information Source	Frequency of access							
	Very often		Often		Sometimes		Never	
	N	%	N	%	N	%	N	%
Journal articles	38	16.7	49	21.5	117	51.3	24	10.5
Review articles	30	13.2	54	23.7	117	51.3	27	11.8
Conference abstracts & proceedings	16	7.0	60	26.3	102	44.7	50	21.9
Books	118	51.8	78	34.2	29	12.7	3	1.3
Professional meetings/workshops	63	27.6	86	37.7	76	33.3	3	1.3
Sources of contents (content pages)	29	12.7	47	20.6	105	46.1	47	20.6
Indexing and abstracting journals	13	5.7	47	20.6	95	41.7	73	32
Research reports/patents	44	19.3	77	33.8	82	36	25	11
Technical reports	85	37.3	87	38.2	46	20.2	10	4.4
Fact sheets	74	32.5	88	38.6	51	22.4	15	6.6
Pamphlets/leaflets	72	31.6	86	37.2	51	22.4	19	8.3
Internet sources	76	33.3	32	14	48	21.1	72	31.6
Thesis and dissertations	17	7.5	48	21.1	71	31.1	92	40.4
Newsletters	32	14	62	27.2	106	46.5	28	12.3
Library catalogue	15	6.6	47	20.6	100	43.9	66	28.9
Face-to-face conversations/ discussions with colleagues	100	43.9	72	31.6	43	18.9	13	5.7
Email/list serve/discussion forums	29	12.7	42	18.4	81	35.5	76	33.3
Librarian/library staff	15	6.6	32	14	93	40.8	88	38.6
Consult knowledgeable person in the field/supervisor	96	42.1	74	32.5	46	20.2	12	5.3

*Table denotes multiple responses

The responses indicate that books were the most frequently used information source, with 118 respondents (51.8%) indicating very often, followed by face-to-face conversations/ discussions with colleagues (100; 43.9%) and consulting knowledgeable persons/ supervisors (96; 42.1%). At the top of resources that were never used were theses and dissertations (92 respondents; 40.4%), consulting library staff (88; 38.6%), e-mail/ list serve/ discussion groups (76 33.3%) and internet sources (72; 31.6%). Very few respondents indicated that they never used books and professional meetings (3; 1.3% for each category). Thus the frequency of use of consulted resource varies, and this seems to corroborate their importance as indicated in 7.2.2.5.

7.2.2.7 Awareness of less recent books and journals

This question sought to highlight the significance of less recent books and journal articles by asking respondents to indicate how they became aware of such sources and the expected role of library staff. Of the respondents, 142 (64%) indicated citations at the end of journal articles, followed by citations at the end of book chapters (132; 59.5%), browsing older volumes (131; 59%), and the librarian/ library staff (161; 72.5%). The question was not restricted to use within libraries as the principles could be applied in any reading or research environment.

7.2.2.8 Journal titles familiar to the respondents

This question aimed to establish the respondents' familiarity with general or specific journal titles in their subject areas. The respondents were able to indicate titles covering various aspects of agriculture. Although most were single entries, *The New Farmer*, *Zimbabwe Journal of Agricultural Research*, *Kirkia*, *Zimbabwe Commercial Farmers Union* magazine, *Commercial Farmers Union* publication, and *Mirimi/Umlimi* were among the local publications cited. International journals were also dominant, examples include: *Acta Horticulture* (2; 0.9%), *African Journal of Range Management* (4; 1.8%), *Zimbabwe Journal of Agriculture* (4; 1.8%), *Farmers Weekly* (5; 2.2%), *New Farmer* (23; 10.1%), *Canadian Journal of Soil Science* (2; 0.9%), and *Journal of Ecology* (3; 1.3%).

7.2.2.9 Extension needs of women

According to Odame, Hafkin, Wessler and Boto (2002:3), there is a strong relationship between gender and agriculture in developing countries, with women's involvement in agricultural activities likely to be twice as high as men's. The respondents were asked to indicate whether they felt that the information needs of women were being adequately addressed in the current research and extension setup. The majority (122; 53.5%) felt that women's information needs were being adequately addressed. This represented 97 (56.4%) of the extension workers and 25 (44.6%) of the researchers. 106 (46.5%) of the respondents disagreed, i.e. 75 (43.6%) of the extension workers and 31 (55.4%) of the researchers.

7.2.2.10 Challenges facing women farmers and how their needs can be addressed

Respondents who felt that women's needs were not being adequately addressed in the previous question were asked to indicate how they felt their needs could be addressed. The responses ranged from general to specific and are summarised as follows:

- Introduce programmes that involve women
- Farmer training schools for women
- Mainstreaming gender extension workers
- Organise workshops for farmers
- Provide more extension workers with information
- Provide resources to address the extension system, e.g. transport to reach out to many farmers
- Hold frequent meetings with farmers
- Women to be consulted on issues during decision making
- Research and extension staff should undergo training in gender and agriculture
- Information is limited to higher offices, starving those on the ground

The respondents felt that attending to the above would go a long way in addressing the gender issues in agriculture.

Part B: Interaction between extension workers and researchers

Communication between researchers and extension workers was one of the foremost aspects of this study. This section sought to explore the frequency and nature of communication between the two categories of respondents.

Questions 7.2.2.11-7.2.2.12 were answered by agricultural researchers only

7.2.2.11 Frequency of interaction with agricultural extension workers

The researchers were asked to indicate how often they interacted with extension workers on a scale of weekly, monthly, quarterly, or never. 3 researchers (5.4%) indicated doing so weekly, 10 (17.9%) monthly, 31 (55.4%) quarterly, while 12 (21.4%) indicated that they never interacted with extension workers.

7.2.2.12 Nature of problems communicated with agricultural extension workers

The researchers were then asked to indicate areas/ topics or the nature of issues they communicated with extension workers. These were summarised below, with percentile indications where applicable:

- Implementation of on-farm trials and crops research
- Staff and management issues (12; 21.4%)
- Addressing problems in crop production (12; 21.4%)
- Information on the use of herbicides
- Livestock funding and production
- Pest and disease control, and extension approach identification (2; 3.6%)
- Potato production and management
- Cassava production and management
- Soil fertility concerns (2; 3.6%)
- Forage seed production and management
- Animal husbandry
- Transport challenges and inadequate resources/ inputs (12; 21.4%)
- Lack of adequate material for dissemination (15; 26.8%)

Questions 7.2.2.13-7.2.2.14 were answered by agricultural extension workers only

7.2.2.13 Frequency of interaction with agricultural researchers

This question required extension workers to indicate how frequently they interacted with agricultural researchers. The majority of respondents (95; 55.2%) indicated never interacting, while those who did (77; 44.8%) indicated the following frequencies: 3 (1.7%) weekly, 15 (8.7%) monthly, and 59 (34.3%) quarterly.

7.2.2.14 Nature of problems communicated with agricultural researchers

The respondents were then requested to indicate areas, topics or the nature of issues they communicated with researchers. The question attracted multiple responses. These were collated and summarised below, with percentile indications where applicable:

- Sociological disease diagnosis (5; 2.9%)
- Animal disease control and treatment improvement (13; 7.6%)
- Problems related to crop breeding and information on new seed varieties (27; 15.7%)
- Progress in research and training (3; 1.7%)
- Administrative and technical issues (9; 5.2%)
- Soil fertility testing (7; 4.1%)
- Farmers' yield production (7; 4.1%)
- Analysing the market gaps that exist between farmers and markets (3; 1.7%)
- Collaborative work on on-farm trials (8; 4.7%)
- Technical issues related to production (3; 1.7%)

7.2.2.15 Level of satisfaction with communication between researchers and extension workers

This question sought to ascertain the perceptions of the respondents with regards to the level of communication between the two categories. The responses indicated that 68 (29.8%) of the respondents were satisfied with the level of communication, representing 57 extension workers (33.1%) and 11 researchers (19.6%). The majority (160; 70.2%) who expressed dissatisfaction with the level communication did so with respect to the dissemination of agricultural information and technologies (115 or 66.9% of the extension workers and 45 or 80.4% of the researchers).

7.2.2.16 Reasons for poor levels of communication

The respondents were further asked to indicate the reasons they felt contributed to the poor communication between the two parties. The responses are summarised below with accompanying statistics from researchers and extension workers:

- The two groups have limited interface for interaction (mentioned by 27; 15.7% of the extension workers and 4; 7.1% of the researchers)
- Limited resources (14; 8.1% of the extension workers and 9; 16.1% of the researchers)
- Lack of expertise in breeding approaches (16; 9.3% of the extension workers and 4; 7.1% of the researchers)
- Limited forums for discussions (47; 27.3% of the extension workers and 24; 42.9% of the researchers)
- Limited research in areas of interest e.g. animal health (10; 5.8% extension workers and 2; 3.6% of the researchers)
- Linguistic challenges (1; 0.6% of the extension workers and 1; 1.8% of the researchers)
- Transport challenges and long distances apart (1; 1.8% of the researchers)

7.2.2.17 Suggestions for improving the linkage between researchers and extension workers

The respondents were requested to suggest ways in which the linkage between the two groups could be improved. The responses are summarised below by the category of the respondent:

- Need for interaction between researchers and extension workers (34; 19.8% of the extension workers and 9; 16.1% of the researchers)
- Provision of transport to extension/ research officers (3; 1.7% of the extension workers and 7; 12.5% of the researchers)

- Use of mobile phones and meetings (21; 12.2% of the extension workers and 5; 8.9% of the researchers)

- Need for more literature and to invite experts (10; 5.8% of the extension workers and 5; 8.9% of the researchers)

- Need for regular refresher courses and information dissemination (45; 26.2% of the extension workers and 8; 14.3% of the researchers)

- Pick up research topics from problems on the ground (5; 2.9% of the extension workers and 13; 23.2% of the researchers)

- Provide funding (1; 0.6% of the extension workers)

- Arrange formal visits and presentations (5; 2.9% of the extension workers)

- Provide a website to improve information access (5; 2.9% of the extension workers)

Regular refresher courses and information dissemination were indicated by the majority of respondents (53; 23.2%), followed by the need to promote interaction between researchers and extension workers (43; 18.9%) and utilising mobile phones and meetings (26; 11.4%).

Part C: Impact of the land reform programme on agricultural research and extension

The land reform programme in Zimbabwe has seen an exponential growth in the number of farmers. The emergence of new farmers has necessitated the research and extension system to respond to these farmers' information and technological requirements. This section looks at the impact of the new farming dispensation on agricultural research and extension.

7.2.2.18 Effect of the land reform programme on research and extension work

The respondents were asked to indicate whether the land reform programme had affected the way they conducted their work as researchers or extension workers. 131 (57.5%) answered in the affirmative, representing 92 extension workers (53.5%) and 39 researchers (69.6%). The remaining 97 (42.5%) indicated that there had been no changes as far as their work was concerned. This represented 80 (46.5%) of the extension workers and 17 (30.4 %) of the researchers.

7.2.2.19 How the land reform programme has changed the way researchers and extension workers conduct their work

This question asked the respondents to indicate how their work had changed due to the land reform programme. The responses are summarised as follows:

- The new farmers have their own way of doing things, hence the need to be coercive and approach them politely (indicated by 14; 8.1% of the extension workers and 15; 26.8% of the researchers)

- There is too much politics on the farms, and the farms are sometimes difficult to access; in some instances, a few farmers want to monopolise assistance (3; 1.7% of the extension workers)

- Farmers find it difficult to follow required procedures (3; 1.7% of the extension workers and 2; 3.6% of the researchers)

- New farmers need to be educated on issues related to their fields, for example best farming practices (40; 23.3% of the extension workers and 19; 33.9% of the researchers)

- Relieving pressure in grazing areas; previously more cattle were concentrated in the communal areas, resulting in overgrazing (4; 2.3% of the extension workers and 1; 1.8% of the researchers)

- Destruction of game reserves resulting in the uncontrolled movement of animals and unintentional spread of diseases (1; 0.6% of the extension workers and 1; 1.8% of the researchers)

- The Department of Research (DR&SS) needs to collaborate more with extension workers (3; 1.7% of the extension workers)

- It is difficult to reach the farmers due to lack of transport (14; 8.1% of the extension workers and 1; 1.8% of the researchers)

- Most farmers require up to date information, which they do not usually have (9; 5.2% of the extension workers)

- There is a need for more individual visits to farmers than group visits (1; 0.6% of the extension workers)

7.2.2.20 Information challenges posed by the land reform programme

This question sought to ascertain the information challenges posed to researchers and extension workers by the land reform programme. The question was open-ended and provided an opportunity for respondents to write in their own terms and vocabulary. The responses ranged from general challenges to more specific challenges dealing with the availability and non-availability of information. The responses are summarised as follows:

- Farmers need information on conserving natural resources (indicated by 53; 30.8% of the extension workers and 4; 7.1% of the researchers)

- Farmers need access to high-end technologies to boost production, for example in irrigation and mechanisation (4; 2.3% of the extension workers)

- Farmers are not patient when being addressed with farming issues, they are sometimes very threatening (12; 7% of the extension workers and 4; 7.1% of the researchers)

- Farmers lack information on stock and farm ownership (2; 1.2% of the extension workers and 1; 1.8% of the researchers)

- Farmers lack information in appropriate languages, specifically in their vernacular for easy understanding (5; 2.9% of the extension workers and 6; 10.7% of the researchers)

- Farmers need information on accessing inputs, credit facilities, marketing, and records keeping (5; 2.9% of the extension workers)

- Farmers need basic information on how to tend for their animals and access dipping facilities (4; 2.3% of the extension workers and 1; 1.8% of the researchers)

- Some farmers politicise the land issue, compromising production (2; 1.2% of the extension workers)

- Lack of adequate transport means that farmers' problems or information needs are not attended to on time (10; 5.8% of the extension workers and 3; 5.4% of the researchers)

- There is a need for more media programmes on farming issues, particularly on the radio as this tends to reach a wider audience (2; 1.2% of the extension workers)

- Extension workers need to be technically competent in order to address the issues raised by farmers (2; 1.2% of the extension workers)

The respondents were able to cite various challenges posed by the land reform programme, in particular with regards to information that could help the farmers boost production.

7.2.2.21 Information required to address the challenges of farmers

This question was more specific to the types of information, and required respondents to select from a provided list of twenty-eight options. The responses are summarised in Table 7.12 below.

Table 7.12: Information required to address the challenges of farmers

Extension workers N=172 and Researchers N=56

Information needs	Agricultural Extension Worker		Agricultural Researcher	
	N	%	N	%
Soil fertility	21	12.2	12	21.4
Horticulture	22	12.8	20	35.7
Soil classification	91	52.9	33	58.9
Agricultural economics	37	21.5	21	37.5

Irrigation drainage	57	33.1	18	32.1
Plant breeding	123	71.5	42	91.3
Poultry	66	38.4	25	44.6
Plant pathology	114	66.3	30	53.6
Dairy farming	98	57	31	55.4
Plant disease and pest	26	15.1	11	19.7
Post-harvest technology	34	19.8	14	25
Animal health	51	29.7	23	41.1
Tobacco culture	49	28.5	38	67.9
Animal breeding	109	63.4	33	58.9
Agro forestry	72	41.9	35	62.5
Agronomy	40	23.2	22	39.2
Range management	116	67.4	31	55.4
Crop protection	36	21	19	33.9
Agricultural engineering	91	52.9	39	69.6
Farm mechanism	65	37.8	27	48.2
Herbicides application	28	16.3	18	32.1
Climate and weather change conditions	52	30.2	13	23.2
Early warning reports	58	33.7	22	39.2
Market information (of harvested crops)	56	32.6	18	32.1
New seed varieties	38	22.1	21	37.5
Advisory information	67	39	19	33.9
Policy developments	99	59.6	26	46.4

*Table indicated multiple responses

There is a marked difference in responses here when compared to responses to the previous question. The majority of extension workers identified information on plant breeding (123; 71.5%), followed by information on range management (116; 67.4%), plant pathology (114; 66.3%), and animal breeding (109; 63.4%). Less essential was information on soil fertility (21; 12.2%) and horticulture (22; 12.8%). Plant diseases and pests (11; 19.7%), soil fertility (12; 21.4%) and climate and weather change (13; 23.2%) received lower responses among researchers, while the majority mentioned plant breeding (42; 91.3%), agricultural engineering (39; 69.6%), and tobacco culture (38; 67.9%). The responses indicate that information on the other topics was also considered to be essential, albeit to varying degrees.

7.2.2.22 Information needs of farmers and period/ season

The aim of this question was to establish if the researchers and extension workers perceived a noticeable trend in the information needs of farmers in particular seasons. 174 (76.3%) indicated that the information needs followed a seasonal pattern, specifically 133 (77.3%) of the extension workers and 41 (73.2%) of the researchers. 54 respondents (23.7%) felt that there were no observable trends, representing 39 (22.7%) of the extension workers and 15 (26.8%) of the researchers.

7.2.2.23 Time/ period during which information is mostly sought

The preceding question established that the respondents generally felt that information needs followed a noticeable trend. This question required respondents to indicate when they considered information to be mostly sought. Four options to select from were provided, with the option to suggest a fifth. 58 respondents (25.4%) indicated that information was mostly required during the land preparation period; 67 (29.5%) during the planting period; 20 (8.8%) during the harvesting period; 26 (11.4%) during the post-harvesting (marketing and storage) period; and 3 (1.3%) during the vaccination period before breeding for animals. The analysis by respondent group is provided in Table 7.13 below.

Table 7.13: Time/period during which information is mostly sought

Extension workers N=172 and Researchers N=56

	Agricultural Extension		**Agricultural Research**	
Time of year/season	N=135	%	N=39	%
During land preparation period	47	27.3	11	19.6
During the planting period	55	32	12	21.4
During the harvesting period	14	8.1	6	10.7
During the post-harvesting (marketing and storage period)	19	11	7	12.5
During vaccination before breeding	-	-	3	5.4
Non-responses	**37**	**21.5**	**17**	**30.4**

The majority of extension workers (55; 32%) indicated that information was mostly sought during the planting season, and least sought during the harvesting period (14; 8.1%). Researchers shared similar observations, with 12 (21.4%) indicating that information was mostly required during the planting season, and least required (3; 5.4%) during the vaccination period and before the breeding period. There were 37 (21.5%) non responses to this question among extension workers and 17 (30.4%) among researchers.

Part D: Communicating agricultural information to farmers

The research-extension linkage should ultimately benefit farmers through improved technologies and farming practices. As shown in the Feedback Flow of Communication model (Fig.4.4) in Chapter four, farmers can either have a direct link with the research system, or an indirect link via the extension system. This section covers methods used to communicate agricultural information to farmers; type and format of information; and the challenges relating to access to farmers.

7.2.2.24 Methods used to communicate information to farmers

The respondents were asked to select from three options: the media, organisation-based channels, and public gatherings. There were multiple responses to this question with an option to indicate other channels that were not on the list.

7.2.2.24.1 Media

Four types of media that could be used to communicate information to farmers were listed, with the respondent given the option to indicate other types. The question received a total of 162 (71.1%) responses. The results are summarised in 7.14a below.

Table 7.14a: Type of media used

Extension workers N=172 and Researchers N=56

Type of media	Agricultural Extension Workers		Agricultural Researchers	
	N=117	%	N=45	%
Radio	38	22.1	11	19.6
Television	9	5.2	14	25
Video units	11	6.4	8	14.3
Newspapers	16	9.3	8	14.3
Meetings	43	25	4	7.1

Overall, the radio was the most popular media channel (49; 21.5% of the respondents), followed by meetings (47; 20.6%), newspapers (24; 10.5%), television (23; 10.1%), and video units (19; 8.3%). Meetings under media were considered to be a platform or interface from which information could be exchanged. When analysed by respondent category, most (43; 25%) of the extension workers indicated their use of meetings, while the television was the least used option (9; 5.2%). Comparatively, the television was highly utilized by researchers (14; 25%), followed by the radio (11; 19.6%), while meetings were the least used option (4; 7.1%). Video units and newspapers were considered to be relatively useful, as indicated in Table 7.14a. 55 extension workers (32%) and 11 researchers (19.6%) did not respond to this question.

7.2.2.24.2 Organisation-based

Organisation-based methods refer to publications such as in-house pamphlets and posters, the internet, and community radio. Overall, publications were rated highly by147 (64.5%) of the respondents, followed by meetings (14; 6.1%), the internet (13; 5.7%), and community radio (5; 2.2%). Table 7.14b provides a summary

Table 7.14b Organisational based:

Extension workers N=172 and Researchers N=56

Organisational based methods	**Agricultural Extensionists**		**Agricultural Researchers**	
	N=127	**%**	**N=52**	**%**
Publications (pamphlets, posters)	105	61	42	75
Internet based (e-mail, etc)	7	4.1	6	10.7
Community radios	3	1.7	2	3.6
Meetings	12	7	2	3.6
Non responses	45	26.2	4	7.1

Most of the extension workers (105; 61%) indicated using publications (pamphlets, posters, etc.), followed by internet based methods (email, etc.) (7; 4.1%),) with community radio being the least used (3; 1.7%) communication tool. Publications (42; 75%) and internet based methods (6; 10.7%) were popular among researchers, with community radios and meetings being the least used (2; 3.3% each) communication tools. Meetings were considered to be a method because they bring members together to deliberate about issues in organisations. The non responses amounted to 45 (26.2%) for extension workers and 4 (7.1%) among researchers.

7.2.2.24.3 Public gatherings

Public gatherings were taken to mean events like agricultural shows, field days, community meetings, and meetings of farmers' organisations. Overall, field days were indicated by the highest number of respondents (89; 39%), followed by meetings of farmers' organisations (47; 20%), community meetings (42; 18.4%), and agricultural shows (36; 15.8%). Table 7.14c provides the summary.

Table 7.14c Public gatherings:

Extension workers N=172 and Researchers N=56

Public gatherings	Agricultural Extensionists		Agricultural Researchers	
	N=161	%	N=53	%
Agricultural shows	23	13.4	13	23.2
Field days	62	36	27	48.2
Community meetings	37	21.5	5	9
Farmer organisation meetings	39	22.7	8	14.2
Non response	11	6.4	3	5.4

Among extension workers, the highest number (62; 36%) indicated that they utilised field days, followed by community meetings (37; 21.5%), meetings of farmers' organisations (39; 22.7%), and lastly agricultural shows (23; 13.4%). Field days were ranked first (27; 48.2%) among researchers, followed by agricultural shows (13; 23.2%) and meetings of farmers' organisations (8; 14.2%), with community meetings (5; 9%) given the least consideration. 11 (6.4%) of the extension workers and 3 (5.4%) of the researchers did not respond to this question.

7.2.2.25 Frequency of use of mass media channels in communicating with farmers

The respondents were requested to indicate how frequently they used mass media channels (radio, television, newspapers) to communicate with farmers. The question did not ask for individual frequencies for each of the three types. The responses are summarised in Table 7.15.

Table 7.15: Frequency of use of the mass media in communicating with farmers

Extension workers N=172 and Researchers N=56

Frequency of use the mass media (radio, TV, newspapers)	**Agricultural Extension workers**		**Agricultural Researchers**		**Total**	
	N=172	%	N=56	%	N=228	%
Very often	4	2.3	1	1.8	5	2.2
Often	9	5.2	5	8.9	14	6.1
Sometimes	52	30.2	33	58.9	85	37.3
Never	107	62.2	17	30.4	124	54.4
Total	**172**	**100**	**56**	**100**	**228**	**100**

The responses revealed that most of the respondents never used the media (124; 54.4%), with only 85 (37.3%) indicating that they sometimes used the media, and 5 (2.2%) indicating that they very often used the media. This corroborates the results in section **7.2.2.24.1** which show that 96 (42.1%) of the respondents used the radio, television and newspapers. Among extension workers, 107 (62%) never used mass media channels, with only 4 (2.3%) using them very often, while 17 researchers (30.4%) never used mass media, with the majority (33; 58.9%) indicating that they sometimes used mass media channels to communicate.

7.2.2.26 Utilisation of media programmes and publications

This question drew 86 (37.7%) responses, with a few examples provided by the respondents. The responses were restricted to radio and television programmes, with no publications provided. "Pamhepo naChiremba: Live on air with the vet doctor" and the television programme "Talking farming" were mentioned by 51 extension workers (29.7%) each. 'Izifuyo zethu: Animal health" and the "Weather report" followed with 50 (29.1%), while the least used media programme was "Murimi wanhasi: Today's farmer", mentioned by 12 (7%). The responses from researchers ranked "Talking farming" first (35; 62.5%) and the "Weather report" second (34; 60.7%), followed by "Pamhepo naChiremba: Live on air with the vet doctor" (33; 58.9%), 'Izifuyo zethu: Animal health" (24; 42.9%) and "Murimi wanhasi: Today's farmer" (13; 23.2%).

7.2.2.27 Frequency of visits to farmers

The aim of this question was to establish how often the respondents visited farmers on site, thus establishing contact on the ground. The majority of respondents (79; 34.8%) indicated that they visited farmers very frequently, while 18 (7.9%) mentioned that they never visited farmers.

Table 7.16: Frequency of visits to farmers

Extension workers N=172 and Researchers N=56

Frequency of visits to farmers	Agricultural Extensionists		Agricultural Researchers		Total	
	N=172	%	N=56	%	N=228	%
Very often	75	43.6	4	7.1	79	34.8
Often	58	33.7	15	26.8	73	32.1
Sometimes	28	16.3	30	53.6	58	25.6
Never	11	6.4	7	12.5	18	7.9
Total	172	100	56	100	228	100

The responses in Table 7.16 indicate that the majority of extension workers visited farmers very often (75; 43.6%), while most of the researchers (30; 53.6%) sometimes visited farmers on their farms. Respondents who indicated that they never visited farmers amounted to 10 (5.8%) extension workers and 7 (12.5%) researchers.

7.2.2.28 Factors affecting visits to the farmers

The aim of this question was to establish factors that hindered or affected the respondents' visits to farmers. The options available were transport, poor road networks, and time constraints. Respondents could also list or indicate other factors. Transport was a major factor affecting visits to farmers (199; 87.5% of the respondents). This represented 158 (91.9%) of the extension workers and 41 (73.2%) of the researchers. Poor road networks were also mentioned by 27 (11.8%) of the respondents, specifically 14 (8.1%) of the extension workers and 13 (23.2%) of the researchers. Time constraints as a contributory factor were mentioned by 2 researchers (3.6%).

7.2.2.29 Language of material communicated to farmers

Respondents were requested to indicate the language of most of the available material. The options were English and vernacular. Most of the available material was written in

English, as indicated by 184 (80.7%) of the respondents, i.e. 136 extension workers (79.1%) and 48 researchers (85.7%). Vernacular was mentioned by 44 (19.3%) of the total respondents, representing 36 extension workers (20.9%) and 8 researchers (14.3%).

7.2.2.30 Translation of material/ content into minority languages

The aim of this question was to establish whether researchers and extension workers were translating material into other minority languages in order to reach out to such groups. Most respondents (142; 62.3%) indicated that they were translating material and this constituted 114 (66.3%) of the extension workers and 28 (50%) of the researchers. 86 (37.7%) of the respondents were not involved with translating, i.e. 28 researchers (50%) and 58 extension workers (33.7%).

Part E: Library collections and services

Access to information by researchers and extension workers is considered to be important for research and decision making purposes. This section looked at the institutional libraries available for access by the two categories of respondents. The section includes the interview schedule for librarians as well as the libraries' observation schedule. While some issues pertaining to libraries have been referred to in the preceding questions, this section focuses solely on library services to users.

7.2.2.31 Access to a library or information resource centre

This question asked the respondents whether they had access to a library, information resource centre or information kiosk in their work environment or community. The results indicated that 129 (56.6%) of the respondents had access, while 99 (43.7%) did not have access to the mentioned facilities. Those who had access represented 78 (45.3%) of the extension workers and 51 (91.1%) of the researchers, while 94 extension workers (54.7%) and 5 researchers (8.9%) did not have access.

7.2.2.32 Frequency of visits to the library or information resource centre

The aim of this question was to establish how frequently the respondents who had access to libraries or resource centres visited these facilities. The majority of respondents (68; 29.8%) used the facilities monthly, with 27 (11.8%) using the facilities weekly. Table 7.17 provides a summary of the responses.

Table 7.17: Frequency of visits to the library or information resource centre

Extension workers N=172 and Researchers N=56

Frequency of visits to library/information resource centre	**Agricultural Extensionists**		**Agricultural Researchers**		**Total**	
	N=78	45.3%	N=51	91.1%	N=129	56.6%
Daily	11	6.4	8	14.3	19	8.3
Weekly	14	8.1	13	23.2	27	11.8
Fortnightly	10	5.8	5	9	15	6.6
Monthly	43	25	25	44.6	68	29.8

Table 7.17 above shows similar trends running through the responses of researchers and extension workers. For example, monthly visits were mentioned by the majority of both extension workers (43; 25%) and researchers (25; 44.6%). Both groups also had the lowest responses to the fortnightly option, with 10 extension workers (5.8%) and 5 researchers (9%) indicating that they visited the library or information centre fortnightly. 99 respondents (43.4%) did not answer this question, representing 94 (54.7%) of the extension workers and 5 (8.9%) of the researchers. The non response rate was very high among extension workers.

7.2.2.33 Alternative information access services

This question sought to establish how the respondents who did not have access to a library or information resource centre were able to access information. The question attracted 100 responses, 95 from extension workers and 5 from the researchers. The majority of respondents (36; 15.8%) indicated that they relied on circulars from the Ministry of Agriculture's Head Office, specifically 34 (19.8%) of the extension workers and 2 (3.6%) of the researchers. Departmental and personal collections were mentioned by 29 (12.7%) of the total respondents, representing 28 extension workers (16.3%) and 1 researcher (1.8%). Newspapers, radio and audio materials were mentioned by 19 respondents (8.3%), i.e. 18 extension workers (10.5%) and 1 researcher (1.8%). The respondents also indicated that they utilised other libraries in town, and these must be distinguished from the institutional libraries or community libraries indicated above. This was mentioned by 12 (5.3%) of the total respondents, i.e. 1 (1.8%) researcher and 11

(6.4%) extension workers. Training materials were mentioned by 4 (2.3%) of the extension workers.

7.2.2.34 Type of material sought from the library

The study sought to establish the type of material the respondents accessed from the libraries. The majority of respondents (35; 15.3%) indicated that they consulted books. However, the bulk of these respondents were extension workers (30; 17.4%), with only 5 researchers (8.9%). Journals came second, consulted by a total of 31 (13.5%) respondents, and again the majority (20; 35.7%) were researchers. Table 7.18 below provides a summary of the results.

Table 7.18: Type of material sought from the library

Extension workers N=172 and Researchers N=56

Type of material sought/consulted	Agricultural Extensionists		Agricultural Researchers		Total	
	N=78	%	N=51	%	N=129	56.6%
Books	30	17.4	5	8.9	35	15.3
Journals	11	6.4	20	35.7	31	13.5
Newspapers	15	8.7	10	17.9	25	11
Government publications	15	8.7	13	23.2	28	12.3
Reference materials	7	4.1	1	1.8	8	3.5
Patents	-	-	2	3.6	2	0.9

99 respondents (43.4%) did not answer this question - 94 (54.7%) extension workers and 5 (8.9%) researchers. The non response rate was very high among extension workers. Overall, reference materials had the lowest usage, i.e. 7 extension workers (4.1%) and 1 researcher (1.8%). Government publications were also consulted, as shown in the table. Extension workers did not indicate using patents.

7.2.2.35 Frequency of assistance from library staff

Respondents were asked whether they sought any assistance from library staff when they visited libraries. The majority of respondents (73; 30%) indicated that they sometimes sought assistance, representing 45 extension workers (26.1%) and 28 researchers (50%). 25 (11%) never sought assistance, i.e. 10 (5.8%) of the extension workers and 15 (26.8%) of the researchers. 23 (10.1%) of the respondents indicated that they often sought help, with 7 (4.1%) of the extension workers indicating that they 'very often' sought help from library staff.

7.2.2.36 Finding information in the library

The study also sought to establish whether the respondents always found the information they were looking for in the library. This would also provide an indication of the level of satisfaction among the patrons. The majority of respondents (86; 37.7%) indicated that they did not always find what they were looking for, representing 46 (26.7%) of the extension workers and 40 (71.4%) of the researchers. A total of 43 (18.8%) of the respondents answered that they found what they were looking for, i.e. 32 extension workers (18.6%) and 11 researchers (19.6%).

7.2.2.37 Inter-library loan requests

The inter-library loan service allows a library to request material on behalf of its patron(s) from another holding library when the material is not available from its own stock. This question intended to explore whether this service was available to the respondents in the study. The majority (90; 39.5%) indicated that their libraries did not request material from other institutions, while 39 (17.1%) indicated that the service was provided.

7.2.2.38 Use of other libraries/ information resource centres

Apart from organisational or institutional libraries, the respondents were asked to indicate whether they consulted other libraries when in need of information. Some libraries have specialist collections with greater depth and scope on particular topics than organisational or institutional libraries, and would normally extend readership to special groups of outsiders. Most respondents (71; 31.1%) indicated that they consulted other libraries, specifically 39 (22.7%) of the extension workers and 32 (57.1%) of the researchers. Of those who did not consult other libraries (58; 25.4%), 39 (22.7%) were extension workers and 19 researchers (33.9%).

7.2.2.39 Libraries or information resource centres used

This question required the respondents to name the libraries that they visited. The question attracted a total of 66 (28.9%) responses. The majority (25; 11%) cited university libraries, examples being the University of Zimbabwe, Bindura University, and Zimbabwe Open University. 17 (7.5%) consulted the Central Library, and this was so because their libraries were autonomous of the Ministry's head office library. NGOs' libraries, including ICRISAT, were mentioned by 6 (2.6%), as were high school libraries (6; 2.6%), while public libraries were mentioned by 4 respondents (1.8%). The FAO Regional Library, Research Council of Zimbabwe, and seed companies were mentioned by 2 each (0.9%), while the Department of National Parks library and the United States Information Centre (Harare) were mentioned by 1 respondent (0.4%) each.

7.2.2.40 Status of institutional library or information resource centre

To sum up this section, respondents were asked to provide an assessment of their library or information centre in terms of the book and journal collection and the services offered. The question did not ask for an evaluation of each of the mentioned categories. Among extension workers, 39 (22.7%) felt the libraries were poor, 27 (15.7%) felt they were fair, 9 (5.2%) indicated good, and 3 (1.7%) very good. Responses from researchers show that 26 (46.4%) felt the services were fair, 15 (26.8%) poor, 9 (16.1%) good, and 1 (1.8%) very good.

7.2.3 ICT access and utilisation

The study sought to investigate the different levels of ICT access and utilisation by researchers and extension workers by way of establishing the infrastructure available, ICT resources and services, and the competencies of the respondents.

7.2.3.1 Access to a computer in the office

The aim of this question was to establish the level of computer access in the offices by single or shared users. The majority of respondents (158; 69.3%) had access to a computer in the office. When analysed by the category of respondent, those with access represented 109 (63.3%) extension workers and 49 (87.5%) researchers. 70 (30.7%) indicated no access to a computer, i.e. 63 (36.7%) extension workers and 7 (12.5%) researchers.

7.2.3.2 Purpose of the computer

Respondents who stated that they had access to a computer in the preceding question were asked to indicate what they were using the computer for. Four options were provided, with room for additional suggestions. Most of the extension workers (73; 42.4%) were using the computer to access the internet, while the highest number of researchers (5; 8.9%) were using it to for spreadsheet purposes. Table 7.19 provides a breakdown of the responses.

Table 7.19: Purpose of the computer

Extension workers N=172 and Researchers N=56

Purpose of the computer	Agricultural Extension Worker		Agricultural Researcher	
	N	%	N	%
Word processing	19	11	3	5.4
Spread sheet (Excel)	45	26.2	5	8.9
Storing documents	27	15.7	4	7.1
Internet access	73	42.4	4	7.1

*Table indicate multiple responses

Word processing was the least mentioned purpose by both categories of respondents, i.e. 19 extension workers (11%) and 3 researchers (5.4%). Overall the question did not draw many responses from both categories of respondents, particularly researchers.

7.2.3.3 Respondents' ICT skills/ competencies

The aim of this question was to assess the levels of ICT competence among the respondents. This was considered to be important in influencing how the ICT resources would be used. Among the extension personnel, the responses indicated that 56 (32.6%) believed their skills to be fair, 26 (15.1%) felt that their skills were good, 8 (4.6%) indicated very good, and 19 (11%) felt that their skills were poor. None of the researchers felt that they had poor ICT skills, with 18 (32.1%) indicating very good skills, 23 (41.1%) good and 8 (14.3%) fair. The question attracted multiple responses.

7.2.3.4 ICT resources available to the respondents in the office or organisation

This question sought to establish what other ICT resources the respondents had access to in the office or within their organisations. Computers were again mentioned here, and this response was validated on the premise that they were being accessed elsewhere within the organisation and not necessarily from the respondents' offices. Table 7.20 provides a summary of the responses.

Table 7.20: ICT resources available to the respondents in the office or organisation

Extension workers N=172 and Researchers N=56

Access to other ICT resources	**Agricultural Extension Worker**		**Agricultural Researcher**	
	N	**%**	**N**	**%**
Computers	38	22.1	3	5.4
Printers	45	26.2	9	16.1
Telephones	31	18	19	33.9
Fax	96	55.8	46	82.1
Television	128	74.4	49	87.5
Radio	122	71	49	87.5
Mobile/cell phone	43	25	14	25
Video recorder	138	80.2	49	87.5
Internet	119	69.2	13	23.2
E-mail	117	68	9	16.1
Electronic Journals (online)	142	82.6	29	51.8
CD-ROM Databases (e.g. TEEAL Database)	144	83.7	38	67.9
Storage/Server	136	79.1	35	62.5
Information management	132	76.7	33	58.9

*Table indicates multiple responses

The above table shows that various ICT resources and services were available to researchers and extension workers in their respective organisations. Among extension workers, the high prevalence of ICTs was not restricted to the immediate environs of the respondents, but to resources that were available at district, provincial, and at national level. Examples include the TEEAL database, which was mentioned by 144 (83.7%) extension workers; online journals (142; 82.6% of the extension workers), which were available through the Central Library; video recorders (138; 80.2%); information management (132; 76.7%); and storage/servers (136; 79.1%). As will be shown in the discussion, this is corroborated with data from other research instruments.

Television, radio and video recorders were each mentioned by 49 (87.5%) researchers. Researchers also demonstrated access to online electronic journals (29; 51.8%) and the TEEAL database (38; 67.9%). E-mail access and printers could be accessed by only 9 researchers (16.1%) each, and computers by only 3 (5.4%).

7.2.3.5 Purpose of ICT resources and services

The respondents were further requested to indicate the use to which the above ICT resources and services were being put, with nine options to choose from. Table 7.21 provides a summary of the results.

Table 7.21: Purpose of ICT resources and services

Extension workers N=172 and Researchers N=56

Purpose of ICT resources and services	Agricultural Extension Worker		Agricultural Researcher		Total	
	N	%	N	%	N	%
To communicate with agricultural extension workers	19	11.0	30	53.6	49	21.5
To communicate with agricultural researchers	67	40.0	12	24.1	79	34.6
To communicate with farmers	31	18.0	31	55.4	62	27.2
Professional communication with colleagues	38	22.1	9	16.1	47	20.6
Personal communication with friends, etc.	67	40.0	14	25.0	81	35.5
To disseminate agricultural information	39	22.7	19	34.0	58	25.4
For purposes of research	97	56.4	4	7.1	101	44.3
For educational purposes	83	48.3	14	25.0	97	42.5
To communicate with publishers	45	26.1	24	42.9	69	30.3

*Table indicates multiple responses

Most respondents (101; 44.3%) cited research purposes, followed by educational purposes (97; 42.5 %) and communicating with friends (81; 35.5%). 97 extension workers (56.4%) indicated research and 83 (48.3%) cited educational purposes. The least number of extension workers (19; 11%) indicated communicating with extension workers. The majority of researchers (31; 55.4%) indicated communicating with farmers, with the least number (4; 7.1%) citing research purposes. Dissemination of agricultural information was mentioned by 58 (25.4%) of the respondents, specifically 39 (22.7%) extension workers and 19 (34%) researchers.

7.2.3.6 Efficiency of ICTs in disseminating agricultural information

The study also sought to determine which ICT resources and services were considered to be efficient in disseminating or communicating agricultural information. For each item on the list, respondents could choose ‘very effective’, ‘effective’, ‘less effective’ or ‘not effective’. The question attracted multiple responses, as shown in Table 7.22 below.

From the responses, computers were considered to be effective/ very effective by the majority of both extension workers (102; 59.3%) and researchers (41; 73.2%). The majority of extension workers (48; 27.9%) considered printers to be very effective, while 20 (35.7%) researchers considered them to be effective. 25 (11%) of the total respondents found printers to be either less effective or not effective.

The telephone was again considered effective by only 6 (3.5%) of the extension workers. Only 1 (1.8%) researcher indicated that the telephone was not effective. Fax was considered to be less effective by the majority of researchers (12; 21.4%), yet it was considered to be very effective by the majority of extension workers (40; 23.3%)

Table 7.22: Efficiency of ICT resources and services in disseminating agricultural information

Extension workers N=172 and Researchers N=56

		Extension workers		Researchers		Total	
Information Resource	**Relative effectiveness**	**N**	**%**	**N**	**%**	**N**	**%**
Computers	Very effective	57	33.1	22	39.3	79	34.6
	Effective	45	26.2	19	33.9	64	28.1
	Less effective	7	4.1	3	5.4	10	4.4
	Not effective	10	5.8	3	5.4	13	5.7
Total		**119**	**69.2**	**47**	**84**	**166**	**72.8**
Printers	Very effective	48	27.9	19	33.9	67	29.4
	Effective	45	26.2	20	35.7	65	28.5
	Less effective	13	7.6	2	3.6	15	6.6
	Not effective	7	4.1	3	5.4	10	4.4
Total		**113**	**65.8**	**44**	**78.6**	**157**	**68.9**
Telephone	Very effective	74	43	15	26.8	89	39
	Effective	40	23.3	20	35.7	60	26.3
	Less effective	9	5.2	11	19.6	20	8.8
	Not effective	6	3.5	1	1.8	7	3.1
Total		**129**	**75**	**47**	**83.9**	**176**	**77.2**
Fax	Very effective	40	23.3	7	12.5	47	20.6
	Effective	31	18	8	14.3	39	17.1
	Less effective	8	4.7	10	17.9	18	7.9
	Not effective	19	11	12	21.4	31	13.6
Total		**98**	**57**	**37**	**66.1**	**135**	**59.2**
Television	Very effective	29	16.9	23	41.1	52	22.8
	Effective	30	17.4	12	21.4	42	18.4
	Less effective	14	8.1	6	10.7	20	8.8
	Not effective	22	12.8	5	8.9	27	11.8
Total		**95**	**55.2**	**46**	**82.1**	**141**	**61.8**
Radio	Very effective	29	16.9	21	37.5	50	21.9
	Effective	37	21.5	14	25	51	22.4
	Less effective	12	6.9	5	8.9	17	7.5
	Not effective	18	10.5	6	10.7	24	10.5
Total		**96**	**55.8**	**46**	**82.1**	**142**	**62.3**
Mobile/Cell phone	Very effective	85	49.4	21	37.5	106	46.5
	Effective	29	16.9	14	25	43	18.9
	Less effective	11	6.4	8	14.3	19	8.3
	Not effective	9	5.2	1	1.8	10	4.4
Total		**134**	**77.9**	**44**	**78.6**	**178**	**78.1**
Video recorder	Very effective	27	15.7	10	17.9	37	16.2
	Effective	21	12.2	12	21.4	33	14.5
	Less effective	14	8.1	10	17.9	24	10.5
	Not effective	23	13.4	9	16	32	14
Total		**85**	**49.4**	**41**	**73.2**	**126**	**55.2**
Internet	Very effective	39	22.7	20	35.7	59	25.9
	Effective	20	11.6	18	32.1	38	16.7
	Less effective	13	7.6	3	5.4	16	7
	Not effective	22	12.8	6	10.7	28	12.2
Total		**94**	**54.7**	**47**	**83.9**	**141**	**61.8**
E-mail	Very effective	32	18.6	19	33.9	51	22.4
	Effective	25	14.5	16	28.6	41	18
	Less effective	14	8	4	7.1	18	7.9
	Not effective	21	12.2	7	12.5	28	12.3
Total		**92**	**53.5**	**46**	**82.1**	**138**	**60.5**
Electronic journals	Very effective	12	6.9	20	35.7	32	14
	Effective	24	14	11	19.6	35	15.3
	Less effective	21	12.2	7	12.5	28	12.3
	Not effective	27	15.7	6	10.7	33	14.5
Total		**84**	**48.8**	**44**	**78.5**	**128**	**56.1**
CD-ROM databases (e.g. TEEAL	Very effective	12	7	12	21.4	24	10.5
	Effective	20	11.6	12	21.4	32	14
	Less effective	19	11	6	10.7	25	11
	Not effective	31	18	9	16.1	40	17.5
Total		**82**	**47.6**	**39**	**69.6**	**121**	**53**

The media were considered to be effective in disseminating agriculture information, with the majority of extension workers (59; 34.3%) and researchers (35; 62.5%) finding that the television was effective or very effective. The radio was not effective according to 18 extension workers (10.5%), with 6 researchers (10.7%) sharing this view. The mobile phone or cell phone was considered to be effective/ very effective by 114 extension workers (66.3%) and 35 researchers (62.5%). Only 9 (5.2%) and 1 (1.8%) of the extension workers and researchers respectively indicated that the mobile phone was not effective. The frequency of use of mobile phones is dealt with in the next section.

The video recorder was considered to be very effective by 27 extension workers (15.7%), with a significant 14 (8.1%) and 23 (13.4%) mentioning that it was less effective and not effective respectively. Equally among researchers, the majority (12; 21.4%) found it to be effective, with 9 (16%) believing that it was not effective. The internet was considered to be very effective by the majority of extension workers (39; 22.7%), although a significant number of 22 (12.8%) thought it was not effective. A similar pattern was observed when extension workers were asked about the email; 32 (18.6%) believed it to be very effective against 21 (12.2%) who felt that it was not effective. The majority of researchers considered the internet and e-mail to be very effective, as indicated by 20 (35.7%) and 19 (33.9%) respectively.

Responses for electronic journals and CD-ROM databases completely reversed the above trend**,** particularly among extension workers. The majority of extension workers (27; 15.7%) mentioned that electronic journals were not effective, with 21 (12.2%) indicating that they were less effective. Similarly, the majority of extension workers (31; 18%) found databases to be less effective. The majority of researchers (20; 35.7%), however, considered electronic journals to be very effective. This was also the case with CD-ROM databases, with 12 researchers (21.4%) finding them to be very effective, and the same margin mentioning that they were effective. The majority of the respondents (40; 17.5%) felt that databases were not effective.

7.2.3.7 Frequency of use of mobile phones/ cell phones in communicating agricultural information

This question specifically focused on the use of mobile phones. Respondents were required to indicate their frequency of use of mobile phones/ cell phones in communicating agricultural information from a list of 'quite often', 'often', 'sometimes' or 'never'. Most of the respondents (97; 42.5%) indicated that they used mobile phones quite often, with 24 (10.5%) indicating that they never used the device. Table 7.23 summarizes the responses.

Table 7.22: Frequency of use of mobile/ cell phone

Extension workers N=172 and Researchers N=56

Frequency of use of mobile/ cell phone	Agricultural Extension Worker		Agricultural Researcher	
	N=172	100%	N=56	100%
Quite often	85	49.4	12	21.4
Often	41	23.8	12	21.4
Sometimes	31	18	23	41.1
Never	15	8.7	9	16.1
Total	**172**	**100**	**56**	**100**

The majority of extension workers (85; 49.4%) indicated that they used mobile phones quite often to communicate agricultural information. Only 15 (8.7%) indicated that they never used the device. The majority of researchers (23; 41.1%) indicated that they sometimes used mobile phones for the mentioned purpose, while 9 (16.1%) indicated never.

7.2.3.8 Communicating agricultural information using mobile phones

The aim of this question was to find out with whom the respondents communicated agricultural information using mobile phones. The majority of extension workers (69; 40.1%) indicated communicating with researchers; reciprocally the majority of researchers (21; 37.5%) indicated communicating with extension workers, and equally with agribusiness companies. Table 7.24 summarises the results.

Table 7.23: Communicating agricultural information using mobile phones

Extension workers N=172 and Researchers N=56

Person whom you communicate with using mobile/ cell phone	Agricultural Extension Worker		Agricultural Researcher	
	N	%	N	%
Farmers	28	16.3	18	32.1
Extension workers	17	9.9	21	37.5
Researchers	69	40.1	7	12.5
Colleagues	33	19.2	6	10.7
Agribusiness companies	31	18	21	37.5

*Table denotes multiple responses

The trend was also noticeable in 7.2.3.5, where 67 extension workers (40%) indicated that they used ICTs to communicate with researchers. The responses also indicate that there was intra communication within the two categories, and also with agribusiness companies as shown by 31 extension workers (18%).

7.2.3.9 Status of ICT infrastructure in the respondents' office or department

The respondents were also requested to rate the ICT infrastructure in their offices or departments. The ICT infrastructure within the research and extension systems was considered to be poor by 147 (64.5%) of the respondents. Among the extension workers, 116 (67.4%) felt that the infrastructure was poor, 51 (29.7%) good, and 5 (2.9%) believed that it was very good. A similar pattern was observed among researchers where the majority (31; 55%) believed the infrastructure was poor, 23 (41.1%) good, and 2 (3.6%) indicated that it was very good.

7.2.3.10 ICTs and services required to improve job performance

Having indicated the ICT resources and services and commented on the status and challenges of ICTs, the respondents were requested to indicate, from a list provided, ICT resources and services that they would require to improve their job performance. Table 7.25 provides a summary of the findings.

Table 7.24: ICTs and services required to improve job performance

Extension workers N=172 and Researchers N=56

ICTs and services required to improve performance	**Agricultural Extension Worker**		**Agricultural Researcher**	
	N	**%**	**N**	**%**
Desktop computer	92	53.5	37	66.1
Laptops	33	19.2	16	28.6
Printer	78	45.3	23	41.1
Internet	66	38.4	25	44.6
E-mail	86	50.0	23	41.1
Access to databases	149	86.6	25	44.6

*Table indicates multiple responses

An overwhelming majority of the extension workers (149; 86.6%) indicated that they required access to databases. Laptops were the least mentioned item. Among researchers, the majority (37; 66.1%) required desktop computers, with laptops being the least required item. Other resources were highly recommended, for example e-mail by 86 (50%) of the extension workers, and the internet by 25 (44.1%) of the researchers.

7.2.3.11 Management of information generated from research and extension services

The aim of this question was to establish how divisions or departments managed information that was generated by researchers and extension workers. These could be research reports, periodic reports, etc. The responses indicate that some form of record keeping was in existence. However, the discussion in the next chapter, which merges the responses from other research instruments, shows that some of the responses below may have referred to abstracts and not full text articles or documents. For example, 144 (83.7%) of the extension workers indicated that copies were sent to the Research Council of Zimbabwe, yet it is only information on current and completed research projects that is sent. Table 7.26 provides a summary of the findings.

Table 7.25: Management of information generated from research and extension services

Extension workers N=172 and Researchers N=56

Information management	**Agricultural Extension Worker**		**Agricultural Researcher**	
	N	**%**	**N**	**%**
Copies are kept in the library	99	57.6	18	32.1
Records are kept in a central database	104	60.5	34	60.7
Copies are retained by individual researchers/extension workers	88	51.2	21	37.5
Copies are sent to the Research Council of Zimbabwe	144	83.7	33	58.9
Copies are kept in departmental collections	41	23.8	10	17.9

*Table denotes multiple responses

Over half of the researchers (34; 60.7%) indicated that copies were kept in a central database. The least number of extension workers (41; 23.8%) indicated that copies were kept in departmental collections.

7.2.3.12 Access to information generated by research and extension services

The respondents were asked to indicate whether the information generated was readily accessible to both internal and external users. According to most of the respondents (131; 57.5%), information was generally not easily accessible, representing 101 (58.7%) of the extension workers and 30 (53.6%) of the agricultural researchers. 97 (42.5%) of the respondents felt that information was accessible, i.e. 71 extension workers (41.3%) and 26 researchers (46.4%).

7.2.3.13 Management/ coordination of information generated by DR&SS and AGRITEX

The study also sought to establish whether respondents felt that the information generated by departments was being adequately captured by DR&SS or AGRITEX. The majority of respondents (205; 90%) felt that information was adequately captured, i.e. 153 (89%) of the extension workers and 52 (92.9%) of the researchers. This information corroborates data collected during the interviews with key informants. Only 23 (10%) of the respondents indicated that information was not adequately captured.

7.2.3.14 Suggestions for the improved management of information generated by departments or divisions

The respondents were asked to offer their suggestions for improving the management of records generated by the divisions and sections within DR&SS and AGRITEX. The summarized suggestions in Table 7.27 were proposed.

Table 7.26: Suggestions for improving information management

Extension workers N=172 and Researchers N=56

Suggestions for Improving Information management	Agricultural Extension workers		Agricultural Researchers		Total	
	N	%	N	%	N	%
Management to make use of mobile phones	3	1.7	2	3.6	5	2.2
Need to improve computer networking (LAN &WAN)	14	8.1	3	5.4	17	7.5
Develop and place information on website for easy access	64	37.2	18	32.1	82	40
Decentralization of research institutes	2	1.2	2	3.6	4	1.6
Establish research offices at district level	4	2.3	1	1.8	5	2.2
Improve communication	5	2.9	2	3.6	7	3.1
Send information to the field officers on the ground	5	2.9	2	3.6	7	3.1

*Table denotes multiple responses

The summarised responses show that the majority of respondents (82; 40%) felt that there was a need to develop and place information on the website for all stakeholders to access. 17 (7.5%) of the respondents indicated the need to improve computer networks, both at local (LAN) and wide area (WAN) level. These sentiments were shared by the majority of both extension workers and researchers. There was also a need for the decentralisation of research institutes, mentioned by 2 (1.2%) of the extension workers, and the need to establish research offices at district level, mentioned by 1 (1.8%) of the researchers.

7.2.4 Indigenous knowledge systems in agricultural research and extension

The use and application of indigenous knowledge in agriculture has been demonstrated in literature. The study sought to establish the importance of indigenous knowledge in agricultural research and extension by looking at its utilisation, frequency of use, and type of sources used.

7.2.4.1 Utilisation of indigenous knowledge in agriculture

Indigenous knowledge was found to be highly utilised in the generation of agricultural innovations, as indicated by 205 (89.9%) of the respondents (153 or 89% of the extension workers and 52 or 92.9% of the researchers). 23 (10.1%) respondents didn't agree (19 or 11% of the extension workers and 4 or 7.1% of the researchers).

7.2.4.2 Frequency of indigenous knowledge utilisation

This question extended on the previous question and sought to find out how frequently indigenous knowledge was utilised by the respondents. The majority of respondents (84; 36.8%) mentioned that they sometimes utilised IK. Table 7.28 below summarises their responses.

Table 7.27: Frequency of indigenous knowledge utilisation

Extension workers N=172 and Researchers N=56

Frequency of use of indigenous knowledge	Agricultural Extensionists		Agricultural Researchers		Total	
	N=172	%	N=56	%	N=228	%
Very often	35	20.3	7	12.5	42	18.4
Often	59	34.3	20	35.7	79	34.6
Sometimes	59	34.3	25	44.6	84	36.8
Never	19	11	4	7.1	23	10.1
Total	**172**	**100**	**56**	**100**	**228**	**100**

Most responses ranged between 'often' and 'sometimes', as shown by 118 (64.6%) of the extension workers and 45 (80.3%) of the researchers. The responses also indicate that a significant number (35; 20.3%) of the extension workers utilised IK 'very often'.

7.2.4.3 Sources of indigenous agricultural knowledge

Indigenous knowledge acquisition is based on numerous formal and informal sources. This question sought to establish the sources of indigenous agricultural knowledge among the respondents. Among the extension workers, the majority (88; 51.2%) mentioned books, 85 (49.4%) mentioned conferences and workshops, while colleagues were mentioned by 71 (41.3%). The least mentioned source was farmers' groups by 28 extension workers (16.3%). Table 7.29 provides a summary of the sources.

Table 7.28: Sources of indigenous agricultural knowledge

Extension workers N=172 and Researchers N=56

Sources of indigenous agricultural knowledge	Agricultural Extension Worker		Agricultural Researcher	
	N	**%**	**N**	**%**
Personal experience	51	29.7	11	19.6
Books	88	51.2	33	58.9
Social gatherings	34	19.8	15	26.9
Conferences/workshops	85	49.4	27	48.2
Village leaders/elders	34	19.8	20	35.7
Agricultural shows	37	21.5	13	23.2
Village meetings	42	24.4	24	42.9
Farmer's groups	28	16.3	11	19.6
Demonstration and observation	51	29.7	20	35.7
Colleagues	71	41.3	25	44.6

*Table indicates multiple responses

Among researchers, books were mentioned by the majority (33; 58.9%), followed by conferences/workshops (27; 48.2%). Farmers' groups and personal experiences were not popular sources (11 or 19.6% each). The responses indicate that indigenous agricultural knowledge is derived from a variety of both formal and informal sources.

7.2.4.4 Types of indigenous agricultural knowledge obtained from sources

The respondents were asked to indicate the types of indigenous agricultural knowledge they obtained from the sources they had mentioned in the preceding question based on a selection of agricultural topics and subtopics. Plant diseases and pests was mentioned by the majority of extension workers (152; 88.4%) followed by plant breeding (139; 80.8%), with dairy farming coming third (135; 78.5%). The least selected type by extension workers was crop harvest and storage (31; 18%). The responses are summarised in Table 7.30 below.

Table 7.29: Types of indigenous agricultural knowledge obtained from sources

Extension workers N=172 and Researchers N=56

Type of indigenous agricultural knowledge obtained	Agricultural Extension Worker		Agricultural Researcher	
	N	%	N	%
Soil fertility	75	43.6	28	50.0
Horticulture	81	47.1	40	71.4
Soil classification	123	71.5	42	75.0
Plant breeding	139	80.8	44	78.6
Poultry	102	59.3	35	62.5
Plant pathology	133	77.3	37	66.1
Dairy farming	135	78.5	45	80.4
Plant diseases and pest	152	88.4	21	37.5
Crop protection	36	20.9	25	44.6
Animal health	90	52.3	36	64.3
Tobacco culture	105	61.0	48	85.7
Animal breeding	127	73.8	41	73.2
Weather patterns	55	32.0	21	37.5
Crop harvesting and storage	31	18.0	14	25.0
Crop varieties	62	36.0	20	35.7

*Table denotes multiple responses

Most of the researchers (48; 85.7%) indicated tobacco culture, followed by dairy farming (45; 80.4%) and plant breeding (44; 78.6%). As with extension workers, crop harvesting and technology was also the least indicated type by researchers (14; 25%).

7.2.5 Research and extension collaboration

The study also sought to establish the nature and extent of national and international research and extension collaboration between researchers and extension workers and other related organisations.

7.2.5.1 Existence of research and extension collaboration nationally

The aim of this question was to ascertain whether there was any collaboration between public and private research and extension organisations at national level. The majority of respondents (138; 60.5%) acknowledged collaborating with private organisations nationally, i.e. 93 (54.1%) of the extension workers and 45 (80.4%) of the researchers. A minority (90; 39.5%) indicated that they did not collaborate with research and extension organisations, representing 79 (45.9%) of the extension workers and 11 (19.6%) of the researchers.

7.2.5.2 Areas of collaboration (nationally)

The respondents had to select from eleven areas of collaboration. The question allowed for multiple answers. Most of the extension workers (73; 42.2%) indicated funding, followed by research facilities (72; 41.9%), with training being the least mentioned area (20; 11.6%).

Table 7.30: Areas of collaboration (nationally)

Extension workers N=172 and Researchers N=56

Areas of collaboration (nationally)	Agricultural Extension Worker		Agricultural Researcher	
	N	%	N	%
Staff exchange programmes	55	32	37	66.1
Research publications	64	37.2	21	37.5
Research facilities	72	41.9	18	32.1
Research results	49	28.5	28	50
Joint research projects	50	29.1	13	23.2
Funding	73	42.4	24	42.9
Extension projects	23	13.2	31	55.4
Extension publications	56	32.6	36	64.3
Zonal/ geographic distribution of projects	66	38.4	42	75
Training	20	11.6	14	25
Technical advice	27	15.7	16	28.6

*Table denotes multiple responses

Responses from researchers show that zonal/ geographical distribution of projects was mentioned by the majority (42; 75%), followed by staff exchange programmes (37; 66.1%). Joint research projects was the least mentioned area of collaboration by researchers (14; 25%). Overall, the majority of respondents (108; 47.4%) mentioned zonal/ geographical distribution of projects, while training was the least mentioned area of collaboration (34; 14.9%).

7.2.5.3 Research and extension collaboration internationally

This question required respondents to indicate whether they collaborated with international organisations in research and extension. The results revealed that the majority (146; 64%) did not collaborate internationally, representing 124 (72.1%) of the extension workers and 22 (39.3%) of the researchers. The majority of researchers (34; 60.7%) indicated collaborating internationally compared to 48 extension workers (27.9%) from a total of 88 respondents (36%).

7.2.5.4 Areas of collaboration internationally

As in *7.2.5.2*, the respondents were asked to indicate areas in which there was international collaboration. Table 7.32 below provides a summary of the findings. Overall, research facilities as an area of collaboration was mentioned by the majority of respondents (62; 27.2%), while training was the least mentioned area of collaboration (21; 9.2%).

Table 7.31: Areas of collaboration internationally

Extension workers N=172 and Researchers N=56

Areas of collaboration (internationally)	Agricultural Extension Worker		Agricultural Researcher	
	N	%	N	%
Research exchange programmes	27	15.7	21	35.7
Research publications	30	17.4	21	35.7
Research facilities	38	22.1	24	42.9
Research results	29	16.9	22	39.3
Joint research projects	39	22.7	18	32.1
Funding	38	22.1	15	26.8
Extension projects	26	15.1	31	55.4
Extension publications	24	14	32	57.1
Training	11	6.4	10	17.9
Technical advice	19	11	15	26.8

*Table indicates multiple responses

The majority of extension workers (39; 22.7%) mentioned joint research projects as an area of collaboration, followed by research facilities and funding (38 or 22.1% each). The least mentioned area of collaboration by extension workers was training (11; 6.4%). Among researchers, extension publications were mentioned by the majority (32; 57.1%) followed by extension projects (31; 55.4%). The least mentioned area of collaboration was training (10 or 17.9% of the researchers). The results thus indicated varying areas of collaboration. The role of researchers in generating material for extension at international level is highlighted in the interview responses.

7.2.5.5 Collaboration with farmers' organisations

The study also sought to establish whether there was collaboration between researchers and extension workers, and farmers' organisations. The responses revealed that the majority (206; 90.4%) collaborated with farmers' organisations, i.e. 158 (91.9%) of the extension workers and 48 (85.7%) of the researchers. 22 (9.6%) of the respondents said there was no such collaboration, specifically 14 (8.1%) of the extension workers and 8 (14.3%) of the researchers.

7.2.5.6 Role of farmers' organisations in research and extension

Respondents were asked to indicate the role of farmers' organisations in research and extension. The majority (147; 64.5%) felt that organisations assisted with funding research and extension programmes, followed by repackaging information for farmers (139; 61%), with the least mentioned role being providing farmers with inputs (18; 7.9%). Table 7.33 provides a summary of the findings.

Table 7.32: Role of farmers' organisations in research and extension

Extension workers N=172 and Researchers N=56

Role played by farmer organisations	Agricultural Extension Worker		Agricultural Researcher	
	N	%	N	%
Provide farmers with information on inputs	8	4.7	10	17.9
Provide farmers with information on markets	14	8.1	15	26.8
Provide legal advice to farmers	82	47.7	30	53.6
Participatory research (on-farm trials)	87	50.6	14	25
Re-packaging information for farmers	110	64.0	29	51.8
Funding research and extension programmes	116	67.4	31	55.4

*Table indicates multiple responses

Among extension workers, the majority (116; 64.7%) indicated funding research and extension, followed by repackaging information for farmers (110; 64%), with significant indications for on-farm trials (50.6%). The majority of researchers mentioned funding research and extension programmes (31; 55.4%), followed by provision of legal advice to farmers (30; 53.6%).

7.2.6 Knowledge gaps, constraints and recommendations

This section aimed to capture gaps, constraints and recommendations as articulated by the researchers and extension workers.

7.2.6.1 Factors affecting access to information on agricultural research and extension

The study required respondents to indicate factors that negatively affected their access to agricultural information. The responses are summarised in Table 7:34 below.

Table 7.33: Factors that inhibit access to agricultural information

Extension workers N=172 and Researchers N=56

Factors which inhibit access to agricultural information	Agricultural Extension Worker		Agricultural Researcher	
	N	%	N	%
Lack of communication between the two departments	163	94.8	49	87.5
Lack of resources	153	89	49	87.5
Poor ICTs for extension and research staff	168	97.7	55	98.2
Lack of adequate and current information resources	150	87.2	28	50
Lack of funding	167	90.1	49	87.5
Lack of transport	157	91.3	55	98.2
Poor staff remittances	153	89	50	89.3

*Table denotes multiple responses

The responses reflect the challenges facing research and extension work highlighted in the previous sections. Poor ICTs for extension and research staff was mentioned by the majority of extension workers (168; 97.7%), followed by lack of communication between the two departments (research and extension), indicated by 163 (94.8%). Lack of ICTs and lack of transport were mentioned by the majority of researchers (55; 98.2% each). Mobility as a contributing factor was considered to affect how the respondents got to the information resources. However, ‘lack of adequate and current information resources’ was mentioned by the least number of respondents in both categories, with 150 (87.2%) for extension workers and 28 (50%) for researchers.

7.2.6.2 Major constraints facing agricultural research and extension

The respondents articulated a variety of challenges or constraints which are a culmination of the problems highlighted throughout the questionnaire. The responses were tabulated and summarised in Table 7.35 below.

Table 7.34: Constraints facing agricultural research and extension in Zimbabwe

Extension workers N=172 and Researchers N=56

Major constraints facing agricultural research and extension	**Agricultural Extensionists**		**Agricultural Researchers**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**
Lack of resources	112	65.1	44	78.6	156	68.4
Poor remunerations	53	30.8	7	12.5	60	26.3
Inadequate funding	47	27.3	34	60.1	81	35.5
Poor lab equipment	5	2.9	25	44.6	30	13.2
Limited ICTs	59	34.3	23	41.1	82	36
Poor linkage between research and extension workers on the ground	22	12.8	2	3.6	24	10.5
Transport (vehicles, motorbikes)	105	61	39	69.6	144	63.1
Road network (new farmers not accessible)	11	6.4	-	-	11	4.8
Outdated information sources (books, journals)	42	24.4	21	37.5	63	27.6
Women play a marginal role	8	4.7	3	5.4	11	4.8
Poor communication between research and extension systems	17	9.9	5	8.9	22	9.6
Lack of expertise in research areas	9	5.2	1	1.8	10	4.4
Limited forums for discussions	23	13.4	3	5.4	26	11.4
Limited material in vernacular or at the level of farmers	44	25.6	7	12.5	51	22.4
Poor access to information resources	71	41.3	15	26.8	86	37.7
More farmers than resources/ extension workers	39	22.7	2	3.6	41	18
Politicizing land at the expense of production	7	4.1	1	1.8	8	3.5

7.2.6.3 Charging farmers for research and extension services

This question sought the respondents' opinions on charging farmers for the research and extension services rendered by the two institutions. The responses were summed up in four major points:

- Farmers should not be charged as they struggling to make ends meet (mentioned by 47; 27.3% of the extension workers and 8; 14.3% of the researchers)
- Charging farmers is not a good practice; most farmers are still struggling to establish themselves (new farmers) and are poor (51; 26.7% of the extension workers and 17; 30.4% of the researchers)

- Charge farmers to keep research and extension structures functional (mentioned by 43; 25% of the extension workers and 24; 42.9% of the researchers)

- Charging is a positive idea but should depend on the model of the farmer, that is, whether commercial, small scale or subsistence (5; 2.9% of the extension workers)

The responses clearly show that charging was not favoured by most of the respondents. The same question was posed to the key informants, whose opinions are listed in the section that follows and discussed in the next chapter.

7.2.6.4 Recommendations for improving communication for research and extension

The respondents were asked to recommend measures that they felt would improve the communication of agricultural research and extension information. The responses are summarised below with percentile indications of the respondents:

- Creation of a mini database for all departments to deposit information (mentioned by 33; 19.2% of the extension workers and 15; 26.8% of the researchers)

- Provide extension workers and researchers with transport for increased mobility and to enable them to reach farmers on time (44; 25.6% of the extension workers and 16; 28.6% of the researchers)

- Researchers should give feedback to extension workers for planning and implementing purposes (7.6% of the extension workers and 7.1% of the researchers)

- Provide extension workers with mobile phones/ cell phones and airtime (12; 7% of the extension workers and 1; 1.8% of the researchers)

- Information should be disseminated to all farmers, regardless of gender (10; 5.8% of the extension workers and 11; 19.6% of the researchers)

- Build libraries and improve community structures (5; 2.9% of the extension workers)

- Improve ICT provision and internet access (15; 8.7% of the extension workers and 13; 23.2% of the researchers)
- Provide resources (5; 2.9% of the extension workers)

The suggestions corroborate the constraints and are valid recommendations for tackling the challenges.

7.3 Section Two: Interview responses

This section covers responses from interviews conducted with key informants from AGRITEX and DR&SS in 7.3.1 and interviews with librarians in 7.3.2. The interviews aimed to capture information from key informants - policy makers from the two departments - and librarians for data on the information services available to the respondents (researchers and extension workers). The two categories were excluded from completing the main questionnaire. Information from the key informants complemented the views of the researchers and extension workers. The librarians provided their opinions on the status of libraries and information services which the researchers and extension workers had evaluated in the main questionnaire.

The interview schedules were sent ahead of the interviews in order for the respondents to familiarise themselves with the questions. Clarity with respect to responses was also sought during data analysis through email correspondence.

7.3.1 Data from interviews with key informants

An interview schedule was prepared for key informants in order to get policy perspectives on the subject under investigation. The study employed both structured and semi-structured interviews. The interviews addressed nine themes which included the responsiveness of research and extension to new technologies, research prioritisation, and the role of the government in capacitating research and extension systems. The interview questions focused on research questions [d, e. f. h, and i] as indicated in Chapter one.

7.3.1.1 Background information and responsibilities of divisions (Q. 1-2)

The key informants (policy makers) drawn from AGRITEX were the Acting Director – Field Services division and Acting Director – Technical Services division; and from

DR&SS, Director - Livestock and Pastures Research, Deputy Director - Crops Research (for the Director), and Deputy Director - Research Services (for the Director).

AGRITEX's acting directors highlighted their division's major responsibilities, indicating the following among others:

- Mobilization of farmers for targeted production
- Development and production of technical materials tailored to meet the needs of different clients for direct use and as reference material
- Dissemination of agricultural and market related information to farmers
- Dissemination and promotion of new technologies through on-farm trials and demonstrations, field days, farm exchange visits, farmer field schools, etc.
- Collate agricultural information and statistics
- Provide a link or interface between researchers and farmers

Responses from the research division were a confirmation of information already indicated in the contextual setting in Chapter two. The technologies, knowledge, and information that the research division generates are designed to facilitate and improve agricultural production. This includes formulating appropriate research priorities and programmes that meet stakeholder requirements for information and technologies, as well as facilitating the development of agriculture by commercialising research based technologies. The significance of these selected functions counters observations made by extension workers in 7.2, where it was felt that research was not being directed or relevant to the needs of those on the ground. This will be developed in the discussion in Chapter eight.

7.3.1.2 New technologies and responsiveness of research and extension (Q. 3-4)

AGRITEX's directors were optimistic that the extension system was promoting technologies that were suitable for different circumstances or needs, particularly with respect to new client demands and the need to boost production. They cited:

- The conservation agriculture drive
- Renewal efforts to address livestock issues, fodder and small stock
- Streamlining climate change into agricultural extension

The general consensus from the DR&SS informants was that the response has been slow due to insufficient resources and manpower. Old equipment for field and laboratory research was highlighted as the main inhibiting factor, rendering results less competitive. The advent of 'new farmers' was also identified as a challenge, particularly in relation to lack of knowledge about best farming practices, resulting at times in the misappropriation of resources. Issues being addressed through research initiatives include research into the suitability of different crops and livestock varieties/ breeds to different climatic conditions, which should result in increased food production. Changes in the economic environment were seen to be bringing positive results to research and extension, albeit slowly.

7.3.1.3 Information provision and management policies (Q. 5-7)

Information services were condemned as totally inadequate and ill-equipped by all the responding directors. Their responses were as follows:

- DR&SS informants felt that the information system had completely broken down, with material having disappeared due to the lack of qualified staff to handle the material
- Research results were largely kept in files with minimum circulation or publication due to lack of resources like paper and toner
- Although ICTs are available, they are now obsolete and irrelevant. Some data/information are stored using the old technologies like floppy disks
- Research institutes did not make information readily available, hence the need for a centralised database of all research output
- The Central Library's collection was considered to be too old to address the needs of current research, with limited access to electronic resources

Information generated by researchers and extension workers is based on the work they do, which includes results from experiments, theses and dissertations, and private or sponsored programmes and manuals covering broad or specific subjects or disciplines. The information generated is also dependent on the needs and priorities of the end users.

The AGRITEX directors were not affirmative of any policies available for managing the information generated by the divisions, while DR&SS indicated that there is no defined policy, although all information generated by DR&SS belongs to the department and has to be acknowledged when used by third parties.

7.3.1.4 Communication between researchers and extension workers (Q. 8-10)

According to FAO (2004:3), bridging the gap between research and extension is the most serious institutional problem in developing research and extension programmes. The informants' responses are provided below:

- 10 years ago, information generated from trials or experiments used to be shared via workshops. AGRITEX would then develop/ transform/ interpret the information into vernacular or the farmers' language

- Dissemination of new technologies is done by applying the results of research, for example with new seed varieties; however little documentation is sometimes generated to support these strategies

- The revival of the Committee on On-farm Research and Extension (COFRE) as a platform for exchanging information and joint work in on-farm activities and field demonstrations

- Information is shared through publications, for example Research Services through the Plant Protection Institute produces a manual on pest control with contributions from local farmers and extension personnel which has expanded into regional cooperation and international organisations like the International Red Locust Control for Central and Southern Africa (IRLCO-CSA)

- Currently, 10 seed companies are contracted to produce certified seed for the market and these work in conjunction with DR&SS. However, the marketing and repackaging of the new technologies is the responsibility of the companies involved. The extension may be done by the companies themselves or in conjunction with AGRITEX.

The directors/ deputy directors from AGRITEX and DR&SS felt that the level of communication between the two systems could be improved by using some of the above suggestions. AGRITEX indicated that they were in the process of creating platforms, which would be participatory.

The informants were asked to indicate the type of information requested by most farmers and the methods being used to disseminate agricultural information. Information is varied and depends on farming systems, local funds, priorities, and market forecast. These systems include tillage, cropping, livestock husbandry techniques, pest control and marketing as well as post harvesting technologies. The informants stated that information was disseminated through a wide range of extension methods, tools and approaches, which include manuals, brochures, factsheets, extension meetings, demonstrations on farms, farmers' field schools, radio and television programmes, and through newspaper articles.

7.3.1.5 Research prioritisation and farmers' participation (Q. 11-12)

The perception was that research priorities are driven by prevailing government policies, national priorities and funding, through consultation with relevant stakeholders. Different research institutes have different priorities which are guided by national policies, which may in turn be influenced by prevailing regional or international trends, for example the impact of climate change on farming seasons and consequently on seed varieties. Some priorities are situational, others are problem oriented and designed to prevent, reduce or eradicate a problem (e.g. pests such as birds, army worms and locusts). The Deputy Director for the Crops Research division provided the example of research on cassava as a priority area, although this might not be a staple food for Zimbabweans. However, the research is meant to stimulate appreciation or acceptance amongst farmers so that they could embark in its production.

AGRITEX indicated that priorities were determined through: surveys or studies, consultations/ dialogue, field experimentation (testing), observations, feedback through formalised structures, staff/ farmer evaluations, and through policy documents and pronouncements. However, the Crops Research representative felt that on-farm trials were an expensive undertaking as this required researchers to be highly mobile. The sentiment was also expressed that the current transport (vehicles and motorcycles) distribution within the ministry was biased towards extension workers.

Farmers were seen to play a considerable role in problem identification and priority setting through participatory approaches with researchers and extension workers, especially during the implementation and evaluation phase of on-farm trials. According to responses from the AGRITEX informants, it is farmers themselves who identify and prioritise their problems; extension workers only help them do it better,

7.3.1.6 Financing and privatisation of research and extension services (Q. 13-15)

The directors/ deputy directors indicated that the financing of agriculture has been on the decline, with DR&SS indicating that allocation of funds from the fiscus was still low compared to extension. Donor funding, that had traditionally sustained some projects through bilateral arrangements, has suffered setbacks and this has been attributed to the current political environment. On the issue of charging for research and extension services, the informants confirmed that this was already taking place within research. Charging was initially implemented as a cost recovery mechanism (e.g. fuel costs), but this has since been extended, for example to seed companies for the breeders' seed production. Institutes also charge as part of their revolving funds. Responses from Research Services through the Plant Protection Institute also suggest that charges were "forced" on farmers as there was little stakeholder consultation. In some instances, charges did not always reflect the services provided, depending on the distance of the farmer from the research centres. Commercial rates were charged mostly to commercial farmers who request advisory services. Responses from AGRITEX indicated that charging should be done for private goods, with free service delivery for public goods; for example, a farmer should pay if a dam is pegged on his farm, in contrast to the control of anthrax which is a public good and which the government should pay for.

On the privatisation of research and extension services, there were mixed views, with DR&SS representatives projecting that in the next 10 years, it could be necessary to privatise these services in order for research and extension to generate their own funds for service delivery. AGRITEX representatives felt that this could not be a wholesaler, since public goods will continue to be offered free to farmers; privatisation would lead to marginalising the most deserving clients.

7.3.1.7 ICTs in agricultural research and extension (Q. 16-17)

The respondents indicated that they were using ICTs such as laptops and internet services extensively in their daily operations. They were also able to access electronic information resources like AGORA and other online journals. However, the respondents indicated that ICT infrastructure was very poor within the research and extension systems and this needs to be improved. Lack of funds was cited as a major obstacle.

7.3.1.8 Research and extension collaboration (Q. 18-20)

DR&SS and AGRITEX indicated that there was collaboration between state and non-state sections and within the government on a wide range of agricultural issues. It was pointed out that the Ministry of Agriculture had engaged a technical advisor who would, among other responsibilities, work on resuscitating research and extension linkages. This would involve a number of stakeholders at provincial level and nationally. The resuscitation of COFRE was again raised in the responses.

The respondents also indicated that there was collaboration with organisations like FAO, CIMMYT, ICRAF, IFAO, DFID, NGOs, ICRISAT, and universities. These were helping in the promotion of technologies developed by research institutions. The constraints raised were lack of funds on the part of government, the existence of parallel extension systems, and that international organisations tended to stick to their mandate and ended up dictating what had to be done. Collaboration was across all areas of agriculture, i.e. cropping, animal and livestock research, extension, etc.

7.3.1.9 Capacitating research and extension and the role of the government (Q. 21-22)

Both DR&SS and AGRITEX felt that resources had not been forthcoming and permitting to capacitate agricultural research and extension services and address the new farming dispensation. Focused funding and improved mobility, manpower development programmes, COFRE, staff and farmer training (including in-service training), and capacity building for farmers' institutions were seen as factors that would help research and extension. In their recommendations, the respondents felt that more funds should be allocated to research and extension; mobility should be improved, particularly in the case of researchers; platforms should be created for collaboration; and the interface of research and extension should be properly managed. Respondents also felt that there should be proper policies with respect to the constitution of boards of parastatals; for example members of the Research Council and the Agricultural Research Council need to be subject specialists and knowledgeable in the areas that they preside over.

7.3.2 Data from the interviews with librarians

The interviews provided information on the status of library and information services within the Ministry of Agriculture. An interview schedule was prepared in order to assess the state of libraries within the Ministry of Agriculture based on responses from the librarians manning the libraries. The interviews targeted librarians from the Central Library and from the research institutes within the Ministry, and excluded college libraries. Data was collected from seven (7) libraries out of the possible nine (9) that had been targeted. These were: the Central Library, Cotton Research, Matopos Research, Grassland Research, Henderson Research, National Herbarium, and Horticulture Research. Failure to get responses from the other institutions was due to the absence of librarians. The interviews addressed issues of membership, accessibility, collection development and utilisation, user support, and the role of ICTs, including database subscriptions and utilisation. The librarians were also asked to comment on collaboration with other libraries and the challenges they faced in providing information to their patrons. An observation schedule of the libraries was also conducted (see **7.4**) to complement and verify the information collected.

7.3.2.1 Background and membership (Q. 1-6)

The Ministry of Agriculture's research institutes face a critical staff challenge, as suggested by the profile of the people interviewed. The Central Library was the only library with a librarian to interview. The Cotton Research Institute Library was manned by a library assistant. At Grasslands, the executive assistant assisted with the responses, while at Matopos, although there was a library helper, the principal research officer provided the responses. At the remaining institutes, interviews were conducted with the research officers.

The libraries' opening hours were in keeping with normal working hours. Where there was no library member in charge, opening hours were determined by the availability of the research officers in charge. The library representatives stated that membership was open to all ministry employees (including those from other government departments), students, researchers, as well as other members of the public on request. At Henderson for example, farmers were identified among the frequent users. Subject specialisation also determines the profile of specific users, for example the National Herbarium was frequented by botany students and researchers from universities.

In terms of the adequacy of sitting and shelving space, only two institute representatives (Horticulture and Matopos) expressed satisfaction, while the rest felt that the library space was no longer adequate.

7.3.2.2 Collection development and usage (Q. 7-15)

The respondents indicated that most of the material related to institutes' themes. For example, Matopos and Henderson's representatives indicated books and journals on livestock research, while the Cotton Research Institute indicated electronic media and daily and weekly newspapers. There were indications that library users were concerned with more current sources than dated 'historical' material. The library collections were fairly small, with the Central Library representative estimating 8000 plus books and more than 500 journals and research and technical reports. Matopos had more than 2000 books, 30 plus journal titles, and approximately 500 research reports, while the Cotton Research Institute representative counted 781 books, 300 journals, and 600 research and annual reports. Newspapers were not archived. Statistics for the other institutes were not on hand due to the absence of library staff or librarians.

As confirmed later in the observations, it was evident that the collections were dated, although some current books and journal titles were available as donations or exchange. This was also mainly due to budgetary constraints. Budgets, where available, went towards subscription to newspapers, for example at the Central Library. The Central Library representative indicated that they last purchased new books in 2004. The Cotton Research Institute had a budget of between US$ 250-500. Donations from CTA, e.g. the Spore Magazine, were on display in most libraries. The representative from the Cotton

Research Library said that they received donations (magazines and pamphlets) on HIV/AIDS prevention, etc., from non-governmental organisations and the Ministry of Health. Lack of any meaningful funds meant that there was no active participation in collection development from library users. However, the representatives believed that the libraries provided support to the researchers and extension workers as and when they required information, albeit not comprehensive information in some instances.

7.3.2.3 User support and ICT utilisation (Q. 16-22)

The respondents were asked about user support and ICT utilization in their libraries. Their response was that new members of staff were registered as members and introduced to the available library services (although no handouts or any material was given to this effect). New materials, received as donations or exchange, were circulated to researchers or extension workers within the institutes or at the Head Offices, before being shelved in the library. Some of the materials were for ‘display and discard’ as they were of a general nature.

The Central Library representative counted 6 computers, 3 of which were reserved for patrons, and a television set. The library had no webpage but had an internet connection, although library services were not automated. Horticulture, Matopos, National Herbarium, Henderson, Grasslands and Cotton Research did not have internet access or ICTs (specifically computers), hence library services were not automated, but an internet setup was available at Henderson and Grasslands.

7.3.2.4 Database subscriptions and utilisation (Q. 23-27)

This section investigated whether institutions were utilising electronic resources and if not, whether they were aware of their availability. This would enable the library to promote their use, even from individual offices. The responses revealed that while libraries were not connected to the internet, access was in some instances available from offices. The Central Library subscribed to the TEEAL database as well as the Global Online Access to Research in Agriculture (AGORA) initiative. Institutes were not subscribing to any databases but the representatives were aware of the TEEAL initiative and access through the Central Library. However, they were not aware of the

INASP/PERI project and open source initiatives, including the annual CTA assistance to institutions.

7.3.2.5 Collaboration, challenges and recommendations (Q. 28-32)

The Central Library assists other libraries within the Ministry of Agriculture, e.g. research institutes' libraries, by standardising operations and material when funds are available. Although the Central Library does not have formal cooperation with other institutional libraries, researchers and extension workers have access to some libraries, for example the University of Zimbabwe Library, as external users or as registered students. Respondents from the research institutes indicated that the Central Library allows them access to the TEEAL database.

In terms of strengths, the Grasslands representative felt that the library was well secured; Matopos indicated that its strengths were adequate space (although it appeared crowded) and patronage; while the Cotton Research Institute representative felt that the library had adequate space, accommodating a maximum of 20 users, and mentioned subscription to current newspapers as a noteworthy feature. The following is a summary of the major weaknesses of the libraries as identified by the representatives:

- Outdated collections
- Lack of ICTs and access to the internet and electronic databases
- Lack of budgets to implement meaningful acquisitions
- Lack of qualified staff (work is usually delegated to office orderlies or messengers) and researchers who have other duties
- Marginalisation in terms of institutional operations (Central Library)

The following recommendations emerged and were identical across the research institutes and the Central Library:

- The need to allocate budgets for books and subscription to journals, including TEEAL, at each institute's library

- Libraries need computers and internet connectivity in order to access electronic resources such as AGORA

- The library should be a department on its own rather than be an appendage of other departments whose interests differ (Central Library)

- The need for dedicated professional librarians to man the libraries and make informed decisions

The library representatives felt that in addressing the above issues, libraries would be able to offer professional services to researchers and extension workers as well as contribute to a national agricultural information database. The consensus was that libraries were not being prioritised and this has to be reversed as information is fundamental in all decision making processes.

7.4 Section Three: Observation

The researcher undertook to physically observe the Central Library and libraries at the research institutes in order to ascertain their status. This helped to consolidate the information generated from the interview schedule with library representatives. The observations centred on the physical infrastructure of the libraries, specifically location, size, lighting, shelving, and office space. The assessment also looked at user assistance features such as guides and posters, the availability of computers and other ICTs, as well as the collections' outlook and utilisation.

7.4.1 Observations in research institutes

Observations were conducted in nine (9) out of the possible eleven (11) research institutes. These institutes (including their locations) were:

- Central Library, Ministry of Agriculture's Head Offices, Harare

- National Herbarium Research Institute Library, Harare

- Henderson Research Institute:

    - Laboratory section

    - Livestock section

- Grasslands Research Institute, Marondera
- Horticulture Research Institute, Marondera
- Chiredzi Research Institute, Chiredzi
- Cotton Research Institute, Kadoma
- Makoholi Research Institute, Masvingo
- Matopos Research Institute, Matopos

7.4.2 Findings

The libraries were observed for among other things, infrastructure, layout and material type and availability of ICTs.

7.4.2.1 Physical location

The libraries were all located within the research institutes, either as part of the main administration buildings or as a separate building in the case of Makoholi. Generally, this makes the libraries more accessible to users within the institutes. In terms of physical maintenance, it was observed that the Makoholi Library building was neglected; some window panes were missing, leaving the library collection exposed to moisture and rodents.

7.4.2.2 Size and lighting

The libraries' sizes were relative to other units within the buildings, although space was considered inadequate. Grasslands, Matopos and Henderson were more challenged in terms of the size of their libraries. In terms of lighting, Henderson's Livestock section's lighting system was not working, which made the place dark.

7.4.2.3 Shelving and sitting space

Shelving space was identified as a one of the major challenges affecting the libraries. For example at the Central Library, some documents were held in boxes on the shelves while the new books display section was congested. The Cotton Research Institute stored its collection in cabinets.

The Cotton Research Institute's Library was observed to have a sitting capacity of sixteen, a boardroom table, and new furniture. Chiredzi had twelve chairs, while the Central Library had sitting space for eight or more individuals, with reading desks in different sections. At Makoholi, there were no chairs in the library. Since the libraries are within the institutions, it can be assumed that users would borrow and read the material in their offices, hence the limited sitting space.

7.4.2.4 Office space

The Central Library and Chiredzi Research Institute were observed to have offices designated for the librarian or the person in charge of the library, while in the other libraries there was a separate desk and chair for the librarian. As discussed previously, the libraries were manned by people who had responsibilities elsewhere; hence they were not always in the libraries. This was the case in Matopos, Henderson, Grasslands, and the National Herbarium.

7.4.2.5 Library guides

Library guides aid users by providing indications of where to locate the different facilities within the library. These were visible in all the libraries except at the Cotton Research Institute and Henderson's Laboratory section. At the National Herbarium, the guides also indicated the specialised classification system of arranging materials. The guides also reinforced library rules and regulations, for example, no noise, use of phones, etc. Despite this, people at the Central Library were seen to be conversing very loudly. A display section for new material was observed at the libraries, which consisted mostly of pamphlets and exchange journals, although these sections were not marked or labelled. Examples of the above can be drawn from the Central Library, National Herbarium Library, Grasslands Research Institute and Makoholi.

7.4.2.6 Availability of computers and other ICTs

Only three of the nine libraries had some ICTs. The Central Library had five (5) computers with internet access and a television set which was transmitting local programmes at the time of the observation. At the Cotton Research Institute, there was one computer and one photocopier which seemed to be there for storage rather than functioning as part of the library equipment. At Chiredzi Research Institute, there was only one computer which was in the library office.

7.4.2.7 Collection outlook and utilisation

The library collections were fairly small, as revealed in 7.4. The collections were mainly bound volumes of periodicals dating back from the pre-1960s to the early 1980s in most instances, after which unbound journals emerge. At the Central Library, there were some new titles published in 2003 and 2005 and these were shelved behind the circulation desk. The titles were mostly commerce related (accounting, economics, management, etc.) and appeared to support those engaged in private study. These books and journals appeared to be heavily used, as shown by the dates on the date slips.

At the National Herbarium Library, there were two current journal titles published in 2011 on display, namely *Systematic Botany* and *Edinburgh Journal of Botany*, both received as donations. The collection at the Herbarium Library was systematically arranged following a classification scheme, although at Henderson's Livestock section, the collection of old bound journals was shelved by accession number. Henderson kept its old collection in the Livestock section was in the process of developing a new collection in the Laboratory section. At the time of writing, the new collection consisted only of newspapers. These collections were visibly old as exhibited by the browning of covers and book edges.

7.5 Summary

This chapter presented the analysis and interpretation of data collected using the research instruments. Data was divided into three major sections based on the research instruments, i.e.: the main questionnaire for researchers and extension workers; the interview schedules for key informants and librarians; and the observation schedule of libraries.

The main questionnaire for researchers and extension workers looked at the distribution of the respondents by department, i.e. DR&SS and AGRITEX; the provinces and districts represented in the study; and the age, gender, designation, work experience and qualifications of the respondents. The findings revealed that nine provinces were represented from the original eight to accommodate Harare, which houses respondents based at the Head Offices only. The majority of respondents were not very experienced in terms of years of experience, and had qualifications ranging from certificates to PhDs.

The chapter also looked at the types of information being sought, their frequencies and importance, gender implications, the frequencies of interaction between agricultural researchers and extension workers, the areas they endeavour to address, the challenges faced in executing their duties, and how the land reform programme was influencing the research and extension landscape in Zimbabwe. On the frequency of interaction between researchers and extension workers, the responses revealed that the majority of extension workers (95; 55.2%) never interacted with researchers, with 12 (21.8%) researchers also indicating that they never interacted with extension workers. Information was sought for various purposes. Responses showed that while the majority of researchers required information for research (44; 78.6%); extension workers mostly needed it to assist farmers (149; 86.6%). The responses revealed that the extension workers were in more contact with farmers.

Major challenges evident from the responses were transport, inadequate resources, and a restricted information base. The study also looked at how the researchers and extension workers were communicating with the farmers and the platforms they used to reach these constituencies, namely the media, organisation-based methods, public gatherings, and the frequency of use of these methods. Although there were vernacular programmes for transmission through radio and television, the respondents expressed that most of the material was available in English. Visits to farmers as well as the frequencies of these visits were also discussed.

The chapter also looked at how and where (institutional and other libraries and information centres) the respondents were accessing information. The role of ICTs in the work of the respondents and as an information channel was also discussed. It was important to note that although mobile phones were available to only 25% of the researchers and extension workers in their offices respectively, they were used to communicate agricultural information by 91.3% of the extension workers and 83.9% of the researchers.

The questionnaire also looked at indigenous knowledge and its role and utilisation in agricultural research and extension. The role of national and international collaboration was also discussed, with respondents indicating areas of cooperation. The respondents were then asked to indicate gaps and constraints and to make recommendations.

The second section looked at the interviews with key informants from AGRITEX and DR&SS. The focus was on the areas of: new technologies and responsiveness of research and extension; communication between researchers and extension workers; research prioritisation; and farmers' participation. Respondents were also asked their views on financing and privatisation. The section also looked at ICTs, and research and extension collaboration.

Responses from the interviews of the key informants acknowledged that there was a need to enhance the linkage between researchers and extension workers and to revive the Committee on On-farm Research and Extension (COFRE) as a platform for the exchange of information. It was revealed during the interviews that the ministry had made a concerted effort to work on the resuscitation of research and extension linkages by engaging a technical advisor. Collaboration with other stakeholders, both nationally and internationally, was also evident in the same areas highlighted by researchers and extension workers, notably with NGOs, academic institutions, and the agro-industry.

Staffing challenges emerged from the interviews with librarians; with the exception of the Central Library, most of the libraries did not have dedicated personnel and the responses were provided by research officers. Major challenges facing libraries were: lack of prioritisation of the library, old stock, no budgets, and no staff. The observation schedule confirmed the poor state of collections, inadequate or poor infrastructure, and challenges of space. While the interviews and the observation of libraries may have found the libraries to be ill-equipped, the respondents expressed general satisfaction, with only 39 (22.7%) of the extension workers and 15 (26.8%) of the researchers considered the collection and services to be poor.

The three data sets show that lack of resources is severely affecting researchers and extension workers as well as the information services in Zimbabwe. Resource challenges include issues of transport, financial support, and the prioritisation of requirements.

However the responses point to the fact that there is a system which has structures in term of responsibilities and hierarchy, although these may not all be operational.

The next chapter discusses the findings.

CHAPTER EIGHT

DISCUSSION OF FINDINGS

8.1 Introduction

The previous chapter presented the data analysis and interpretation. Data was collected from researchers and extension workers, key informants and librarians through questionnaires and interviews. Libraries and information centres were also observed in order to confirm or refute the responses. This chapter discusses the findings from the analysed data and builds on literature discussed in the previous chapters. The discussion draws from the research questions and addresses the following: characteristics of the respondents; information needs and information seeking; ICT access and utilisation; collaboration in research and extension; indigenous knowledge systems in agricultural research and extension; and challenges and recommendations for research and extension.

8.2 Characteristics of the respondents

The respondents were drawn from the desired catchment areas, representing eight provinces (Harare being on the list for Head Office respondents only), as well as forty-four (44) of the sixty (60) districts targeted and 94% of the research institutes (see 7.2.1). The extension workers who completed the questionnaires consisted of one divisional director, 15 agricultural specialists (8.7%), 6 provincial (3.5%) and 38 district AGRITEX extension officers (22%), and 51 AGRITEX workers at ward level (29.7%) (see Table 7.2). Two directors from AGRITEX (Field Services division and Technical Services division) were interviewed and did not have to complete the questionnaires.

From DR&SS, questionnaires were completed by two directors based at the research institutes, one head of institute, 14 (25%) agricultural specialists, as well as 32 (57%) research officers, with the remainder being senior research officers, chief research officers and principal research officers (see 7.2.1.4). Interviews were conducted with one director and two deputy directors of the research divisions. There was a high non-response rate among researchers at different points during data collection. One contributory factor is believed to be that the respondents and potential respondents were on study leave within and outside the country.

While the librarian at the Central Library was successfully interviewed, in other libraries interviews were conducted with the researchers in charge of the libraries, with the administrative assistant interviewed at Grasslands Research Institute. This shows the extent to which the libraries were understaffed, and is worrying in terms of how much their operations are compromised.

The study revealed that the majority of extension workers (37.2%) had work experience of 5 years or less, with a total of 63.4% having attained less than 10 years experience. 51.8% of the researchers had less than 5 years on the job, with a total of 85.7% having 10 years working experience or less. The study also established that the majority of extension workers (65.1%) and researchers (69.9%) had 5 years or less of experience in their current positions. Comparatively, 85.4% of the extension workers and 96.4% of the researchers had 10 years or less in their current positions. The number of respondents decreased with the years of experience, although 3.5% of the extension workers had more than 26 years on the job. None of the researchers who completed the questionnaire had more than 20 years experience. The fact that the majority of researchers and extension workers were 'less experienced' can be attributed to the departure of experienced personnel for greener pastures and due to retirement. During the interviews, a key informant mentioned that the Ministry of Agriculture was thinking of hiring retired extension workers to fill this void.

Studies have shown that the issue of brain drain is not peculiar to agriculture alone. Gibson and McKenzie (2011) explain that brain drain worries many policy makers as it decimates a country's best and most highly skilled professionals. Zimbabwe has experienced an upsurge in the brain drain of professionals across all fields since the turn of the century (Tevera and Crush, 2003; Chimanikire et al., 2007). According to Topouzis (2003:15), staff turnover is high among the Ministries of Agriculture (MOAs) in Eastern and Southern Africa, resulting in increased workloads across headquarters and field levels alike. Topouzis found that the workload of extension workers in a number of countries had increased to the extent that many were unable to work effectively. Topouzis (2003:16) concluded that: "The loss of staff and the corresponding loss of knowledge, expertise and experience, depletes the pool of highly specialised MOA personnel and affects the quality and continuity of MOA's services."

The qualifications of the respondents indicated that 66.1% of the researchers had a bachelor's degree, 21.4% had a Master's, and one a Doctorate. One of the key informants also had a Doctorate. However, according to the department's human resources officer, there are more Doctorate holders amongst researchers in the ministry. As already indicated, some of the respondents were on study leave for higher degrees. Most extension workers (39%) had a bachelor's degree; only 7% had a Master's qualification. All the extension workers (34.8%) at village/ ward level, who were mostly drawn from Mashonaland Central province, had a certificate qualification, a minimum requirement for this category.

With respect to age, the majority of respondents (32.9%) fell in the 40-49 year age bracket. When analysed by the category of respondents, the number of extension workers increased with the average age group, reaching 36% for 40-49 years, while the number of researchers decreased with the average age group, down to 3.6% for 50 plus years. The study thus revealed that on average, researchers were younger than the extension workers. There were more male (66.7%) than female respondents (33.3%), and this distribution was also observed within the two categories of researchers and extension workers.

Overall, the demographic characteristics of the respondents revealed that the respondents were highly qualified, although they had limited work experience. This could be attributed to the increase in the number of universities in Zimbabwe, giving many people the opportunity to attain degree qualifications (see Table 2.1). Most universities offer qualifications in agriculture and related disciplines, both as conventional programmes and through distance education.

8.3 What are the information needs and information seeking behaviour patterns of researchers and extension workers?

According to Leckie, Pettigrew and Sylvain (1996) and Belkin (in Kelly and Fu, 2007:32), information seeking behaviour involves: personal reasons for seeking information, the kind of information being sought, and the sources via which the necessary information is being sought. The study looked at information needs and information seeking behaviour patterns in relation to the type of information that was required, the interaction between researchers and extension workers, and the nature of communication. The country's agricultural system has seen a significant rise in the number of farmers due to the land reform programme. The impact of this on the information needs and information seeking behaviour of researchers and extension workers and how they communicate agricultural information to farmers was therefore examined. Information services were considered to be an important ingredient in supporting research and extension systems. Consequently the strengths and challenges of libraries were also looked into in this section.

The respondents clearly required various types of information, with a capricious pattern in prioritisation. In Table 7.12, the respondents also articulated the perceived information needs of farmers, i.e. the information that they felt would adequately address their challenges. This observation reflected a similar pattern to the needs of researchers and extension workers as shown in Table 7.7. For example, the most sought after information by extension workers was information on range management, with the least prioritised information being information on horticulture and agronomy. This is corroborated in Table 7.8 (information seeking purposes); where the majority of respondents indicated that their main reason for searching for information was in order to assist farmers. Mitigating factors were being put in place to address some of the needs of researchers and extension workers, for example on climate change in Table 7.7 and climate and weather conditions in 7.12; the key informants in AGRITEX indicated that they were promoting technologies that would help to streamline climate change into agricultural extension. Agricultural colleges have also been reviewing their curricula in order to incorporate courses which include the effects of climate change and conservation agriculture (The Herald, Friday, October 28, 2011). Agricultural research, on the other hand, was responding through the development of new livestock and crop varieties that are suitable and responsive to Zimbabwe's different climatic conditions.

Under the impact of land reform, two of the challenges facing farmers that were mentioned by the respondents were lack of best farming practices and the destruction of game land, which explains why range management was one of the top priority areas among extension workers. The pilot study revealed that the respondents were concerned with the uncontrolled movement of livestock and game, which they said results in the spread of diseases like foot and mouth disease. The implications of land reform and the advent of the ‘new farmer’ were also confirmed by the key informants, who mentioned that besides lacking knowledge about farming practices, there were high incidences of the misappropriation of resources/ inputs by these farmers. Due to their scarcity, inputs like fertiliser, seed and fuel were often sold on the ‘parallel market’ (‘black market’).

Overall, information was mostly sought for research purposes by researchers. Information was also sought for other purposes, such as assisting fellow extension workers and researchers. Tobacco culture was highly sought after by researchers, and as with extension workers, information on climate change was poorly rated. Current trends indicate that farmers are increasingly growing tobacco more than traditional crop varieties as figures surge to pre-2000 records. According to The Zimbabwean (Monday, 25 July 2011), the number of black tobacco growers has grown from 4000 in 2004 to 47 000 in 2011, and this has seen production rise to more than 135 million kilograms compared to 220 million kg per year before 2000. While the researchers were actively involved in this success story, only 27% of the extension workers were targeting these farmers (as indicated in Table 7.7).

Information on advisory services and policy development was also sought by the respondents. The cumulative responses indicate that most information was sought for research and extension (assisting farmers’) purposes.

8.3.1 Information sources accessed and level of utilisation

The study established that the majority of extension workers consulted their departmental collections first, with 90.7% indicating their preference for print sources. In contrast, the majority of researchers consulted the internet first, with 66.1% indicating their preference for electronic sources. The preference for printed information was confirmed in 7.2.2.24.2, where publications were the most highly rated organisation-based method of communicating information to farmers by extension workers. Researchers, who are usually based in institutions, have greater access to the internet than extension workers who are highly mobile and may not have such access on the field, particularly at ward level. The contradiction, as shown in Table 7.20, lies in the assertion by the majority of extension workers (69.2%) that they could access the internet in the office compared to 23.2% of the researchers. This would imply that while extension workers had relatively high access, they were not utilising the internet for information purposes, while researchers with limited access were maximising their use of this resource. However, an extension worker at ward level is more likely to find a mobile phone useful and not see the point of the internet in their work. In addition, with technological developments, the internet is now available on mobile phones. Dependence on print sources was therefore not the result of access or connectivity, if the indications in Table 7.20 are to be believed. Technical reports were considered to be a very important source of information by 71.9% of the researchers, followed by books, professional meetings/ workshops, fact sheets, and the internet. This corroborates Gamage's (2006:20) observations that scientific information is communicated by scientists through scientific reports, research articles, papers presented at conferences, dialogues with colleagues, and through workshops. Gamage adds that the continued evolution of ICTs and the internet has also enhanced the availability of information in scientific disciplines. The internet provides access to the most current information, particularly research publications and online journals. This explains why 100% of the researchers considered the internet to be important, while 98.2% considered journals to be important.

Majid and Eisenschitz (2000) and Gamage (2006) observe that besides the formal communication platforms described above, informal channels, like conversations, e-mail and colleagues, also played a significant role in the communication of agricultural information. It can be deduced from this analysis that a variety of sources were consulted by the respondents when faced with an information need, and the preference for print or electronic sources was also influenced by connectivity.

In terms of frequency of utilisation, books were the most frequently consulted formal source, while face-to-face conversations, discussions, and consulting colleagues were the most frequently used informal communication channels. While the internet was regarded to be very important by the researchers, it was nevertheless ignored by 31.6% of the total respondents. The same applied to other resources like the email/ list serve (33.3%) and theses and dissertations (40.4%). The dependence on print sources was also confirmed when the respondents indicated how they became aware of less recent books and journals, with 64% mentioning citations at the end of journals articles and 59.5% citations at end of book chapters. The study revealed that information was communicated through a wide range of extension methods, tools and approaches, including manuals and other internal publications like factsheets, the media (radio and television), and through personal contact via on-farm demonstrations and field days.

8.3.2 Role of institutional libraries

The study also looked at institutional libraries and how they supported or endeavoured to meet the information needs of the respondents. Most respondents (56.6%) indicated that they had access to a library or information kiosk at work or in their community. The study showed that the majority of researchers (91.1%) had access to libraries, while the majority of extension workers (54.7%) did not have access to library services. The frequency of use and utilisation of library resources was therefore low among the extension workers. Dulle (2000) made similar observations, finding that the use of libraries was very unpopular among extension workers. The absence of access to libraries confirms: why the majority of extension workers consulted departmental collections first (see Table 7.9), why they consulted print sources first (see 7.2.2.4), and their preference for using publications in disseminating information to farmers (7.2.2.24.2). This demonstrates that extension workers generally have a propensity to use print sources. The respondents also utilised alternative sources of information, including circulars from the ministry's head office, personal and departmental collections, media sources (newspapers, radio, audio materials), and other libraries. University libraries were the most utilised alternative by 11% of the respondents. Libraries in NGOs, ICRISAT, FAO and SeedCo were also mentioned.

Mangstl (in Rhoe, Oboh and Shelton, 2010:2) posits that libraries support agricultural research by enhancing access to information through the effective management of its resources and the provision of a wide range of information services and products to researchers, scientists, and policy makers in the agricultural sector. The libraries of the ministry were generally not adequately equipped to support the information needs of researchers and extension workers, with 37.7% of the respondents indicating that they did not always find what they were looking for, even with the assistance of library staff.

Although the Central Library's strength was reflected in the availability of and access to databases, the inability of users to access these resources from other centres or institutes cancelled this advantage. The resources were only concentrated in one locality. The key informants expressed dissatisfaction with the performance of the ministry's information services, and this was also confirmed with data from the observation of libraries. The quality of resources was poor. The use of the inter-library loan service was low, with 39.5% of the respondents indicating that their libraries did not provide this service.

In order to maximise access, an immediate solution for providing access to current information services would be for research institutes and other users in the periphery to fully utilise the TEEAL and AGORA databases. Institutes could send their information requests to the Central Library, which would in turn conduct searches and send the retrieved information electronically or as hard copies. Given adequate staff, the Central Library could also develop SDI profiles for the research institutes, to whom they would send contents pages from databases on a regular basis. Researchers and extension workers could also utilise the Central Library each time they visited the Head Office.

The most utilised resources were books (15.3%), journals (13.5%) and government publications (12.3%). However, when the respondents were asked to indicate the journal titles they were familiar with, they suggested outdated titles like *Kirkia* and the *Zimbabwe Journal of Agricultural Research*, which have not been in press for some time. The observation schedule confirmed the outdated state of journals in the research institutes' libraries. The library as an information resource was not rated highly by both categories of respondents (22.7% of the extension workers and 26.8% of the researchers indicated that the services were poor). However, 6.9% of the extension workers and 17.9 % of the researchers stated that they were satisfied with the libraries' resources. This lack of confidence in library services stems from the libraries' inability to enforce their status as information providers within the different institutions surveyed. Studies by Dulle, Lwehabura, Mulimila and Matovelo (2001) and Rhoe, Oboh and Shelton (2010) revealed similar challenges facing libraries in meeting agricultural information needs, emanating mostly from poor funding which affected their capacities to expand.

On the importance of various information sources, 129 (75%) of the extension workers indicated that the library catalogue was important. This is despite earlier indications by extension workers, where 94 (54.7%) indicated having no access to a library in their work environment or community. This again highlights some of the contradictions and inconsistencies in the responses.

Respondents indicated consulting other institutional libraries, and this represented 39 (22.7%) of the extension workers and 32 (57.1%) of the researchers. While the extension workers and researchers indicated that they had access to ICTs, the majority of libraries did not have any, leaving the patrons to access ICTs from their offices and other sources.

8.3.3 Impact of the land reform programme on agricultural research and extension vis-a-vis information needs

The exponential growth of farmers as a result of the land re-distribution programme has exerted considerable pressure on the research and extension systems, as indicated by 57.5% of the researchers and extension workers. New farmers needed to be educated on issues relating to best farming practices, including natural resources conservation and the controlled movement of animals. The political climate's influence on the farmers was evident to the respondents, who mentioned that it made access to the farms difficult, particularly for the extension workers. The farms need to be transformed into commercial entities, but in order to achieve this, farmers need to cooperate with researchers and extension workers. The respondents called for more liaisons between DR&SS (researchers) and extension workers when assisting farmers. Engagements which may improve this rapport may include farm visits, field days, and tours. The provision of transport would also help researchers and extension workers reach out to the increasingly large number of farmers. The Herald (Friday, October 28, 2011) reported that agricultural colleges were working towards equipping farmers with skills, particularly the newly resettled farmers.

The respondents articulated specific information challenges that were posed by the land reform programme to researchers and extension workers. The majority (31%) of extension workers mentioned lack of proper conservation practices, and 10.7% of the researchers observed the lack of appropriateness of the language in which the materials were communicated/ available, which was mostly in English. It also emerged that there was a need for more media programmes to reach wider audiences. The translation of materials and vernacular broadcasts were mentioned as some of the initiatives in place to tackle this challenge. It was also observed that there were delays in attending to farmers' problems due to mobility, a perennial challenge that was highlighted throughout the study. The results demonstrated that although farmers' information needs were diverse, their perceived information needs were consistent with those of researchers and different to those of extension workers. While extension workers felt that most farmers required information on plant breeding (71.5%), range management (67.4%), plant pathology (66.3%) and animal breeding (63.4%), the majority of researchers mentioned information on plant breeding (91.3%), agricultural engineering (69.6%), and tobacco culture (67.9%).

In retrospect, when the respondents were asked to indicate the type of information that they required (7.2.2.1), the majority of extension workers mentioned range management (70%), animal breeding (68%) and agricultural engineering, while the majority of researchers workers indicated tobacco culture (96%), dairy farming (82%) and agricultural engineering (82%). This again highlights inconsistencies in the extension workers' statements of the type of information that they required (Table 7.7), the perceived information needs of farmers under the land reform programme (Table 7.12), and the information seeking purposes as highlighted in Table 7.8. Evidently the information that the extension workers sought was not reflective of the needs of farmers, although they purportedly sought information to help the farmers.

The study revealed that the information needs of farmers followed an observable seasonal pattern. Information was mostly sought during the planting period, and this corroborated the perceptions of extension workers and researchers that most farmers required information on plant breeding. Among extension workers, information was also sought by a few respondents during the vaccination and breeding period. The harvesting season was identified as the period during which information was least sought by both researchers and extension workers.

8.3.3.1 Gender, agriculture and the land reform programme

According to Lahai, Goldey and Jones (2000:223), while the majority of women in developing countries are farmers, they face particular gender-related challenges in gaining access to agricultural extension services. Lahai, Goldey and Jones (2000:223) observed that women farmers who were supervised by female (extension) agents had more access to services than women farmers supervised by male agents**.** The present study was also aware of the fact that women constitute the majority of the population in Zimbabwe, and consequently form the majority of farmers in rural households. Manjengwa and Mazhawidza (2009:1) found that an estimated 86% of those who till the land in Zimbabwe are women, and land is a major source of women’s livelihoods. Despite this, the current land reform programme continues to marginalise women, privileging men as primary recipients of land.

There were fewer women than men among the respondents in the case of both researchers and extension workers**.** The majority of the respondents felt that the information needs of women were not being adequately addressed by the research and extension systems. This was attributed to lack of programmes and consultation with women as stakeholders in agriculture. Suggestions for redressing this anomaly include training researchers and extension workers in gender issues and agriculture, and consulting and introducing programmes that involve women, for example, farmers’ training schools for women. Moyo (in Manjengwa and Mazhawidza, 2009:4) concluded that these gender inequalities are a result of bias in selection (land recipients) and lack of information on the required processes, among other factors.

8.4 What role do researchers and extension workers play in the dissemination of agricultural information?

Researchers and extension workers play an important role in the dissemination of agricultural information to farmers. FAO (2004:3) observes that lack of appropriate communication structures, methodologies, and tools results in the poor identification of farmers' needs and priorities, inappropriate research programmes, and poor or irrelevant extension and information technologies, which lowers the farmers' uptake of technological innovations. This was alluded to in the theoretical framework in Chapter four.

8.4.1 Interaction between researchers and extension workers

The study looked at how frequently researchers and extension workers interacted and the nature of the issues that they addressed. Most researchers (54.5%) indicated that they communicated with extension workers on a quarterly basis, with 21.8% indicating that they never communicated with extension workers. Reciprocally, 34.3% of the extension workers communicated with researchers on a quarterly basis, while the majority (55.2%) indicated that they never interacted with researchers. The latter's lack of communication with researchers can be partly explained by the fact that some of the extension workers (38.4%) were working at ward/ operational level (i.e. grassroots level), as shown in Table 7.5. Extension workers at ward level are less likely to communicate with researchers because there are subject specialists at district and provincial level who act as intermediaries between research and extension. This can also be observed in Table 7.21, where less extension workers (40%) utilised ICTs to communicate with researchers than researchers (53.6%) used to communicate with extension workers. It would appear that researchers initiated more communication in the research-extension linkage than extension workers. This observation concurs with Dulle's (2000) study, which found that Tanzanian extension workers' contact with researchers was very low. The frequency of communication above was echoed by the key informants, who added that the interaction may not be in a formal setup alone, but can also be observed in the application of research results, e.g. new technologies like seed varieties, and in publications in which extension workers play key roles.

The key informants, researchers, and extension workers all lamented the dissolution of the Committee of On-Farm Research and Extension (COFRE) and hoped that its resuscitation (a key recommendation) would provide a platform for exchanging information and for reinforcing joint work in on-farm trials and field demonstrations. As a step forward (7.3.1.8), the Ministry of Agriculture had engaged a technical advisor to work on resuscitating research and extension linkages by incorporating stakeholders in different provinces and districts. The ten seed companies contracted to the DR&SS for certified seed production are another example of linkage through research output, although it was felt (by the informants) that the companies usually provide their own extension services through sales and marketing teams and in some cases in conjunction with AGRITEX.

The researchers and extension workers were able to identify the nature of information they communicated, among them technical and administrative issues, pest and disease control, extension identification, soil fertility, marketing and markets, and animal husbandry. The results revealed that a wide spectrum of challenges was addressed. Given the nature and working relationship of the two 'protagonists', it was therefore not surprising that 70.2% of the respondents expressed dissatisfaction with the level of communication between researchers and extension workers. The lack of communication was attributed to limited interface and resources, lack of expertise, and limited research interest, especially in livestock production and health. Linguistic challenges were also identified as a challenge.

The respondents were able to articulate suggestions for improving the researcher-extension linkage which again pointed to the need for: increased interaction through meetings; provision of resources like funding, transport, mobile phones, etc.; regular refresher courses; and better information dissemination processes. The creation of more participatory communication platforms was also identified as a way to bridge the gap between research and extension.

Websites are an example of such a communication platform and the information on such websites could include contact details, market information, early warnings, weather predictions, and any other information that may be deemed useful by all the stakeholders (researchers, extension workers, farmers and the public). The website would need to be updated regularly in order to keep the information current and relevant. In a library, a website can provide a platform for accessing open source electronic resources through subject gateways/ portals or as subscriptions. Unlike TEEAL which does not have remote access, databases like AGORA could be accessed via the website (IP configuration) or through password access. This would change or influence the acquisition policies as information would be available 'just in time' upon request. Traditionally, libraries have acquired books 'just in case' they were asked for.

At the time of writing there was no website for the Ministry of Agriculture, except for a dummy version with limited content (http://www.moa.gov.zw). Previously the website contained information about the ministry's departments and detailed the ministry's different functions, activities and personnel.

8.4.2 Research-extension-farmer linkage

Opara (2008:289) observes that effective agricultural information delivery requires recognizing the needs of farmers and determining how best to provide them with the information that they need. The author adds that access to the right information at the right time in the right format and from the right source may shift the balance between the success and failure of the farmer. Farmers access agricultural information from a variety of information sources and through different media. As discussed in 4.6.2, these communication channels are either interpersonal in nature or mass media platforms, and originate from either localite or cosmopolite sources. According to FAO (2004:4), communication for development encompasses different media, ranging from folk and traditional social groupings, to print, rural radio, mobile phones, video, the internet and other multi-media channels.

The television (25%) and the radio (19.6%) were highly utilized by researchers to communicate information to farmers, while meetings (25%) and the radio (22.1%) were popular with extension workers. Studies by Opara (2008) and Meitei and Devi (2009) likewise established that the radio is the most utilized media channel in disseminating agricultural information. Researchers were frequent guests on the national television programme, "Talking farming", and also participated on the radio with extension workers, as highlighted in 7.2.2.24. Newspapers were also utilised, even though they were mostly in English.

Although the study established that there were mass media platforms (radio, television and newspapers) available, it was revealed that their frequency of utilisation in reaching out to farmers was low. For example, 30.2% of the extension workers indicated that they sometimes used the mass media, with 62.2% mentioning that they never utilised mass media platforms. Similarly, 58.9% of the researchers indicated sometimes using mass media platforms, while 30.4% never utilised mass media channels.

Among organisation-based sources, publications (pamphlets, posters) were the most utilised source by the respondents. These can be produced en-mass for distribution, and because they have images, they can be understood by even the least literate farmers. Examples of posters and related materials can be found in instructional materials, e.g. on handling pesticides, seed varieties, etc. Manuals and handbooks can also be used by farmers as quick reference guides. The Herald (Friday, March 18, 2011), for example, reported that every extension worker was going to be given a farm management handbook for use as ready reference. Public gatherings, in particular field days, were utilised by the majority of extension workers and researchers. While agricultural shows were mentioned by 23.2% of the researchers, 22.7% of the extension workers indicated that the meetings of farmers' organisations provided a platform for communicating information to farmers. In their study, Bagnall-Oakeley et al. (2004:124) found that in terms of different types of information, farmers preferred 'awareness information' to be delivered via the radio, but reinforced through meetings and other media like posters. They further observed that technical information was best delivered through a 'learning by doing' approach, and better yet if supported by other media such as fliers, brochures, and leaflets.

Farrington (1998:2) observes that the move towards stronger participation of farmers in agricultural research and extension is fuelled by the growing realisation that socio-economic and agro-ecological conditions (especially low income) are complex, diverse, and risk-prone, and that conventional approaches based on research trials, followed by unidirectional technology transfer, are unlikely to be fruitful. Contact between the farmers and the respondents, i.e. researchers and extension workers, has been mostly limited to the use of the media, meetings, and field days.

The study sought to establish how often the respondents actually visited the farmers'/ farms to observe the situation on the ground. There appeared to be substantial contact with the farmers, as indicated by 92.1% of the respondents, albeit at varying frequencies.

For example, 43.6% of the extension workers indicated that they visited farmers very often compared to 7.1% of the researchers in the same category, while the majority of researchers (53.6%) indicated that they sometimes visited farmers. This could be partly attributed to the composition of the sampled respondents; extension workers represented all levels of the organisational structure, from the Head Offices down to ward (grassroots) level, while the majority of researchers were from research stations. Lack of transport was viewed to be a major impediment to visits to farmers (87.5% of the respondents). It was ironic that given the transport problems in its own backyard, the Ministry of Agriculture was in the press donating motorbikes to the police department (The Herald, Friday August 12, 2011). Some respondents indicated that this move had taken them by surprise. Besides poor road networks, 3.6% of the respondents indicated that lack of time was also one of the factors that affected their visits to farmers. It was, however, unclear why the respondents would fail to allocate time or schedule such visits.

The above observations indicate that linkages exist between researchers, extension workers and farmers. As discussed in the theoretical framework (4.6.4.1) and demonstrated in Figure 4.4, the communication of agricultural innovations and technologies involves researchers on the one end, extension workers as go-betweens/ intermediaries, and farmers on the other. The feedback mechanism also showed that farmers are able to use the extension system to provide feedback to the research system. The theoretical framework also demonstrated that information flow is not a ‘top down approach’ but involves farmers’ input as they are able to communicate directly with researchers, and vice versa if necessary. The respondents indicated that this was achieved through field days, on-farm visits, and meetings.

The unavailability of material in local languages was another challenge experienced by the respondents. Most of the material was published in English, as indicated by 80.7% of the respondents, although they indicated that they translated some of the material into vernacular.

8.5 What means and processes are in place for managing information generated by research and extension systems?

According to Kalusopa (2005:422), agricultural development activities are based on the utilisation of information, and for this information to be effective, it has to be systematically collected, organised, and repackaged to supply the consumer as and when needed. The study looked at what information management processes were in place, the availability of ICTs, and their utilisation in managing and disseminating agricultural information.

Researchers and extension workers generate information during the course of their work as research results, reports, manuals, commissioned projects, and private studies. The utilisation of ICTs in managing information generated by DR&SS and AGRITEX showed that while ICTs were being utilised, most documents were distributed/ disseminated as hard copies. Although there was no defined policy on the management of the information, a large number (90%) of the respondents felt that the information generated was adequately captured, and this view was supported by evidence from key informants. In terms of how the information was managed, the respondents explained that copies were sent to the library (as hard copies) and to the Research Council of Zimbabwe (as hard copies and containing abstracts of current and completed projects). The respondents also indicated that copies were kept in a central database and by individual researchers and extension workers, but they did not reveal where or to whom and in which format.

During interviews with key informants, it was revealed that most research publications did not circulate due to printing challenges, and some of them could no longer be retrieved as the technology (floppy disks) was obsolete. Because of limited printing and reproduction facilities, most of the respondents indicated that the material was not readily accessible. Despite their unavailability, the importance of internally generated information can be seen in 7.2.2.24.2, where organisation-based methods like publications (pamphlets, posters) were listed as highly prioritized methods of disseminating agricultural information to farmers. Internally generated information sources like circulars were also found to provide alternative information services to libraries, as indicated by the majority of extension workers in 7.2.2.23. Because of their usefulness to the research and extension processes, it is imperative for these information sources to be properly documented for posterity.

8.6 What is the level of ICT development within the Ministry of Agriculture and its impact on the generation and dissemination of agricultural information?

Addison (2006:3) observes that while information before the advent of the internet was mostly disseminated on paper, it is now available to virtually anyone who can access the internet through a proliferation of services that include organisational websites, document servers, and electronic versions of journals, project databases, and news and events in the form of blogs or RSS feeds. Researchers and extension workers were found to have access to various ICTs within their organisations. The majority of both extension workers (63.3%) and researchers (87.5%) had access to a computer in the office, although the study did not seek to establish whether the computers were shared or for individual use.

All the key informants had access to laptops and internet services and were able to access databases like AGORA and other online journals. Other ICTs which were available to them included printers, telephones, and fax machines. However, some of the ICTs that the extension workers purported to have access to were not necessarily located within their immediate environs, but available at district offices or the Head Offices in Harare. Included among these were storage servers (79.1%), electronic journals (82.6%), and the TEEAL database (83.7%) which was only available at the Central Library. The librarians and observations confirmed that the other libraries were poorly equipped in terms of computers and other ICTs.

ICTs such as the television, radio, and video recorders were accessible to the majority of both extension workers and researchers. Mobile phones were accessible to 25% of the extension workers and 25% of the researchers. Although various ICTs were available to the researchers and extension workers, the majority of respondents (64.5%) and the key informants felt that the infrastructure was poor.

8.6.1 Utilisation of various ICTs

According to Kalusopa (2005:422), ICTs can enhance systematic collection, repackaging, and the provision of current and accurate information by opening up new sources of information and new communication avenues. The study demonstrated that the available

ICTs were being utilised for various purposes and to different extents by the respondents. The respondents indicated that their ICT skills and competencies were good to excellent, save for 11% of the extension workers who felt that their skills were poor. Generally, ICT skills and competencies tend to have a perceived influence on ICT utilisation (Mugwisi, 2002; Nkomo, 2010).

Overall, the computer was used as a storage device, for word processing, and to access the internet. The ICTs were mostly used for research purposes (44.3%), educational purposes (42.5%), and to communicate with publishers (30.3%). Extension workers were also involved in research (56.4%), although the study did not distinguish between work related research and personal research. However, the majority of extension workers (48.3%) indicated that they used ICTs for educational purposes. The study revealed that ICTs were utilised by extension workers when communicating with agricultural researchers (40%), and correspondingly by researchers when communicating with extension workers (53.6%). Extension workers' utilisation of ICTs in communicating with farmers was low (18%), although 22.7% mentioned using ICTs to disseminate agricultural information. In contrast, a large number of researchers (55.4%) utilised ICTs to communicate with farmers.

8.6.2 Effectiveness of ICTs in disseminating agricultural information

Various ICTs were considered to be effective in the dissemination of agricultural information. However the level of effectiveness of different ICTs varied between researchers and extension workers. Mobile phones were considered to be effective/ very effective in communicating agricultural information by 65.4% of the respondents, despite the fact that only 25% from each category could access them from the office. This suggests that the respondents were using their personal mobile phones for work-related purposes. The study did not, however, ascertain whether they were compensated for airtime as is the practice in some organisations. Only 5.2% of the extension workers and 1.8% of the researchers considered the mobile phone to be less effective, with an overall non-response rate of 21.9%.

The number of people using mobile phones in Zimbabwe has increased exponentially, with the mobile-cellular subscription estimated at 7.7 million subscribers in 2010

(International Telecommunication Union, 2010). The Zimbabwean government supports the development and application of ICTs and has a Ministry of Information and Communication Technology that is dedicated to this purpose. The growth in mobile phone utilisation is partly attributed to the government policy allowing the importation of ICT products duty-free which resulted in the reduction of the prices of products, including handsets. The price of starter packs (SIM cards) has also been drastically reduced, once pegged at US$100, down to US$1 on the official market.

The majority of researchers indicated that they sometimes used mobile phones, while most extension workers indicated that they used them quite often. The majority of extension workers indicated that they used mobile phones to communicate with researchers, results which support their stated use of ICTs. Researchers also indicated communicating mostly with extension workers and agribusiness companies. Although the study did not seek to list the agribusiness companies, it was noted in Chapter 7 that DR&SS was working in partnership with ten seed companies. The new generation of gadgets like mobile phones although not readily available to respondents in their work environment, were highly preferred. The use of mobile phones in communicating agricultural information was evident in this study; communication occurred not only between researchers and extension workers, but also between themselves and farmers, agribusiness companies, and colleagues.

The telephone was considered to be effective/ very effective in communicating agricultural information by 65.3% of the respondents, with 3.5% of the extension workers and 1.8% of the researchers stating that it was not effective. The theft and vandalism of telephone and copper cables has affected the effectiveness of telephones, particularly in farming areas, leading to greater reliance on cell phones wherever networks are available. Computers were considered to be effective/ very effective by 62.7% of the respondents. 5.7% of the respondents did not consider computers to be effective, and 27.2% did not respond to this question. Computers were thus one of the most highly recommended ICTs by the respondents. Printers are generally used in conjunction with computers and were considered to be effective/ very effective by 57.9% of the respondents, although 4.4% did not find them to be effective. As indicated in 7.3.1.3, the circulation of information generated by research was affected by lack of printing facilities, among other factors. 31.1% did not respond to this question.

The radio was considered to be effective/ very effective by 44.3% of the respondents, with 10.5% stating that it was not effective. However, 55.8% of the extension workers responded to this question and 10.5% did not believe the radio to be effective, in comparison to 82.1% of the researchers who responded to the question and 10.7% who did not think it was effective. A similar trend featured when the respondents were asked about the effectiveness of the television; 12.8% of the extension workers felt that the television was not effective, while 8.9% of the researchers did not believe the television was effective. This seems to support the results in Table 7.14, where 22.1% of the extension workers and 19.6% of the researchers indicated that they used the radio to communicate with farmers, while 5.2% of the extension workers and 25% of the researchers used the television for the same purpose. The radio's main advantages are that it can reach a wider audience and transmit vernacular content. The state run Zimbabwe Broadcasting Corporation (ZBC) is the only radio and television broadcaster in Zimbabwe. ZBC radio operates four channels: Radio Zimbabwe (broadcasting in Shona and Ndebele), National FM (minority languages), Sport FM (sports and current affairs), and 3FM (pop/ entertainment). ZBC TV operates two channels. Channel one is the main channel that broadcasts news, sports and entertainment, while Channel two focuses mostly on entertainment.

The use of ICTs as tools and vehicles of communicating and disseminating agricultural information was evident from the above discussion. A contrast was noted between the availability of resources and their utilisation. For example, while mobile phones, telephones, computers and printers were the least available ICTs (Table 7.20), their perceived effectiveness was high compared to the television and radio, which were not considered to be effective by many despite high availability (74.4% and 71% respectively). Electronic journals were not considered to be effective by 15.7% of the extension workers, with 51.2% not responding to this question, while 10.7% of the researchers considered e-journals to be ineffective, with a non-response rate of 21.5%. A similar trend was observed with databases (e.g. TEEAL), where 18% of the extension workers and 16.1% of the researchers indicated that they did not consider them to be effective in disseminating agricultural information. This is surprising considering the statements by 42.5% and 40.4% of the respondents that the internet and email respectively were effective tools in communicating agricultural information. With 61% of the respondents having revealed that they required information in order to conduct research (Table 7.8), it was expected that the use of e-journals would be high since they provide the most current information. Journals remained key sources of information; 86.8% of the respondents considered them to be important/ very important, as shown in Table 7.10, and only 10.5% never used them as demonstrated in Table 7.11. Compared to the information purposes cited in 7.21, it was noted that the use of ICTs in disseminating agricultural information was low despite their availability.

8.6.3 ICT requirements for improved access and utilisation

The respondents were requested to indicate which ICT services and resources they required in order to improve their job performance, and their responses revealed some contradictions. For example, while in Table 7.22 only 20.9% and 18.6% of the extension workers considered electronic journals and databases respectively to be effective, 86.6% indicated that they required access to databases in order to improve their job performance. This also contradicted the responses in Table 7.20, where 82.6% and 83.7% of the extension workers indicated that they had access to e-journals and databases respectively. Listed among the requirements of the respondents were desktop computers, printers, e-mail, and internet access. Laptops were the least required ICT among both researchers and extension workers. The need to develop and place information on a website was considered to be important by 40% of the respondents. The importance of websites to their respective organisations and for communication was emphasized by these respondents (see 8.4.1).

8.7 What is the significance and level of collaboration in research and extension?

According to the Global Forum on Agricultural Research (GFAR) (in Giovannetti, 2001:244), organizing an information system in order to serve agricultural and rural development must rely upon the formation of partnerships between different stakeholders, and these partnerships must be based on coherent and consensual principles that define modalities for the production, diffusion, and sharing of information.

The study established that there was cooperation between public and private research and extension organisations, both nationally and internationally. At national level, 80.4% of the researchers mentioned collaborating with private organisations compared to 54.1% of the extension workers. The respondents who did not collaborate with private organisations represented 45.9% of the extension workers and 19.6% of the researchers. A large number (64%) of the respondents indicated that they did not collaborate with organisations at international level, representing 72.1% of the extension workers and 39.3% of the researchers. Lack of international collaboration among extension workers can be partly attributed to the composition of the sample and the bureaucratic nature and centralisation of the ministry's operations. Matters of international collaboration and policy would normally be the preserve of senior staff based at the Head Offices in Harare, whereas implementation is decentralised. To this effect, the key informants were able to articulate a number of international organisations like DFID and those of the United Nations, and these were working in areas of promoting technologies generated by research institutes.

The study established that the researchers and extension workers collaborated with other organisations in a multiplicity of areas both locally and internationally. At national level, most extension workers mentioned funding (42.4%), followed by research facilities (41.9%), zonal/ geographical distribution of projects (38.4%), and research publications (37.2%). In Zimbabwe, NGOs do not normally work on the same project in the same area but are distributed geographically by the type of activity and need. For example, while Plan International may be drilling boreholes in Matebeleland South and building schools in Mashonaland Central, Care International will focus on agro-based projects in urban and rural communities. However the key informants pointed out that the provision of extension services by private companies, NGOs and international organisations resulted in parallel extension systems that in some instances dictated what had to be done.

The majority of researchers (75%) indicated that national collaboration was in the area of zonal or geographical distribution of projects, followed by staff exchange programmes (66.1%), extension publications (64.3%), and extension projects (55.4%). The involvement of researchers in extension-related areas and reciprocally, the participation of extension workers in research-related projects was evident, although joint research projects was the least mentioned activity by researchers.

International collaboration among extension workers was high with respect to joint research projects, research facilities and funding. Research publications, research exchange programmes, research results and extension projects were also some of the cited areas of international collaboration by extension workers. Training was indicated as the lowest area of collaboration, possibly because 52.4% of the extension workers had certificates and diplomas, qualifications which can be attained locally. However, the Danish Agency for Development (DANIDA) did have a hand in facilitating the upgrade of facilities at four agricultural colleges and the training of extension workers to certificate level, later upgraded to diploma programmes (see 2.3.1). When the training was oversubscribed and the graduates could no longer find employment, some of these college graduates joined the teaching profession as agricultural teachers, with some moving on to the private sector.

Although research facilities, research results, research exchange programmes and research publications were mentioned by researchers, the majority indicated that they collaborated in extension projects (55.4%) and extension publications (57.1%). The publication of the Manual on Pest Control in conjunction with the International Red Locust Control for Central and Southern Africa (IRLCO-CSA) was one of the publications mentioned by a key informant. The informants also confirmed that international organisations based in Zimbabwe, such as ICRISAT and CIMMYT, partner with local researchers in different areas, including research and publications.

The political environment and the land reform programme and its impact on commercial farming were seen as having significantly affected international collaboration in research and extension, particularly with respect to funding and training. The international donor community, with whom universities and research institutes had strong partnerships, suddenly withdrew their support or scaled down activities, and this affected agricultural institutions negatively. Organisations like CTA continue to support agricultural research and extension through projects like TEEAL, AGORA, HINARI and book donations for students, researchers and extension workers through their institutional libraries.

8.7.1 Farmers' organisations and research and extension

Wennink and Heemskerk (2006:93), focusing on Benin, Rwanda and Tanzania, observed that farmers' institutions and organisations provide important social capital that creates impetus for the enhanced adoption of technological innovations and the transformation of the agricultural sector through access to knowledge sources, inputs and markets. They note that these organizations provide interactive learning in collaboration with the private sector and are at the centre of agricultural sector policy formulation and implementation. Collaboration between farmers' organisations and researchers and extension workers was high (90.4% of the respondents), and this was in a number of areas. Funding research and extension programmes was considered to be the main role played by farmers' organisations, as indicated by the majority of extension workers and researchers. Participatory research (on-farm trials) and repackaging information for farmers were considered to be the second and third most important collaborative roles played by farmers' organisations according to the researchers.

Unlike Wennink and Heemskerk's (2006) study, providing information on markets was mentioned by only 8.1% of the extension workers, while providing farmers with information on inputs was considered to be the least important role of farmers' organisations (4.1%). Researchers also considered providing information on inputs to be the lowest area of collaboration. Lack of collaboration in relation to inputs is one of the challenges of the Grain Marketing Board (GMB), a parastatal that has the monopoly to distribute subsidised inputs to farmers while at the same time procuring grain from the farmers. While most farmers collect these inputs as a loan, many do not sell their harvest through GMB in order for it to recover the loans, opting to side market instead because private buyers pay more and give the farmers instant cash. GMB as a buyer has failed to pay farmers on time for their grain deliveries, with some farmers not getting paid for more than a year. Under such circumstances, farmers' organisations can only lobby and provide legal advice to farmers, as indicated by 47.7% of the extension workers.

The International Federation of Agricultural Producers (IFAP) (in Del Rosario, 2009:131) notes that improving the involvement of farmers' organisations in setting, designing and implementing agricultural research priorities is vital to reaching the

Millennium Development Goal (MDG) of halving poverty by 2015. With restricted donor funding and limited support from the government, farmers' organisations are important alternative sources of funding. Provision of legal advice to farmers and repackaging information for farmers were also considered to be important roles, and perhaps surprisingly, participatory research (on-farm trials) was also considered significant by 25% of the researchers. As emphasised by IFAP in Del Rosario (2009:131), collaboration between farmers' organisations and research centres integrates the farmers' points of view in research, from the definition of agricultural research priorities to the dissemination of research results.

8.7.2 Research and extension prioritisation and funding

The key informants articulated that government policies, national priorities, and funding were some of the factors that determined research priorities. The research institutes also determined their priorities depending on their specialisation and in line with national mandates. According to AGRITEX, consultations with relevant stakeholders and surveys help to determine the extension priorities, although in some instances these were situational or problem solving. Through participatory approaches, farmers as stakeholders are able to identify and prioritise their problems with the extension system, which helps with implementation and evaluation.

The funding of agriculture has been on the decline, particularly allocations from the government's fiscus. Within the Ministry of Agriculture, researchers expressed concern about the allocation of funds, alleging that this tended to favour their counterparts in AGRITEX. Deterioration in funding has mainly been due to the harsh economic downturn experienced post 2000. The hyper inflationary environment from around 2008 also contributed significantly to the decline in agricultural production as agricultural inputs were unavailable or too expensive for many farmers. Most manufacturing industries (including fertiliser manufacturers) faced closure as they had to import raw materials amid low foreign currency availability. The government, through various initiatives supported by the Reserve Bank of Zimbabwe's quasi-fiscal policies, introduced input subsidised schemes which were meant to benefit resource poor farmers with respect to fuel, mechanisation, and other inputs. However the schemes were abused, with inputs being looted, and fuel and other inputs like fertilisers and seed never reaching the intended beneficiaries. The Zimbabwe Mail (Tuesday January 17, 2012) confirms that the US$30 million “Presidential Well Wishers Input Scheme” was looted and inputs could not be accounted for.

To date, the challenge of accountability within agricultural financing or support still remains large. Input schemes monitored by the state’s Grain Marketing Board continue to be abused by a few privileged individuals. This coupled with donor fatigue has resulted in the scaling down or complete withdrawal of assistance in some cases.

Alternative financing for agriculture is provided by the banks, although farmers experience considerable challenges in accessing funds. The main challenge has been that financial institutions require collateral in order for farmers to access funds. Most of the new farmers do not have such documentation, and it is only recently that the government started issuing ninety-nine (99) year lease agreements to the farmers (The Zimbabwean Wednesday, 5 October 2011). However this has not alleviated the problem as banks insist that the lease agreements are not bankable, and hence have no monetary value. The lease agreements can be terminated should the beneficiaries fail to utilise the land for two consecutive years.

As pointed out in 2.2.2.8, AGRIBANK was established with the major objective of supporting emerging farming clients until they are mature enough to be absorbed as commercial banking clients. It has not been able to facilitate loans to most farmers due to defaults. According to The Zimbabwe Mail (Thursday January 19, 2012), the Zimbabwe Commercial Farmers’ Union estimated that 80% to 90% of large scale farmers require loan financing each year. Failure to repay loans by the farmers has been a major stumbling block in accessing financing from banks, AGRIBANK included. This issue was highlighted earlier where it was pointed out that even farmers who accessed inputs from the Grain Marketing Board did not repay their loans by delivering their produce to GMB, choosing instead to side market and hence circumventing the repayment process. These private buyers also provide their own transport when collecting produce from the farmers, which also makes them attractive. While mechanisms for alternative financing and support have been put in place, poor management renders them ineffective.

The respondents were requested to indicate their views concerning charging farmers for research and extension services. Despite the positive aspects of privatisation and charging, it was not favoured by the majority of respondents (54% of the extension workers and 54.4% of the researchers). However among researchers, the key informants felt that it was necessary in order to raise funds to sustain research. In contrast, the key informants from extension felt that doing so would erase the concept of public good and further discriminate the most deserving farmer groups. The key research informants acknowledged that this practice was already taking place, having been initially implemented as a cost recovery measure, e.g. fuel for trips to farmers who requested assistance. Concerns were raised about the implementation of service charges as it was felt that the stakeholders, i.e. farmers, had not been consulted, suggesting that the charges were imposed. Extension workers felt that charging should be determined by whether the service was for a private or public good. For example, it was felt that should extension workers or researchers provide consultancy to a farmer as a private undertaking, charging would be justified. In the absence of substantial government funding, the funds raised would help to sustain research and extension structures, albeit to a minimum extent.

In their study, Foti, Nyakudya, Moyo and Chikuvire (2007:33) observed that the level of farmers' demand for fee-for-service extension was low, and this was more of the case with crops than livestock. They concluded that free extension services should be provided only to those farmers who are needy. In the present study (7.2.6.3 and 7.3.1.6), it is suggested that while charging is a positive idea, it should depend on the model of the farmers, i.e. whether they are commercial, small scale or subsistence (also referred to as A2, A1 and communal) farmers.

8.8 What is the extent of indigenous knowledge systems' utilisation in agricultural research and extension?

Bagnall-Oakeley et al. (2004:119) observe that, "Although farmers utilise an indigenous knowledge system, the coverage of their indigenous knowledge system is frequently restricted and does not blend well with the more formal research and extension networks." Van den Ban and Hawkins (1998:20) note that it is generally recognised that indigenous farmers' knowledge is crucial in developing sustainable agriculture because this way of farming is attuned to local situations which the farmer usually understands better than the researcher or the extension agents. This study revealed that that there was a high utilisation of indigenous knowledge (89.9% of the respondents), although there were variations in the frequencies of utilisation between researchers and extension workers. Most (44.6%) researchers indicated that they sometimes used indigenous knowledge, with 20.3% of the extension workers stating that they utilised it very often. Those who did not use indigenous knowledge constituted 11% of the extension workers and 7.1% of the researchers.

The formal and non-formal nature of indigenous knowledge was also reflected in the sources mentioned by the respondents. Among extension workers, formal sources, i.e. books and conferences/ workshops, were mentioned by the majority (51.2% and 49.4% respectively), while colleagues were mentioned by 41.3%. A similar pattern was observed among researchers, with books and conferences/ workshops mentioned by 58.9% and 48.2% respectively, and colleagues by 44.6%. Demonstrations or observations and personal experience were also rated highly by the extension workers (29.7%), with the least mentioned IK source being farmers' groups. Among researchers, village meetings, village leaders/ elders, and demonstrations/ observations were considered to be important sources.

Studies by Gyampoh et al. (2009), Akullo et al. (2007), and Kiplang'at and Rotich (2008) have demonstrated that elderly people in traditional societies provide the main source of IK based on experiences that have been accumulated over generations. Farmers' groups and personal experiences were the least mentioned source by researchers. However, the responses revealed that social gatherings and agricultural shows were also considered to be sources of indigenous knowledge by researchers and extension workers.

Akullo et al. (2007:2) explain that for centuries, farmers have planned agricultural production and conserved natural resources with the instruments of indigenous knowledge (IK). Gliessman (in Ghouzhdi, 2010:4108) observes that about 60% of the world's cultivated land is still farmed via traditional and subsistence methods, and this type of agriculture has benefited from centuries of cultural and biological evolution. In light of this, different types of indigenous agricultural knowledge can be obtained from different sources. The study found that among extension workers, the higher categories of

IK obtained were information on plant diseases and pests (88.4%), plant breeding (80.8%), and dairy farming (78.5%), while information on plant pathology, animal breeding, and soil classification was also reportedly obtained by more than 70% of the extension workers. Information on tobacco culture was mentioned by the majority (85.7%) of agricultural researchers, followed by information on dairy farming (80.4%) and plant breeding (78.6%), and information on soil classification, animal breeding and horticulture (more than 71% of the researchers). Information on crop harvesting and storage was the least mentioned IK source by researchers and extension workers, which tallies with responses in 7.2.2.23 that showed that in general, information was least sought/ required by researchers and extension workers during the harvesting and post-harvesting period.

The effectiveness of IK in agriculture is demonstrated in studies by Handayani and Prowito (2010), Fenta (2009), Dakora (1996), Kiplang'at and Rotich (2008), Fenta (2009), and Tikai and Kama (2004). These studies looked at different types of IK, including soil fertility, diseases and pests, sources of indigenous knowledge, as well as methods of disseminating IK. For example, Fenta (2009:3) found that farmers use IK pest and disease control methods that include spraying animal urine on crops, dusting seeds with ash and pepper, and mixing animal urine, donkey waste, poisonous plant leaves and ash and spraying it on crops where diseases and pests occur. AGRITEX provides another example of IK in The Herald (Thursday March 24, 2011), of gumtree leaves and Zumbani (*lippia javanica)* being used in the storage of cowpeas (*nyemba*). Mutasa (2011) also established that farmers relied on indigenous knowledge to determine weather patterns as a result of the absence of conventional weather reports from AGRITEX.

The study thus revealed that different types of indigenous agricultural knowledge were being obtained from a variety of sources by researchers and extension workers, with varying emphasis on different topics among researchers and extension workers.

8.9 What are the challenges in and recommendations for agricultural research and extension?

The respondents articulated the challenges they faced in executing their duties as researchers and extension workers and cited what they felt could be done to improve their work and the work of farmers. In descending order, the top five constraints were: lack of resources, transport shortages, poor access to information resources, limited ICTs, and inadequate funding. Extension in particular is an undertaking that requires mobility; lack of transport is an obvious challenge to reaching farmers and attending to their problems in time. At the time of study, the ministry was embarking on distributing motorbikes nationally through provincial and district AGRITEX offices in a bid to improve mobility. The respondents still felt that the numbers did not correspond with extension workers on the ground. Although the researchers were also facing transport challenges, the informants revealed that they (researchers) had not been considered in the allocation of motorbikes.

The respondents also felt that the land issue was being politicised at the expense of production. The land distribution exercise continues to face challenges; most recently already resettled (new) farmers were being removed from the land they had just occupied, usually to pave the way for political heavyweights. At times this happened when they were already planting, resulting in considerable disruption. The respondents also indicated that there were more farmers than resources. Other challenges mentioned were: poor remunerations resulting in high staff turnover; outdated information sources; and limited material in vernacular languages. The government's exercise in recruitment has been greatly affected by its budget, resulting in some positions being frozen, not only in agriculture but in areas such as health as well.

Top of the respondents' list of factors that hindered access to information and literature on research and extension was the poor state of ICT facilities and infrastructure, despite the majority's (69.3%) statements that they had access to a computer in the office (7.2.3.1) and to other ICT resources, as shown in Table 7.20. Lack of transport as an obstacle to information access was also mentioned by almost all the researchers (98.2%) and by 91.3% of the extension workers. The respondents stated that in order to access the TEEAL database and other sources of information, they had to travel to the Central Library at the Head Offices in Harare. 87.2% of the extension workers and 50% of the researchers felt that they lacked adequate and current information sources at their places of work. The observation schedule of libraries and interviews with librarians confirmed the respondents' perceptions. Most collections were old (based on the dates of publication) and generally consisted of bound periodicals. Lack of resources, for example printing and other publishing facilities, were seen to compound the limited circulation of material generated by researchers and extension workers. The librarians lamented the state of their library collections, which were archaic given the scientific nature of their clientele. The research institutes were characterised by lack of ICTs and poor internet access. Unless the ministry starts allocating budgets for the acquisition of materials, the state of these libraries will not change.

Poor communication between the research and extension systems continues to plague the agricultural sector. Poor staff remuneration was also highlighted; the informants revealed that low salaries meant that they could not afford to buy their own literature as additional reading, even when such material was available in local bookshops. Most of these challenges hinge on lack of funding, as shown throughout the study and repeated by 90.1% of the extension workers and 87.5 % of the researchers. The resuscitation of COFRE was mentioned by the respondents as a platform that could help to improve research-extension linkages. The ministry should strive to allocate resources (material, human and financial) equitably. In terms of information management, the respondents suggested the creation of a management system into which information could be deposited. Challenges may arise as to who becomes responsible for administering the database, hence copies should be deposited with the libraries as this guarantees security while maximising availability and access to the material. As already discussed, the material generated by the departments was not accessible because it was scattered across different locations. In order to enhance information access and the dissemination of information, the recommendation by the respondents on the implementation of a website is plausible. The advantages of a website are numerous. A website promotes or facilitates information sharing and enables users to post and access information from remote locations (across the country and internationally) without physically going to the source. Information can be uploaded and downloaded depending on the need and is easily shared.

8.10 Summary

This chapter discussed the findings of the study. The demographic characteristics of the respondents revealed that: they were drawn from the desired provinces, districts and research institutes, and adequately represented the target population of researchers and extension workers; male researchers and extension workers considerably outnumbered females; qualifications ranged from certificates for extension workers at ward level to a PhD among researchers; and the work experience of the majority of extension workers and researchers was 10 years or less.

The chapter also looked at the information behaviour of the respondents, establishing that behaviour varied and information was needed for a variety of purposes, ranging from work to personal use. Information sources depended on the purpose of the information and immediate availability, for example the majority of extension workers consulted their department's collection first. The internet, meetings, and workshops were also popular sources of information, as was indigenous knowledge, which was found to play an important role in agriculture.

The land reform programme was also discussed, as well as it implications on research and extension, including the effects of the increased number of new farmers and the prevailing resource challenges. While communication between researchers and extension workers is believed to be paramount, the study established that 55.2% of the extension workers never interacted with researchers. Mechanisms for improved communication were recommended, chief among them the resuscitation of COFRE and in-service training.

The libraries of the ministry were found wanting in terms of meeting the information needs of researchers and extension workers due to outdated materials. Most of the respondents indicated that they did not always find the information that they were seeking. This was corroborated by the key informants who condemned the information services as totally inadequate. Also looked at was the role of ICTs in agricultural research and extension, both as sources and vehicles of communicating information. Although access to electronic databases like TEEAL was possible, this was restricted to the Central

Library which was not networked. Other resources required the internet, and this was not readily available in other centres.

The chapter also discussed issues pertaining to agricultural financing and the respondents' views on privatisation and charging for research and extension. While some researchers indicated that charging was already taking place as a cost recovery measure, some extension workers felt that doing so would discriminate against underprivileged farmers. Collaboration in research and extension nationally and internationally was also discussed in the areas of funding, training, material generation, and staff exchange programmes, among others. Farmers' organisations in research and extension were found to play important roles in on-farm trials, repackaging information, and providing legal advice to farmers.

The next chapter presents a summary of the findings and the conclusions and recommendations of the study.

CHAPTER NINE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

9.1 Introduction

This chapter provides a summary of the findings of the study, draws conclusions, and provides recommendations for improving the agricultural system in Zimbabwe by addressing the information needs and challenges of researchers, extension workers, and farmers.

The aim of this study was to investigate the information needs and challenges of agricultural researchers and extension workers in Zimbabwe in pursuance of the following objectives:

a. To investigate the information needs and information seeking behaviour of agricultural researchers and extension workers in Zimbabwe;

b. To examine the role played by agricultural researchers and extension workers in communicating agricultural information to farmers;

c. To investigate knowledge management systems within the Ministry of Agriculture's divisions and research institutes and the use of ICTs in the generation and dissemination of agricultural information;

d. To assess the role of agricultural researchers and extension stakeholders as potential uptake/ dissemination pathways for agricultural technologies;

e. To determine whether researchers and extension workers utilize indigenous agricultural knowledge in the generation of agricultural information;

f. To identify knowledge gaps, challenges, and constraints affecting the extension and dissemination of agricultural information; and

g. To make recommendations for a national agricultural information policy based on the outcome of the study.

9.2 Summary of findings

9.2.1 Characteristics of the respondents and the research environment

The respondents were drawn from all eight of the provinces defined in the target population. 73% of the expected districts and 94% of the research institutes were represented in the responses. The Ministry of Agriculture's organogram was clearly defined, hence the study was able to capture responses from the directors' level down to grassroots level (ward extension workers), as well as to capture the responses of research officers at the various institutes. The number of vacant posts was duly noted, and this was attributed to staff departing for greener pastures and retirement. The study was not able to capture responses from some researchers as they were on study leave, an indication that there was continuous education among staff at the ministry.

In terms of qualifications, the majority of the researchers (66.1%) had a bachelor's degree, with (21.4%) master's and one doctorate. According to the informant (during the interview), the number of postgraduates at Master's and PhD level would have been higher had more researchers responded to the questionnaire. Among the extension workers, 34.8% had certificates, and these were all the extension workers at ward/ village level. The certificate qualification still remains the minimum qualification for the ward/ village category of extension workers, even though Danida (1991) raised the minimum qualification to diploma level. The number of respondents with diplomas among the extension workers was 14%.

In terms of age, the extension workers were on average older than the agricultural researchers. The majority of extension workers (36%) fell in the 40-49 age group, with another 15.1% above 50 years of age. In contrast 39.3% of researchers were between 20-29 years of age, while a total of 73.2% of the researchers were 39 years old or less. This analysis corresponds with the work experience of the respondents, which showed that the majority had less than 10 years working experience (63.4% of the extension workers and 85.7% of the researchers). Male dominance was evident with only 33.3% female respondents, even when the data was analysed according to respondent category.

9.2.2 Summary of the findings by research objective and corresponding research question(s)

The findings of the study are summarised according to the research objectives and research questions.

9.2.2.1 Objective one

To investigate the information needs and information seeking behaviour of agricultural researchers and extension workers in Zimbabwe:

i. What are the information needs of agricultural researchers and extension workers in Zimbabwe?

ii. What are the information seeking behaviour patterns of agricultural researchers and extension workers in Zimbabwe?

The information needs of farmers and researchers vary in terms of the type of information required, with no specific inclination to a specific discipline. They also vary between researchers and extension workers. Information on range management, animal breeding, agricultural engineering, dairy farming, and plant breeding constituted what was required by most extension workers, while information on horticulture, crop protection, agronomy, and plant diseases and pests fell in their least required category. Researchers were inclined towards information on tobacco culture, agricultural engineering, dairy farming, animal health, and poultry, with less interest in climate change, soil fertility, and advisory information. Variations between the researchers and extension workers' needs were evident, for example while information on tobacco culture was required by the highest number of researchers (96%), only 27% of the extension workers indicated that they required it. Overall, the information needs of the researchers and extension workers were diverse within the agricultural discipline (see Table 7.7), and these covered the major areas of animal science, crop science, agricultural engineering, and advisory services and policy development.

Conspicuous by its absence was information on agricultural economics or marketing, perhaps included under the policy and advisory option, although it would have been visible on its own. Farmers need to be advised on market information, particularly on selling their produce and the long term benefits derived from honouring contracts with GMB, (which provides them with inputs on credit), banks, and institutions that would potentially fund their inputs, versus the short term benefits of defaulting and side marketing. Such information should be required by researchers and extension workers to support farmers. FAO (2005) observes that agricultural marketing information has played an important role in improving food marketing systems and promoting food security by giving farmers accurate knowledge about price movements, thus enabling them to identify new trading opportunities. FAO (2005) asserts that accurate and timely agricultural marketing information also enables farmers to make more informed decisions and minimises the losses caused by over-saturating the market with certain commodities.

The information seeking pattern of the respondents was largely determined by the information sources and their availability in terms of proximity and format. The majority of the agricultural extension workers indicated that their first point of call when in need of information was their departmental collections, with 90.7% of the extension workers preferring print sources. In contrast, most researchers consulted internet sources and hence preferred electronic sources. The library as the first point of call was poorly rated (14% of the extension workers and 10.7% of the researchers).

The respondents were asked to rate the importance of the various sources of information in keeping up to date in their areas of work (see Table 7.10). The majority of extension workers highlighted the importance of consulting knowledgeable people (e.g. the field supervisor) (95.3%) and face-to-face conversations/ discussions (92.4%). All the researchers in the study (100%) considered the internet to be a very important source. The need for current information in research is vital, and the internet is known to offer this service. Technical reports were considered to be very important by the majority of respondents (95.1%), followed by books and professional meetings and workshops. Technical reports were also considered to be handy because they can be used as quick reference guides. The rate of frequency of use of the different sources varied; sources that were least frequently used (20% and above) include theses and dissertations, librarians and library staff, list serve/discussion forums, internet sources, sources of contents, and conference abstracts. However, all the sources were consulted at some point. There was demonstrated use of other referral sources and the respondents were able to identify titles relevant to their subject areas, although these were outdated, pointing to the state of their immediate (library) collections. All the key informants had access to electronic resources like AGORA, for the other respondents, this was limited to those who had access to the internet. The TEEAL database was also available to the respondents, but this meant travelling to the Central Library in Harare. Electronic resources were grossly underutilised given the amount of full text articles available in AGORA and TEEAL. Some of the respondents confirmed using these resources, but found travelling to be a challenge.

The researchers and extension workers also used libraries in their information seeking processes. The study showed that the majority of researchers had access to a library or information resource centre in their work environment or community, while the majority of extension workers did not have such access. In terms of frequency of use, the majority of researchers and extension workers who had access visited the libraries monthly. Government circulars, departmental and personal collections, newspapers, the radio, and training materials were mentioned as alternative sources of information by those who did not have access to libraries. Traditional print sources (books, journals and government publications) were the main types of material accessed in the libraries, ostensibly due to the absence of other material in these libraries. The respondents indicated that they sought assistance from library staff when using libraries at different times, although 11% claimed that they never sought such assistance.

In terms of fulfilment in the use of libraries, the majority indicated that they did not always find what they were looking for. To compound this, most of the libraries did not have an active inter-library loan (ILL) facility in place. Other libraries, particularly university and NGO libraries were also consulted by the respondents because they provided alternative sources of information. School libraries were also consulted. Overall, however, the respondents still felt that their libraries were offering meaningful service.

9.2.2.2 Objective two:

To examine the role played by agricultural researchers and extension workers in communicating agricultural information to farmers:

iii. What role do researchers and extension workers play in the dissemination of agricultural information to farmers?

Researchers and extension workers play a significant role in the dissemination of agricultural information to farmers, as demonstrated in their information seeking purposes and their ability to identify the farmers' perceived needs as shown in Table 7.12. The majority of the extension workers (86.6%) indicated that their main reason for searching for information was in order to assist farmers. For researchers, assisting farmers came in behind research. As highlighted in the preceding chapters, extension involves the transfer of agricultural information and technologies to farmers, and reciprocally from farmers to researchers. This information flow was also demonstrated in the theoretical framework in 4.6.4.1 (Fig.4.4). The problem statement (1.3) also highlighted how lack of technical skills and preparedness on the part of extension workers affects the assistance they render to farmers. According to The Herald (Friday March 18, 2011)**,** the Ministry of Agriculture acknowledged that some extension workers lacked the requisite skills, which is why some farmers were not willing to work with them. In order to improve this, the ministry was embarking on equipping these extension workers with skills by upgrading them from certificate to diploma qualifications. Every extension worker was also going to be given a farm management handbook to use.

In order for information to be relevant, it must be availed in a timely manner and when it is most required. The respondents' information needs were observed to be seasonal, and this differed between researchers and extension workers. As already discussed, one of the reasons for seeking information was in order to assist farmers. According to the responses, information is generally most sought/ required during the planting period and least required during the harvesting season. Researchers and extension workers have to plan well and be proactive to these trends. This is mentioned against the background of the land reform programme which has resulted in the proliferation of new and inexperienced farmers, exerting insurmountable pressure on the research and extension systems. The respondents indicated that the land reform programme had affected the way they conducted their work, meaning that there is a need to redefine their roles and/or incorporate new responsibilities in what they do. The information challenges also relate to areas that include lack of conservation policies and lack of material in appropriate languages. The new farmers need guidance on farming practices as most were formerly subsistence or small scale farmers who moved into commercial farming. This requires additional skills and refreshing on the part of the respondents.

In enhancing their role, facilitating communication between researchers and extension workers was considered to be very important. The study demonstrated that there was communication between researchers and extension workers; although the majority of the respondents (70.2%) indicated that they were not satisfied with the level of communication between the two groups with respect to disseminating agricultural information and innovations. While the majority of researchers (78.6%) indicated communicating with extension workers at various intervals, 55.2% of the extension workers never communicated with researchers. The dissolution of COFRE was seen as having widened this gap and its resuscitation would provide a platform for better interaction. The lack of communication was attributed to lack of interface, the level of extension workers and limited resources, among the other reasons. However the nature of problems communicated were in the areas of crops, livestock, pests, pesticides and diseases, animal health, farm production and marketing and these were ultimately benefiting the farmers**.**

Various methods and tools were used in the research-extension-farmer linkage to communicate information to farmers. These included the media (radio, television, newspapers, video units, etc.) and meetings as a platform. The radio was mostly used by researchers and the second most used platform by extension workers after meetings. Organisation-based methods included publications (pamphlets and posters), internet based sources, community radios and meetings. Publications were the highest used platform in this category by both groups of respondents. Public gatherings encompassed agricultural shows, field days, community meetings, and farmers' organisations' meetings. Field days were the most utilised in this category.

The responses indicate that there was frequent contact between researchers and extension workers and farmers through actual visits to the farms. Only 6.4% of the extension workers and 7.9% of the researchers indicated that they never visited farmers. Visits enable the researchers and extension workers to identify what is happening on the ground by seeing what the farmers are actually doing, which helps them make informed judgements in the solutions they may prescribe to farmers. Such visits were, however, being weighed down by lack of resources such as transport. Other platforms were also used, although to a lesser extent compared to those highlighted.

When asked about the frequency of use of the mass media in communicating with farmers, it was surprising when the majority then turned to say that they never used this platform to communicate with farmers. This was seen as an inconsistence. Radio and television broadcasts included programmes in vernacular and other minority languages and listeners who got the opportunity to pose questions live. Experts from research and extension were often guests on such programmes to tackle questions on various challenges affecting farmers.

The researchers and extension workers also have a role to play in bridging the gender gap by assisting female farmers. It was observed that while the majority of women till the land, they were being marginalised in terms of access and ownership. Their information needs were not being adequately addressed by the research and extension systems.

9.2.2.3 Objective three

To investigate knowledge management systems within the Ministry of Agriculture's divisions and research institutes and find out the application and use of ICTs in the generation and dissemination of agricultural information:

iv. What means and processes are in place for managing information generated by the Ministry of Agriculture, Mechanisation and Irrigation Development's research and extension divisions and research institutes?

v. What is the level of ICT development within the Ministry of Agriculture, Mechanisation and Irrigation Development's research and extension divisions and research institutes and what is ICT's impact on the generation and dissemination of agricultural information among researchers and extension workers?

Information generated by the researchers and extension workers is based on their work, and includes reports and other publications. The study found that while information is generated electronically, it is often distributed and circulated in print format. The challenges of print resources restricted the amount of documents that could be reproduced. This was particularly evident during Zimbabwe's economic meltdown, with the situation improving as resources gradually became available.

According to the informants, research results were largely kept in files, with minimum circulation or publication. The study showed that information generated from research and extension was sent to multiple locations as part of the circulation process or for safe keeping. The locations cited include: the central database, Research Council of Zimbabwe, individuals returning their copies, and library departmental collections. The departmental collections were mentioned as the first point of call when the researchers required information. What was not clear, however, was who presided over the central database and in what format? It was also disclosed that some information from research was kept as soft copies, but because the technology (floppy disks) is obsolete, they could no longer retrieve the data. Most of it was now outdated and had no print equivalent. What is clear, however, is that the Research Council received progress reports which contained information about the project, status, researcher(s), and an abstract. The libraries did not have current reports or related materials, e.g. annual reports and publications, from other units of the ministry. The majority of respondents (90%), however, felt that although there was no defined policy on the management of information, it was adequately captured. Because it was 'scattered' in different locations, 57.5% of the respondents indicated that it was not accessible. The Biometrics and Computing Services Institute did, however, compile the Directory of Research Planned Projects, and some copies of this were sent to the Research Council of Zimbabwe as already indicated.

The study has shown that various ICTs were available to researchers and extension workers. The computer was available in offices to 69.3% of the respondents. Other ICTs include fax, television, radio, video recorders, printers, servers, information management, telephones and mobile phones. The internet and its resources, such as email and databases (online, networked and standalone), were also mentioned. There was no functional website for the ministry except for a dummy version which had incomplete information. Most of the respondents had good ICT skills; hence the computers were used to do word processing, spreadsheets, to store documents, and to connect to the internet. The ICTs were used for a variety of purposes, top of the list being for research and educational purposes. They were also used to communicate with researchers, extension workers and with farmers. The various ICTs were found to be effective in communicating agricultural information and there was concurrence between researchers and extension workers to this effect, except for electronic journals and CD-ROM databases which were regarded as ineffective by extension workers. Disseminating agricultural information was mentioned by 25.4% researchers while the ICTs were also used for professional communication with colleagues, personal communication with friends, and to communicate with publishers. Documents can now be attached to email and communicated between publishers and authors or researchers.

The mobile phone/ cell phone was singled out and was found to be highly utilized, although the frequencies varied. For example, only 8.7% of the extension workers and 16.1% of the researchers indicated that they never used it. The mobile phone was used by researchers and extension workers to communicate agricultural information with farmers, with other researchers and extension workers, colleagues, and with agribusiness companies. In terms of the status of ICT infrastructure, 64.5% of the respondents believed it to be poor. Thus although ICTs were available, they were still considered to be inadequate. In the laboratories, for example, the equipment was regarded as old, and in the libraries there were no computers or the internet, with the exception of the Central Library. Research stations either did not have or had very few computers and no internet access. Extension workers also suffered the same fate. Some of the district extension officers barely had any ICTs in their offices.

9.2.2.4 Objective four

To assess the role of agricultural researchers and extension stakeholders as potential uptake/ dissemination pathways for agricultural technologies:

vi. What is the significance of stakeholders' collaboration with the Ministry of Agriculture, Mechanisation and Irrigation Development's research and extension systems, and what role do stakeholders play in the generation and dissemination of agricultural information?

The study showed that there was collaboration between public and private research and extension institutions, both nationally and internationally. Literature showed that as a government department, there were ties with other ministries (inter-ministry) and with other units within the same ministry (intra-ministry), for example with the Division of Veterinary Services. At national level, the majority of respondents indicated collaborating with private organisations (54.1% of the extension workers and 80.4% of the researchers). Researchers mainly collaborated in the distribution of projects, staff exchange, and extension publications. For extension workers, most respondents indicated collaborating with respect to funding, research facilities, and research publications. Research facilities and results, and extension projects as areas of collaboration (see Table 7.31) result in the generation of publications or documentation, and at the same time are consume or use information for the processes to be achieved. The study indicates that researchers and extension workers, through this participatory collaboration, were able to generate research and extension publications that are useful in disseminating information to farmers. Collaboration also resulted in new technologies like new seed varieties; for example over ten (10) seed companies were contracted by the ministry to produce certified seed for sale to the farmers. However, it was indicated that private organisations engaged extension teams for their projects and this resulted in parallel extension systems in agriculture.

Fewer respondents collaborated with organisations and other institutions at international level. The majority (64%) did not participate in such collaboration, and of those who did there were more extension workers (72.1%) than researchers (39.3%). According to the informants, organisations like CIMMYT, DFID, NGOs, UN, and ICRISAT were among those partnering the ministry. For extension workers, collaboration was mostly in the areas of research facilities, joint research projects and funding, while researchers indicated that it was mostly in extension publications (e.g. International Red Locust Control for Central and Southern Africa (IRLCO-CSA), extension projects and research facilities. These products benefit farmers immensely as the publications are the result of research output. Other areas include training; technical advice and funding (see Table 7.32). The informants, however, indicated that one of the challenges facing such partnerships was that international organisations tended to stick to their mandates and ended up dictating what they felt should be done.

The study indicated that 90% of the researchers and extension workers collaborated with farmer organisations, and this was in several areas. Extension workers viewed the role of farmer organisations in collaborations to be mostly in funding research and extension programmes, and re-packaging information for farmers. For researchers, three outstanding areas were funding research and extension programmes, providing legal advice to farmers, and repackaging information for farmers. Farmer organisations also played significant roles in providing farmers with information on markets and inputs.

The study also looked at the role of stakeholders in research and extension prioritisation and funding, with reference to AGRIBANK and projects supported by the Reserve Bank. AGRITEX, for example, indicated that farmers as stakeholders, through participatory approaches, were able to identify and prioritise their problems, with the extension system helping with implementation and evaluation. Financing for agriculture from the government has declined and farmers have to turn to banks for support. The study revealed that alternative support through input support schemes (already mentioned above) and loans from AGRIBANK suffered setbacks due to defaulting on repayment. The 99 year lease agreements were not acceptable as collateral from the commercial banks, so farmers were failing to meet the set requirements for loans. Privatisation and charging for research and extension services were proposed, and although already operational, were considered discriminatory against disadvantaged farmers.

9.2.2.5 Objective five

To examine the level of utilisation of indigenous agricultural knowledge by researchers and extension workers in the generation and dissemination of agricultural information:

vii. To what extent do researchers and extension workers utilise indigenous agricultural knowledge in the generation of agricultural information?

Indigenous agricultural knowledge was highly utilised, as indicated by 89.9% of the researchers and extension workers, although the frequency of utilisation varied between the two groups. Only 11% of the extension workers and 7.1% of the researchers did not utilise IK. Indigenous agricultural knowledge was acquired from a variety of formal and informal sources. The top three sources of IK for both researchers and extension workers were books, conferences/ workshops, and colleagues, with farmers' groups being the least used source by both groups. Social gatherings, personal experience, village leaders/ elders and agricultural shows were also among the sources mentioned by the respondents (see Table 7.29).

Information that was mostly obtained from IK sources by researchers was information on plant diseases and pests and plant breeding, while for researchers it was information on tobacco culture and dairy farming. Information on crop harvesting and technology was poorly rated by both groups. The study revealed that indigenous knowledge derivation transcended different agriculture disciplines (crop science, soil science, animal science, post harvest storage, etc.) among both researchers and extension workers (see Table 7.30).

9.2.2.6 Objective six

To identify knowledge gaps, challenges and constraints affecting the extension and dissemination of agricultural information:

viii. What knowledge gaps exist and what are the challenges and constraints affecting the extension and dissemination of agricultural information?

The study has indicated that the majority of respondents (68.9%) had less than 10 years working experience. Further analysis also indicated that 37.2% of the extension workers and 51.8% of the researchers had between one to five years working experience. These respondents therefore needed mentoring in order for them to effectively execute their duties. As shown in 9.2.2.2, extension workers lacked requisite skills that would enable them to attend to farmers' problems, The Herald (Friday March 18, 2011) confirmed that there was a need to develop extension workers through further training and also by upgrading them academically from certificate to diploma level. There is also the problem of brain drain following the departure of experienced researchers and extension workers for greener pastures, and the knock on effect of qualified but less experienced replacements.

The respondents identified a number of factors that inhibited their access to agricultural information as well as the major constraints facing agricultural research and extension. Lack of requisite ICTs was seen to affect access to electronic information resources, and this was particularly evident at the research institutes which required internet access and access to online sources via passwords, e.g. AGORA. These resources were limited to the Central Library, in particular the TEEAL database which was not networked to provide remote access. Researchers or extension workers therefore have to travel to the Central Library in order to access these facilities, meaning that lack of transport is also a contributory factor to poor information access. Lack of adequate current information, especially in library collections, is another factor emanating from poor access to databases as well as the old state of most collections. Lack of communication between researchers and extension workers also affected the exchange and flow of information.

Inadequate funding was viewed to be one of the major constraints facing agricultural research and extension. Lack of funding has a ripple effect on the challenges affecting access to information, with one challenge leading to the next. Financing of agriculture by the government has declined due to the unstable economic environment. Donor funding had traditionally sustained a number of projects, and withdrawal has been attributed to the 'unstable' political environment. As with the constraints above, a large 68.4% observed that lack of funds resulted in the ministry failing to provide adequate material and human resources. They cited ill-equipped laboratories, poor ICT infrastructure, and hence poor access to information resources. Old equipment for field and laboratory research affected some of the research results, rendering them less competitive. All the libraries indicated that they did not have library budgets, meaning that their collections were not being updated, and stated that they relied mostly on donations. The respondents could not afford to acquire their own materials because of low remunerations. A large number (63.1%) of the respondents also expressed dissatisfaction with the lack of transport for research and extension work, although the ministry was in the process of distributing motorbikes for use throughout the country. However, researchers also felt that the motorbike initiative was biased towards extension workers.

It was also felt that the number of farmers did not match the resources at the disposal of researchers and extension workers. The link between research and extension was considered to be poor due to poor communication, with indications of lack of expertise in some research areas. Material in local languages was seen as another factor affecting the research and extension systems, although the respondents indicated that they assisted with translating some material into local languages. Radio and television programmes in vernacular provided some relief in this respect. The political climate that is still prevailing on farms and the new farmers' lack of farming practices and commitment was also said to result in the misappropriation of resources.

9.2.2.7 Objective seven

To make recommendations for a national agricultural information policy based on the outcomes of the study:

ix. What recommendations on a national agricultural information policy can be derived from the study?

Recommendations from the respondents were addressed as proposed solutions for the challenges highlighted in the course of the study, and particularly in sections 7.2.2.10; 7.2.2.17; 7.2.2.21; 7.2.3.10; 7.2.6.4 and 7.3.14. These recommendations mirror the challenges experienced by the respondents, who felt that addressing these challenges would go a long way in uplifting the services of agricultural researchers and extension workers.

These and other considerations form the basis of the recommendations of the study in 9.4.

9.3 Conclusions

The study has established that there are clearly structured research and extension systems within the public sector under the Ministry of Agriculture, Mechanisation and Irrigation Development in Zimbabwe. These structures have largely benefited and been sustained by trained personnel, as evidenced by the qualifications of the respondents as well the training institutions highlighted. Although once very vibrant, research and extension systems and services have suffered due to the harsh economic and political climate, particularly with respect to funding, leading to the loss of qualified and experienced personnel. The study has shown that with signs of economic recovery on the horizon, research and extension systems have the potential to improve.

The study fulfilled the research objectives and answered the research questions; it articulated the information needs of researchers and extension workers as well as the perceived information needs of the farmers, and highlighted the information challenges encountered in research and extension. The information needs varied for researchers and extension workers and covered the major disciplines of agriculture. Various sources of information were at the disposal of the respondents, both print and electronic, with researchers opting for electronic sources and extension workers highlighting print sources. Limited internet access was said to affect access to databases and other electronic resources. However it was ascertained that in cases where the available databases were consulted and were considered important, they were still not fully utilised. The study concluded that a concerted effort is necessary to improve the state of the ministry's libraries as information is paramount in research and extension activities.

The results have revealed that researchers and extension workers play a significant role in the dissemination of agricultural information to farmers, achieved through various communication channels that range from electronic sources to print media and public gatherings, among others. Lack of material in local languages was one of the challenges cited, although translations were being made by the researchers and extension workers in some instance. Overall, communication between researchers and extension workers was found to be weak.

The Ministry of Agriculture did not have a "visible policy" regarding the management of information generated by its departments. It was shown that documents were generated electronically but circulated as hard copies, and the scarcity of resources hampered the amount of material printed, restricting circulation. ICTs such as the radio, television, the internet, databases and telephones were used in the dissemination of agricultural information. Lack of computers and limited access to the internet were seen to negatively affect the generation and dissemination of information, especially in research institute libraries. The mobile phone, although not readily available in the office environment, appeared to be highly utilized in communicating agricultural information.

Agricultural researchers and extension workers were in collaboration with other stakeholders and organisations both locally and internationally and there were benefits derived in terms of agricultural information, including research and extension publications, research facilities, and staff exchange. Farmers' organisations were found to play a significant role in the research and extension process by re-packaging information for farmers and funding research. The study concluded that indigenous knowledge remains relevant in modern day agriculture and is prevalent, as shown by its high utilisation by researchers and extension workers. Indigenous knowledge is drawn from both formal and informal sources.

Funding remains a major challenge to research and extension institutions. Inadequate funding from the government and donor fatigue has stalled some projects as they cannot sustain themselves. This has resulted in lack of resources and the failure to upgrade existing infrastructure such as laboratory equipment and information resources, and the failure to retain staff as the conditions are not attractive. Privatisation and charging for research and extension services, while providing alternative sources of funding, were considered discriminatory against poor farmers. Farmers face challenges in securing funding from banks because of stringent conditions, e.g. collateral which they fail to raise, while those who access funds have been accused of defaulting which has disadvantaged new applicants.

Further studies into the information needs of farmers using other methodological approaches like focus group interviews would provide further insights into their information needs, utilisation, and challenges. The diffusion of innovations framework, while considered appropriate for this study, has been criticised for its shortcomings; future studies could explore other theoretical approaches, in particular approaches that are more participatory, e.g. where farmers are involved in problem identification.

9.4 Recommendations

The recommendations are derived from the respondents' suggestions for an improved agricultural research and extension system, empirical evidence, and from literature on the subject.

9.4.1 Information needs: Identification, support and utilisation

According to Chowdhury (2004:194), information needs are largely dependent on the environment and vary from person to person and job to job. These information needs are also not stagnant, but change with time. The study established that researchers and extension workers require different types of information and prefer different types of information sources. In order to adequately address their needs, the study recommends that within each category, user profiles should be created to identify areas of speciality as well as different information requirements. Such a profile could then be used in conjunction with the library to create a selection dissemination of information (SDI) service, so that any new information related to their interests may be directed to them. The profile may also include the time/ season when information is sought, and different formats. For example, e-mail facilities could also be used to forward electronic documents.

It is recommended that the Central Library should be empowered in terms of personnel and other resources to could conduct searches and send documents to researchers and extension workers upon request, as in the Question and Answer Service (QAS). In fact all the library and information centres of the Ministry of Agriculture were poorly serviced; hence it is recommended that they be capacitated with the required personnel and resources. Currently they are unattractive because their collections are dated. The ministry should allocate annual budgets to help the libraries update and replace their collections. The publishing landscape has evolved, and a lot of scholarly material is now available online (open access initiatives), and the ministry should improve connectivity to this material within and across government institutions and research institutes. In order for the ministry's libraries to effectively transform themselves, they also need to be manned by professional librarians dedicated solely to library and information work, unlike the current setup.

9.4.2 Research-extension farmer linkage

The DR&SS and AGRITEX have been affected by the departure of experienced personnel, resulting in the recruitment of young and inexperienced researchers and extension workers (see Tables 7.3, 7.4, 7.6). Extension workers need to be capacitated to enable them to transfer the requisite knowledge and skills to the farmers, and this can be achieved through in-service training and the provision of manuals (e.g. farm management handbooks). The research system, on the other hand, needs to continuously develop the research skills of all new researchers as a cover for unforeseen departures. The government should also strengthen the delivery of research and extension services by capacitating research and extension institutions in order to meet the challenges brought about by the research mandate to cover all farmers, who have since tripled in number due to the land reform programme.

In order to enhance communication between researchers and extension workers, the resuscitation of the Committee for On-farm Research and Extension (COFRE) is paramount. As shown in Pazvakavambwa and Hakutangwi (2006:228), COFRE had been responsible for coordinating on farm trials and demonstrations as well as giving researchers and extension workers a platform to interact at field level in real farm situations. The government should also provide budgets as well as a clear structure/ plan of action, as these were some of the challenges that led to its previous demise.

9.4.3 Information management and ICT services

The study has shown that there was no defined policy on the management of information generated through research and extension, and that the information was not accessible. It is imperative for a policy to be in place that would facilitate the collection and storage of such material. Since the respondents indicated that the information is being documented (7.2.2.13), this should form the basis of a national agricultural collection together with other current initiatives, for example the 'Biometrics Directory of Current Research'. A central database of current research should be created with details that would necessitate follow ups. It must also be mandatory for all research to be registered and deposited once completed. The database would also include periodic reports and should be submitted in both electronic and print formats. The electronic version would allow for remote access on the intranet or internet. Subsequently ministry libraries and other relevant stakeholders should be provided with copies of such materials for reference purposes. It is therefore necessary for information/ materials to be sent to all levels of staff where necessary. Departmental collections were considered to be the first point of call by extension workers (7.2.2.3), hence it is essential that records of these collections be kept to augment the conventional collections of the libraries.

The Ministry of Agriculture's ICT infrastructure needs to be developed in order to enhance access. An audit should be carried out to ascertain the current state of ICTs within the country in order to enable the ministry to budget for the upgrade of infrastructure. The government of Zimbabwe has a Ministry of Information and Communication Technology which should fulfil its mandate of empowering government departments with ICTs for e-government. The ministry's infrastructure needs to be upgraded with new computers, networking, internet and bandwidth, among other components. There is also a need to develop the ministry's website in order to enhance remote access to information, downloads, and communication. The study has shown that although mobile phones were not readily available as government ICTs, they were widely used in communicating agricultural information by the respondents, suggesting the need for more investment in such resources.

9.4.4 Funding and the provision of resources

Funding is one of the main challenges affecting the provision of resources for research and extension in Zimbabwe. Like most government departments, the Ministry of Agriculture, is not adequately funded to address the expectations of the government and other stakeholders. The demise of the Zimbabwean dollar compounded the funding situation, although the adoption of multiple currencies (Rand, Pula, US dollar) has seen a slight improvement in the country's economic performance. Funding has had a negative impact on the following areas:

- **Transport resources**

  Researchers and extension workers need to travel in order to assess the performance of technologies and farmers on the field, and hence require transport. The study acknowledges current efforts and recommends that motorbikes and other appropriate transportation means be extended to researchers (7.2.6.1; 7.2.6.2).

- **Staff retention**

  Staff turnover has resulted in the loss of experienced personnel due to poor remunerations (7.2.6.1, 7.2.6.2). In order to motivate the return of staff, the government should instil incentives and special skills allowances.

- **Information resources**

  Information services need to be financed in order for researchers and extension workers to access competitive information. This includes books, journals, and subscriptions to databases.

- **Equipment**

  Archaic laboratory and field equipment appeared to be compromising the quality of research and the competitiveness of results compared to other institutions. The ministry should identify and partner with institutions for the purposes of sharing research facilities (7.3.1.8).

9.4.5 Integrating IK in research and extension

The study showed that indigenous knowledge is being used and is highly appreciated by researchers and extension workers, with both formal and informal methods of acquisition. Such methods should be documented and integrated into the curricula, particularly in extension training. Efforts have already been made for such integration in Uganda (Gorjestani, 2001) and Kenya (Kiplang'at and Rotich, 2008).

9.4.6 Strengthening collaboration with stakeholders

AGRITEX and DR&SS should strengthen relationships with other research and extension service providers, particularly where both groups stand to benefit. This is especially the case with research facilities, funding, training, and publications (7.2.5.2, 7.2.5.4, 7.2.5.6), which are areas where the system is currently weak. Besides having modern research facilities, private and international organisations also produce publications to support their activities for their extension and marketing programmes. Libraries and information services stand to benefit from these publications, as exchange or for free, for example SeedCo allows downloads of research related information from their website.

The above recommendations should be applied selectively depending on the requirements and challenges being addressed.

9.5 Suggestions for further research

This study has focused on the information needs and challenges of agricultural researchers and extension workers and the perceived information needs of farmers in Zimbabwe. Although some information was derived with respect to the latter, the researcher believes that it is necessary to carry out further research on the topic. Such a study may use a different methodological approach, such as focus group discussions and/or interviews with farmers. The use of the mobile phone and its penetration in Zimbabwe may also provide a further area of study on how this technology may be utilised in disseminating agricultural information, especially when taking into account success stories among traders and farmers in Uganda, India and Bangladesh.

REFERENCES

Abalu, G.I. 2001. Education in the political economy of African Agricultural Knowledge Systems: staying abreast of the changing environment. Paper presented at the *2001-CIEA Seminar on Excellence in Agricultural Education, a Challenge for Africa*, hosted by Elsenburg College of Education, Stellenbosch, South Africa, 3-14 December 2001. Available: http://www.ciea.ch/documents/s01_sout_abalu.pdf Accessed: 28/06/2010.

Addison, C. 2006. Coherence in agricultural information: Report of an expert workshop, held on 19 -20 May 2005 in Lexington, USA. Available: ftp://ftp.fao.org/gi/gil/consultations/lexington_report.pdf Accessed: 05/12/2011.

Africa University. 2010. *Africa University: About us.* Available: http://www.africau.edu/ Accessed: 29/06/2010.

Agbamu, J. U. 2000. Agricultural research-extension linkages systems: an international perspective. *Agriculture Research and Extension Network.* 106:1-7.

AGORA. 2010. *Access to Global Online Research in Agriculture.* Available: http://www.aginternetwork.org/en/ Accessed: 17/07/2010

AGRIBANK. 2011. *Agricultural Development Bank of Zimbabwe*. Available: http://www.agribank.co.zw/. Accessed: 29/02/2012

Agricultural Research Trust. 2008. *Agricultural Research Trust: background*. Available: http://www.artfarm.co.zw/ Accessed: 07/07/2010.

Aina, L.O. 1990. Informing African farmers: some obstacles to information flow. *Information Development*, 1:6: 201-203.

Aina, L.O. 1991. Information for successful agriculture. *World Libraries* 2:1 (Fall). Available: http://www.worlib.org/vol102no1/print/aina_print.html Accessed: 12/05/06.

Aina, L.O. 1995. Information and agriculture in Africa. In: L.O. Aina, A.M. Kaniki, and J.B. Ojiambo. *Agricultural information in Africa.* Ibadan: Third World Information Services. Pp. 1-11.

Akullo, D. 2007. *Indigenous knowledge in agriculture: a case study of the challenges in sharing knowledge of past generations in a globalised context in Uganda.* World Library and Information Congress: 73rd IFLA General Conference and Council. 19-23 August 2007, Durban, South Africa. Available: http://www.ifla.org/iv/ifla73/index.htm

Albers, M. J. 2008. *Communication of complex information: user goals and information needs for dynamic Web information*. Mahwah (NJ): Taylor & Francis.

Alene, A. D. and Coulibaly, O. 2009. The impact of agricultural research on productivity and poverty in sub-Saharan Africa. *Food Policy* 34:198-209.

Ali, J. and Kumar, S. 2011. Information and communication technologies (ICTs) and farmers' decision-making across the agricultural supply chain. *International Journal of Information Management*, 31:149-159.

Asopa, V.N. and Beye, G. 1997. *Management of agricultural research: a training manual*. (Vol.8: Research and extension linkage). Rome: FAO.

Assessing the impact of agricultural research on poverty alleviation: some issues and priorities. [Editorial]. 2000. *Food Policy* 25:379-388.

Bagnall-Oakeley, H. et al. 2004. Mapping and understanding farmers' indigenous agricultural knowledge and information systems and the implications for contracted research and extension systems. *Ugandan Journal of Agricultural Sciences*, 9:119-125.Available: http://www.naro.go.ug/Events/NARO%20Conference/Documents/Papers/Theme%202/UJAS%209(1)%200119-0125%20Bagnall-Oakeley.pdf Accessed 29/03/2012

Bailey, K. D. 1994. *Methods of Social Research*. 4th ed. New York: The Free Press.

Bates, M.J. 2003. *Toward and integrated model of information seeking and searching*. Available:http://gseis.ucla.edu/faculty/bates/articles/info_seeksearch-i-030329.html Accessed: 23/09/2010.

Bawden, D. 2006. A three-decade perspective on Tom Wilson's "On user studies and information needs" *Journal of Documentation.* 62:6:671-679.

Belkin, N.J. 1980. Anomalous state of knowledge as a basis for information retrieval. *Canadian Journal of Information Science*, 5:133-143.

Benczur, A. 2003. The evolution of human communication and the information revolution: a mathematical perspective. *Mathematical and Computer Modelling*. 38:691-708.

Bhattacharyya, D.K. 2003. *Research methodology*. New Delhi: Excel Books.

Borlaug Global Rust Initiative. 2010. *Rattray Arnold Research Station, Seed Co.* Available: http://globalrust.org/traction/permalink/advocacy2231 Accessed 07/07/2010.

Budak, D.B. and Yurdakul, O. 2004. Sustainable agricultural development through extension education. *Asian Journal of Plant Sciences*, 3:2:215-218.

Burns, R.B. 2000. *Introduction to research methods.* London: Sage.

Burton, L.D. 2010. *Agriculture: fundamentals and applications*. 5th ed. New York: Delmar.

CARE International. 2008. Zimbabwe. Available: http://www.care international.org/Download- document/189-Zimbabwe.html Accessed: 04/02/2012.

Case, D. O. 2007. *Looking for information: a survey of research on information seeking needs*. 2nd ed. London: Academic Press.

Chema, S., Gilbert, E. and Roseboom, J. 2003. *A review of key issues and recent experiences in reforming agricultural research in Africa*. [London]: International Service for National Agricultural Research (ISNAR). pp. 183-194.

Chimanikire, P. 2007. Factors affecting job satisfaction among academic professionals in tertiary institutions in Zimbabwe. *African Journal of Business Management*. 1:6:166-175. Available: http://www.academicjournals.org/ajbm/pdf/Pdf2007/Sep/Chimanikire%20et%20al.pdf Accessed 22/07/2011

Chimhowu, A. 2009. *Moving forward in Zimbabwe: reducing poverty and promoting growth.* Manchester: University of Manchester, Brooks World Poverty Institute. Available: http://www.bwpi.manchester.ac.uk/research/ResearchAreaProjects/Africa/Moving_forwa rd in_Zimbabwe_whole_report.pdf Accessed: 25/06/2010.

Choo, C. W., Detlor, B., and Turnbull, D. 2000. *Web work: information seeking and knowledge work on the World Wide Web.* Dordrecht: Kluwer Academic.

Chowdhury, G. G. 2004. *Introduction to modern information retrieval*. 2nd ed. New York: Facet.

CGIAR. 2011. Consultative Group on International Agricultural Research (CGIAR). Available: http://www.cgiar.org/ Accessed: 02/04/2011.

CIMMIYT. 2010. *CIMMYT Research Centres*. Available: http://www.cimmyt.org/index.php/en/about-us Accessed: 07/07/2010.

Clapp, J. 1997. *Adjustment and Agriculture in Africa: farmers, the state and the World Bank in Guinea.* London: Macmillan.

Contado, T.E. 1997. Formulating extension policy. In: B.E. Swanson, R.P. Bentz, and A.J. Sofranko (Eds). *Improving agricultural extension: a reference manual*. Rome: FAO. pp. 107-114.

Contant, R.B. 2001. Priority setting. In: G. Gijsbers *et al* (Eds). *Planning agricultural research: a sourcebook.* Wallingford (Oxon): CABI in association with ISNAR.

Creswell, J.W. and Clarke, V.L.P. 2007. *Designing and conducting mixed methods research.* London: Sage.

CTA. 2010. *Question and Answer Service.* Available: http://internships.cta.int/about/qas.htm Accessed: 03/07/2010.

CTA (2011). *Indigenous knowledge systems*. Available: http://knowledge.cta.int/en/Dossiers/Demanding-Innovation/Indigenous-Knowledge-Systems Accessed: 18/02/2011.

Dakora, F.D. 1996. Using indigenous to increase agricultural productivity in Africa. In: H. Normann and I, Snyman, M. Cohen (Eds). *Indigenous knowledge and its uses in Southern Africa.* Pretoria: HSRC Publishers.

DANIDA. 1991. *Evaluation of Danish Assistance to Four Agricultural Training Institutes: report prepared by an Evaluation Mission visiting Zimbabwe, 24 September - 10 October, 1990.* Denmark: Centre for Development Research.

Dao, M.Q. 2009. Poverty, income distribution and agriculture in developing countries. *Journal of Economic Studies* 36:2:168-183. Available: http://www.emeraldinsight.com/journals.htm?issn=0144-3585&volume=36&issue=2 Accessed: 26/10/2011

Dawson, C. 2009. *Introduction to research methods: a practical guide for everyone undertaking a research project*. 4th ed. Oxford: How to Books.

Del Rosario, Beatriz P. 2009. Fostering farmer-scientist research collaboration: the role of the International Federation of Agricultural Producers. In: I. Scoones, and J. Thompson (Eds). *Farmer first revisited: innovation for agricultural research and development*. Rugby, Warwickshire: Practical Action Publishing. p.p. 131-132.

Denucci, A. and Fre, Z. 2003. *Understanding indigenous knowledge and information systems of pastoralists in Eritrea*. Rome: FAO.

Derr, R.L. 1983. A conceptual analysis of information need. *Information Processing & Management.* 19:5:273-278.

Dervin, B. 1983. An overview of sense-making research: Concepts, methods and results. Paper presented at the annual meeting of the International Communication Association, Dallas, TX, May. Available: http://faculty.washington.edu/wpratt/MEBI598/Methods/An%20Overview%20of%20Sense-Making%20Research%201983a.htm Accessed: 16/01/2013

Dervin, B. 1998. Sense-making theory and practice: an overview of user interests in knowledge seeking and use. *Journal of Knowledge Management*, 2:2:36-46.

Dervin, B. and Nilan, M. 1986. Information needs and information uses. *Annual Review of Information Science and Technology (ARIST)* 21:1-16.

Deshpande, R. 1983. A Comparative Review of Innovation Diffusion Books Innovation Diffusion: A New Perspective by Lawrence A. Brown; Diffusion of Innovations by Everett M. Rogers; Patterns of Technological Innovation by Devendra Sahal. *Journal of Marketing Research*, 20:3:327-334. Available: http://www.jstor.org/stable/pdfplus/3151838.pdf?acceptTC=true Accessed: 04/03/2012

Devadason, F.J. and Lingam, P.P. 1996. *A methodology for identification of information needs and users.* Paper presented at the 62nd IFLA General conference-Conference proceeding, August 25-31, 1996. Available: http://www.ifla.org/IV/ifla62/62-devf.htm Accessed: 16/06/2004.

Devlin, A.S. 2006. *Research methods: planning, conducting and presenting research*. Belmont (Calif.): Thomson/Wadsworth.

Dey, B., Newman, D. and Prendergast, R. 2011. Analysing appropriation and usability in social and occupational lives: an investigation of Bangladeshi farmers' use of mobile telephony. *Information Technology & People*, 24:1:46-63.

DFID. 2011. *Consultative Group on International Agricultural Research (CGIAR).* Available: http://www.dfid.gov.uk/r4d/MR_CGIAR.asp accessed 02/04/2011.

Diao, X. 2007. *The Role of Agriculture in Development: implications for sub-Saharan Africa*. Washington D.C.: International Food Policy Research Institute.

Dulle, F.W. 2000. The extension triad approach in disseminating agricultural information to extension workers: some experiences from the Southern Highlands Dairy Development Project, Tanzania. *Journal of Information Science* 26:2: 121-128.

Dulle, F.W. 2001. Researchers' perspectives on agricultural libraries as information sources in Tanzania. *Library Review* 50:4:187-192.

Eicher, C.K. and Baker, D.C. 1982. *Research on Agricultural Development in Sub-Saharan Africa: a critical survey*. East Lansing: Department of Agricultural Economics, Michigan State University.

Ekpenyong, G. D. 2001. Agricultural research in Nigeria: the role of institutional libraries *Information Development*, 6:17: 118 - 122.

Ellis, D. 1989. A behavioral approach to information retrieval system design. *Journal of Documentation*, 45:3:171–212

Enakrire, T.R. and Onyenania, O.G. 2007. Factors affecting the development of information infrastructure in Africa. *Library Hi Tech News* 2:15-20.

Encyclopaedia Britannica. 2010. Extensive agriculture. Available: http://www.britannica.com/EBchecked/topic/198903/extensive-agriculture. Accessed: 11/10/2010.

FAO. 1996. *Agro-ecological zoning: guidelines*. Rome: Food and Agriculture Organization of the United Nations. Available: http://www.fao.org/docrep/w2962e/w2962e-03.htm Accessed: 11/10/2010.

FAO. 2000. *Improving access to agricultural information*: 1st Consultation on Agricultural Information Management. Working Document. Rome, 5-7 June 2000. Available: http://www.fao.org/docrep/meeting/X7035E.htm Accessed: 04/06/2011.

FAO. 2003. *The agricultural extension system in Zimbabwe.* Available: http://www.fao.org/DOCREP/005/AC913E/ac913e05.htm Accessed: 09/07/2010.

FAO. 2004. *Report of the FAO Expert Consultation on mechanisms for documenting and disseminating outputs of agricultural research in Sub-Saharan Africa*, 12-14 May 2004, CABI International Africa Regional Centre, Nairobi, Kenya. Rome: FAO.

FAO. 2005. *Improved agricultural marketing information empowers farmers: Bangladesh.* Available:http://www.fao.org/tc/tcp/pdf/Factsheet_clearedfinal_ENGLISH.pdf Accessed: 24/01/2012

FAO. 2010. *Agricultural Bank of Zimbabwe (AGRIBANK)* Available: http://www.fao.org/AG/ags/agsm/banks/banks/zimbabwe.htm Accessed: 17/07/2010.

FAO/World Bank. 2002. *Agricultural Knowledge and Information Systems for Rural Development: strategic vision and guiding principles*. Rome: FAO/The World Bank. Available: ftp://ftp.fao.org/SD/SDR/SDRE/AKIS.pdf Accessed: 05/07/2010.

Farrington, J. 1998. Organisational roles in farmer participatory research and extension: lessons from the last decade. *ODI Natural Resources Perspectives* No.27

Fatima, N. and Ahmad, N. 2008. Information seeking behaviour of the students at the Ajmal Khan Tibbiya College, Aligarh Muslim University: a survey. *Annals of Library and Information Studies*, 55:141-144. Available: http://nopr.niscair.res.in/bitstream/123456789/1775/1/ALIS%2055(2)%20141-144.pdf Accessed: 14/03/2011

Fenta, G. 2009. Farmers' indigenous knowledge, the missing link in the development of Ethiopian agriculture: a case study of Dejen district, Amhara region. *Social Science Research Report series*, 34:3-5. Available: http://publications.ossrea.net/index.php?option=com_content&view=article&id=40&limitstart=1 Accessed: 18/02/2011

Filson, G.C. 2004. *Intensive agriculture and sustainability: a farming systems approach.* Vancouver: UBC Press.

Foti, R., Nyakudya, I., Moyo, M. and Chikuvire, J. 2007. Determinants of farmer demand for fee-for-service extension in Zimbabwe. *IAALD Quarterly Bulletin*, LII:1/2:28-34.

Fox, W. and Bayat, M.S. 2007. *A guide to managing research*. Cape Town: Juta

Frankfort-Nachmias, C. and Nachmias, D. 1996. *Research methods in the social sciences.* 5th ed. London: Arnold.

Gamage, C. 2006. Information needs and information seeking behaviour of environmental scientists in universities in Sri Lanka: major issues and concerns. *Journal of the University Librarians of Sri Lanka.* 10:19-28. Available: http://www.sljol.info/index.php/JULA/article/view/315

Ganzel, B. 2007. *Diffusion of information*. Available: http://www.livinghistoryfarm.org/farminginthe50s/crops_02.html Accessed: 04/03/2012

Gephart, R. 1999. Paradigms and research methods. *Research Methods Forum. 4: (summer)* Available: http://division.aomonline.org/rm/1999_RMD_Forum_Paradigms_and_Research_Methods.htm Accessed 16/11/2010.

Ghouzhdi, H.G. 2010. Indigenous knowledge in agriculture with particular reference to black cumin (*Nigella sativa*) production in Iran. *Scientific Research and Essays*, 5:25:4107-4109. Available: http://www.academicjournals.org/SRE Accessed: 28/05/2011.

Giovannetti, J. 2001. *Networking and partnership in information and communication for agricultural and rural development in ACP countries.* In: Information for agricultural and rural development in ACP countries: emerging stakeholders, new media, and priority themes: Proceedings of a CTA seminar, Paris, France, 29 May – 2 June 2000. Wageningen: CTA. pp. 239-262.

Gliessman, S.R. 2007. *Agro-ecology: the ecology of sustainable food systems*. 2nd ed. Boca Raton: CRC Press.

Government of Zimbabwe 1979. *Agricultural Research Council Act, Chapter 18:05. Acts 31/1970, 18/1975, S.I. 566/1979*. Harare: Government Printers.

Government of Zimbabwe. 1996. *Zimbabwe' agricultural policy framework, 1995-2020.* Harare: Ministry of Agriculture.

Government of Zimbabwe. 2001. *Pig Industry Board Act 18:15.* Harare: Government Printers.

Government of Zimbabwe. 2001. *Tobacco Industry and Marketing Act 18: 20* Harare: Government Printers.

Gray, D. E. 2009. *Doing research in the real world*. 2nd ed. London: Sage.

Green, J. and Browne, J. 2005. *Principles of Social Research.* Maidenhead: Open University Press.

Greenhalgh, T. et al. 2005. *Diffusion of innovations in health services organisations*. Oxford: Blackwell Publishing.

Gyampoh, B.A. *et al*. 2009. Using traditional knowledge to cope with climate change in rural Ghana. *Unasylva* 60:231/232:70-74 Available: ftp://ftp.fao.org/docrep/fao/011/i0670e/i0670e00.pdf Accessed: 02/06/2011.

Haider, H. and Kreps, G.L. 2004. Forty years in diffusion of innovations: utility and value in public health. *Journal of Health Communication*, 9:3-11. Available: http://dx.doi.org/10.1080/10810730490271430 Accessed: 02/03/2012

Handayani, I.P and Prowito, P. 2010. Indigenous soil knowledge for sustainable agriculture. In: E. Lichtfouse Ed, *Sociology, Organic Farming, Climate Change, and Soil Science.* London: Springer Dordrecht.

Hanyani-Mlambo, B.T. 2002. *Strengthening the Pluralistic Agricultural Extension System: a Zimbabwean case study*. Rome: Integrated Support to Sustainable Development and Food Security Programme, FAO.

Hayes, R.M. 1993. Measurement of information. *Information Processing & Management.* 29:1:1-11.

Henefer, J. and Fulton, C. 2005. Krikelas' model of information seeking. In K. Fisher, S. Erdelez, & L. McKechnie (Eds). *Theories of information behaviour* Medford (NJ): Information Today. Pp 225-229.

The Herald. Tuesday, March 14, 2006. "Arex battles to fill 6600 posts, service delivery compromised" Harare: Zimpapers. p.6.

The Herald. Tuesday, November 27, 2006. "Farmers struggle to access extension services" Harare: Zimpapers. pB2.

The Herald. Tuesday, February 2, 2010. "*Zimbabwe Agricultural Marketing Authority re-established". Harare: Zimpapers. p.2

The Herald. Friday March 18, 2011. "*Ministry equips extension officers*". Harare: Zimpapers. p.B.2

The Herald. Thursday, March 24, 2011. "Tips on harvesting, storage of cowpeas" Harare: Zimpapers.

The Herald. Friday, August 12, 2011. *"Minister Made hails role of police"* Harare: Zimpapers. p.2.

The Herald. Friday, October 28, 2011. "*Agric colleges challenged to broaden curriculum"*. Harare: Zimpapers.

Herren, R.V. and Donahue, R.L. 1991. *The Agriculture Dictionary*. New York: Delmar.

Hjørland, B. 1997. *Information seeking and subject representation: an activity-theoretical approach to information science*. Westport (Conn.): Greenwood Press.

ICRISAT. 2010. *International Crops Research Institute for the Semi-Arid Tropics.* Available: http://www.icrisat.cgiar.org/Icrisat-aboutus.htm Accessed: 06/07/2010.

ICRISAT/FAO. 2009. *FAO and ICRISAT: a vital partnership*. Available: http://www.icrisat.org/whoweare/investorspartners/donorflyers/15_FAO_and_ICRISAT_scr.pdf Accessed: 07/07/2010

Ikoja-Odongo, R. and Mostert, J. 2006. Information seeking behaviour: a conceptual framework. *South African Journal of Library and Information Science.* 72:3:145-158.

INASP. 2010. *International Network for the Availability of Scientific Publications* Available: http://www.inasp.info Accessed 17/07/2010.

International Telecommunication Union. 2010. *Statistics and database: Mobile cellular subscriptions*. Available: http://www.itu.int/ITU-D/ict/statistics/ Accessed: 20/01/2012.

International Telecommunications Union/World Telecommunication/ICT Indicators database. 2010. *The world in 2010: ICT facts and figures*. Available: http://www.itu.int/ITU-D/ict/material/FactsFigures2010.pdf Accessed: 16/03/2010.

Islam, M.S. and Hasan, M.N. 2008. Multipurpose community telecentres in Bangladesh: problems and prospects. *The Electronic Library*, 27:3:537-553.

ITOCA 2010. *The Essential Electronic Agricultural Library.* Available: http://www.itoca.org/node/6#teeal Accessed: 17/07/10.

ITOCA. 2011. *International Training and Outreach Centre for Africa: Programmes* http://www.itoca.org/ Accessed: 18/11/2011.

Ives, C.L., Bedford, B.M., and Maredia, K.M. 1998. *Agricultural biotechnology for sustainable productivity project: a new model in collaborative development*. In: Ives, C.L. and Bedford, B.M. (Eds). Agricultural biotechnology in international development. Oxon: CABI. Pp1-14.

Jain, T.R. 2006. *Principles of economics*. New Delhi: V.K. Publications

Jones, G.E. and Garforth, C. 1997. *The History, Development, and Future of Agricultural Extension.* In: Swanson, B.E., Bentz, R.P., Sofranko, A.J. Eds. Improving agricultural extension: a reference manual. Rome: FAO. Pp. 3- 12.

Jones, M.P. and Sanyang, S. 2009. *The politics of inclusion in African agricultural research and development.* In: I. Scoones, and J. Thompson Eds. Farmer first revisited: innovation for agricultural research and development. Rugby, Warwickshire: Practical Action Publishing.

Kalusopa T. 2005. The challenges of utilizing information communication technologies (ICTs) for the small-scale farmers in Zambia. *Library Hi Tech*, 23:3:414-424

Kangasniemi, J. 2002. *Financing Agricultural Research by Producers' Organisations in Africa.* In: Byerlee, D. and Echeverria, R.G. Eds. Agricultural research policy in an era of privatisation. London: CABI. Pp. 81-104.

Kaniki, A.M. 1992. Meeting the needs of agricultural researchers in Africa: the role of unpublished reports. *Information Development*, 1:8: 83 - 89.

Kaniki, A.M. 1995. Agricultural information user populations and critical tasks in Africa. In: Information and agriculture in Africa. In: L.O. Aina, A.M. Kaniki, and J.B. Ojiambo. *Agricultural information in Africa.* Ibadan: Third World Information Services. Pp.12-31.

Kaniki, A.M. 2003. *Information needs for basic research: and African perspective.* [Paper presented at the] Symposium on Open Access and the Public Domain in digital data and information for science, UNESCO Headquarters, Paris, France, 10- 11 2003. Available: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.103.4069. Accessed: 15/09/2010

Kebede, G. and Rorissa, A. 2008. A model of information needs of end users (MINE) in the electronic information environment. *Proceedings of the American Society for Information Technology and Society*, 45:1:1-3.

Kelly, D. and Fu, X. 2007. Eliciting better information need descriptions from users of information search systems. *Information Processing & Management* 43:30-46.

Kingrey, K.P. 2002. Concepts of information seeking and their presents in the practical library literature. *Library Philosophy and Practice* 4:2 (spring). Available: http://www.webpages.uidaho.edu/~mbolin/kingrey.html Accessed: 23/09/2010

Kiplang'at, J. 1999. An analysis of the opportunities for information technology in improving access, transfer and the use of agricultural information in the rural areas of Kenya. *Library Management* 20:115-127.

Kiplang'at, J. 2004. *Diffusion of information and communication technologies in communication of agricultural information among agricultural researchers and extension workers in Kenya*. Ph.D. Thesis (Unpublished), University of Zululand.

Kiplang'at, J.N. and Rotich, D.C. 2008. *Mapping and auditing of agricultural indigenous knowledge in Uasin Gishu and Keiyo districts in Rift Valley province, Kenya.* World conference on agricultural information and IT, IAALD AFITA WCCA 2008, Tokyo University of Agriculture, Tokyo, Japan, 24-27 August 2008. pp. 719-730. Available: http://www.cabi.org/gara/FullTextPDF/2008/20083298153.pdf Accessed: 30/05/2011.

Kizilaslan, N. 2006. Agricultural information systems: a national case study. *Library Review*, 55:8:497-507.

Kuhlthau, C.C. 1991. Inside the search process: information seeking from the user's perspective. *Journal of the American Society for Information Science* 42:5:361-371.

Kuhlthau, C.C. 1999. Investigating patterns in information seeking: concepts and contexts. In: Wilson, T.D. and Allen, D.K. eds. *Exploring the contexts of information behaviour.* London: Taylor Graham. Pp. 10-20.

Kumar, R. 2005. *Research methodology: a step-by-step guide for beginners*. London: Sage.

Lahai, B.A.N., Goldey, P., and Jones, G.E. 2000. The gender of extension agent and farmers' access to and participation in agricultural extension in Nigeria *Journal of Agricultural Education and Extension 6:4:223*-233.

Leckie, G.J., Pettigrew, K.E. and Sylvain, C. 1996. Modelling the information seeking of professionals: a general model derived from research on engineers, health care professionals and lawyers. *Library Quarterly* 66:2:161-193.

Leedy, P.D. 1997. *Practical Research: Planning and Design* 6th ed. Upper Saddle River: Merrill.

Leedy, P.D. and Ormrod, J.E. 2010. *Practical research: planning and design*. 9th ed. Boston (Mass.): Pearson Education.

Leeuwis, C. 2004. *Communication for rural innovation: rethinking agricultural extension*. 3rd ed. Oxford: Blackwell Science in association with CTA.

Loebenstein, G. and Thottappilly, G. (Eds). 2007. *Agricultural Research Management*. Dordrecht: Springer.

Luiz, J. 2010. Infrastructure investment and its performance in Africa over the course of the twentieth century. *International Journal of Social Economics*. 37:7:512-536.

Lwoga, E.T. 2011. Knowledge management approaches in managing agricultural indigenous and exogenous knowledge in Tanzania. *Journal of Documentation.* 67:3:407-430. Available: www.emeraldinsight.com/0022-0418.htm Accessed: 02/04/2012

Lwoga, E.T., Ngulube, P. Stilwell, C. 2010. Managing indigenous knowledge for sustainable agricultural development in developing countries: knowledge management approaches in the social context. *The International Information & Library Review*, 42:174:185.

Majid, S., Anwar, M.A. and Eisenschitz, T.S. 2000. Information needs and information seeking behaviour of agricultural scientists in Malaysia. *Library & Information Science Research* 22:2:145-163.

Manjengwa, J. and Mazhawidza, P. 2009. Gender implications of decentralised land reform: The case of Zimbabwe. Policy Brief no. 30, December 2009. PLAAS, University of the Western Cape. Available: http://repository.uwc.ac.za/xmlui/bitstream/handle/10566/87/Manjengwa_Gender 2009.pdf?sequence=1 Accessed: 28/11/2011.

Maritz, J. 2009. Africa's number of mobile phone users now higher than United States. *TradeInvest*. Available: http://www.tradeinvestnigeria.com/news/979687.htm Accessed: 16/03/2011.

Manda, P. A. 2002. Information and agricultural development in Tanzania: a critique. *Information Development* 18:3: 181-188.

Marker, P., McNamara, K. and Wallace, L. 2002. *The significance of information and communication technologies for reducing poverty*. London: DFID.

Marongwe, N. 2004. *Socio-economic conflicts of the Fast Track Resettlement Programme*. In: Masiiwa, M. Ed. Post-independence land reform in Zimbabwe: controversies and impact on the economy. Harare: Friedrich Ebert Stitung and Institute of Development Studies, University of Zimbabwe. Pp.25-34.

Maru, A. and Latchem, C. 2005. *Using information and communication technologies (ICTs) for agricultural extension.* Vancouver: Commonwealth of Learning.

Mason, J. 2002. *Qualitative researching*. 2nd ed. London: Sage.

Mattelart, A. and Mattelart, M. 1998. *Theories of communication: a short introduction*. London: SAGE.

Masiiwa, M. and Chipungu, L. 2004. *Land reform programme in Zimbabwe: disparity between policy design and implementation.* In: Masiiwa, M. Ed. Post-independence land reform in Zimbabwe: controversies and impact on the economy. Harare: Friedrich Ebert Stitung and Institute of Development Studies, University of Zimbabwe. Pp.1-24.

Mashingaidze, K. 2006. *Maize Research and Development.* In: Rukuni, M., Tawonezvi, P., Eicher, C., Munyuki-Hungwe, M., Matondi, P. (Eds). Zimbabwe's agricultural revolution revisited. Harare: University of Zimbabwe Publications. Pp.363-378.

Maxwell, S. and Percy, R.H. 2001. *New trends in development thinking and implications for agriculture.* In: Stamoulis, K.G. Current and emerging issues for economic analysis and policy research. Rome: FAO. pp.47-85.

McClure, G.D. 1991. An integrated communication system for technology transfer: the CTTA project. In: W.M. Rivera and D.J. Gustafson, *Agriculture extension: worldwide institutional evolution and forces for change*. Amsterdam: Elsevier. pp. 175-187.

McCreadie, M. and Rice, R.E. 1999. Trends in analysing access to information. Part 1: cross- disciplinary conceptualisations of access. *Information Processing & Management*. 35:45-76.

Mchombu, K. 2001. *Key issues on the characteristics of agricultural information.* In: Technical consultation on assessing the performance and impact of agricultural information products and services: proceedings of a CTA/IICD/LEAP-IMPACT Technical consultation. Wagingen: CTA. pp 35-40.

Meadow, C.T. and Yuan, W. 1997. Measuring the impact of information: defining concepts. *Information Processing & Management.* 33:6:697-714.

Meho, L.I. and Tibbo, H.R. 2003. Modelling the information seeking behaviour of social scientists: Ellis's study revisited. *Journal of the American Society for Information Science and Technology*, 54:6:570–587.

Meitei, L.S. and Devi, T.P. 2009. Farmers' information needs in rural Manipur: an assessment. *Annals of Library and Information Studies*, 56: 35-40. Available: http://nopr.niscair.res.in/bitstream/123456789/4165/1/ALIS%2056%281%29%2035-40.pdf Accessed: 04/12/2011.

Meyer, H.M.J. and Boon, J.A. 2003. Provision for agricultural information for development: a case study on crossing communication boundaries. *Libri* 53: 174-184

Midlands State University. 2010. *This is MSU.* Available: http://www.msu.ac.zw Accessed: 29/06/2010.

Miller, R.L. and Brewer, J.D. 2003. *The A-Z of Social Research: a dictionary of key social research concepts*. London: Sage.

Ministry of Agriculture, Mechanisation and Irrigation Development. 2009. *Department of Economics and Markets*. Available: http://www.moa.gov.zw/index.php?option=com_content&view=article&id=72&Itemid= 55 Accessed: 01/07/2010.

Ministry of Agriculture, Mechanisation and Irrigation Development. 2009. *Mission Statement.* Available: http://www.moa.gov.zw Accessed: 01/07/2010.

Ministry of Agriculture, Mechanization and Irrigation Development. 2009. *Senior Management*. Approved by Public Service Commission on 14.05.09.

Ministry of Agriculture, Mechanisation and Irrigation Development. 2010. *Agriculture Education.* Available: http://www.moa.gov.zw/index.php?option=com_content&view=article&id=66&Itemid= 59 Accessed: 01/07/2010.

Ministry of Agriculture, Mechanisation and Irrigation Development. 2010. *Department of Agricultural Technical and Extension Services.* [Unpublished document].

Ministry of Agriculture, Mechanization and Irrigation Development. 2010. *Division of Animal and Pastures Research.* Available: http://www.drss.gov.zw/index.php?option=com_content&view=article&id=42&Itemid=40 Accessed: 01/07/2010

Ministry of Agriculture, Mechanization and Irrigation Development. 2010. *Division of Crops Research*. Available: http://www.drss.gov.zw/index.php?option=com_content&view=article&id=50&Itemid=43 Accessed: 01/07/2010.

Ministry of Agriculture, Mechanisation and Irrigation Development. 2010. *Division of Research Services.* Available: http://www.drss.gov.zw/index.php?option=com_content&view=article&id=70&Itemid=50 Accessed: 01/07/2010.

Ministry of Agriculture, Mechanization and Irrigation Development. 2011. Division of Crops Research. *Management Report for the period January-December 2011*. Harare: DR&SS

Ministry of Agriculture, Mechanisation and Irrigation Development . 2011. *Brochure for DR&SS*. Harare: Department of Research and Specialist Services.

Mittal, S., Gandhi, S. and Triphathi, G. 2010. Socio-economic impact of mobile phones in Indian agriculture. (n.p.): Indian Council for Research on International Economic Relations. Available: http://ideas.repec.org/p/ess/wpaper/id2443.html Accessed: 16/03/2011.

Morehead, D.R. and Rouse, W.B. 1982. Models of human behaviour in information seeking tasks. *Information Processing and Management*, 18:4:193-205.

Moyo, S., Moyo, Y., Matondi, P. 2004. *Land reform policies in Zimbabwe.* In: Munyuki-Hungwe, M. Ed. Land reform & tenure in southern Africa: current practices, alternatives and prospects. Harare: Documentation Unit, University of Zimbabwe. pp 153-168.

Mudhara, M. 2004. *The impact of land redistribution on Large Scale Commercial agriculture.* In: Masiiwa, M. Ed. Post-independence land reform in Zimbabwe: controversies and impact on the economy. Harare: Friedrich Ebert Stitung and Institute of Development Studies, University of Zimbabwe. pp 57-70.

Mudimu, G.D. 1986. *Planning and Evaluating Agricultural Research in Zimbabwe: a preliminary assessment and research proposal. (A plan B paper).* MSc Thesis (Unpublished), University of Michigan. Available: http://ageconsearch.umn.edu/bitstream/11155/1/pb86mu01.pdf Accessed: 24/06/2010.

Mugwisi, T. 2002. The internet as a source of research, teaching and learning: a comparative study between the University of Zimbabwe and the University of Zululand. M.A. Thesis (Unpublished), University of Zululand.

Muir-Leresche, K. 2006. *Agriculture in Zimbabwe.* In: Rukuni, M., Tawonezvi, P., Eicher, C., Munyuki-Hungwe, M., Matondi, P. Eds. Zimbabwe's agricultural revolution revisited. Harare: University of Zimbabwe Publications. pp 99-118.

Munyua, H. 2000. *Information and Communication Technologies for rural development and food security: lessons from field experience in developing countries.* Available: http://www.fao.org/sd/cddirect/CDre0055b.htm Accessed: 03/03/2011

Mutangadura, G. 1997. *Meeting development objectives with agricultural research: priority setting in Zimbabwe.* PhD Thesis (Unpublished), Faculty of the Virginia Polytechnic Institute and State University. Available: http://scholar.lib.vt.edu/theses/available/etd565121059721601/unrestricted/thes971.PDF Accessed: 08/06/2010.

Mutasa, M. 2011. Marrying indigenous knowledge and modern science sustains agriculture. Available: http://mukundi.wordpress.com/2011/01/06/marrying-indigenous-knowledge-and-modern-science-sustains-agriculture/ Accessed: 31/05/2011.

Mutisi, C. 2009. *Implementation of Agricultural Research and Training (ICART) in the SADC Region: Situational Analysis of Agricultural Research and Training and Support Strategies for the National Agricultural Research System in Zimbabwe*. Gaborone: FARN Directorate, SADC Secretariat.

Muto, M. and Yamano, T. 2008. The impact of mobile phone coverage expansion on market participation panel data evidence from Uganda, Draft Discussion Paper, Japan International Co-operation Agency (JICA). Available: http://www.jica.go.jp/jica-ri/publication/archives/jbic/report/review/pdf/37_05.pdf Accessed: 16/03/2011.

Mwala, K.S. 1997. Using the library for problem solving in African agriculture. *Information Development* 9:13:132 - 134.

Nagel, U.J. 1997. *Alternative approaches to organising extension*. In: Swanson, B.E., Bentz, R.P., Sofranko, A.J. Improving agricultural extension: a reference manual. Rome: FAO. pp 13-20.

Neuman, W. L. 2011. *Social research methods: qualitative and quantitative approaches.* 6th ed. Boston (Mass.): Pearson Education.

Ndungu, F.W., Nkonge, C. and Rees, C.J. 2000. *Agricultural knowledge and information systems (AKIS) paradigm: its potential in disseminating soil* *management technologies.* Available: http://www.kari.org/fileadmin/publications/Legume_Project/Legume2Conf_2000/72.pdf Accessed 02/04/2012

Nkomo, N. 2009. A comparative analysis of the web information seeking behaviour of students and staff at the University of Zululand and the Durban University of Technology. M.A. Thesis (Unpublished), University of Zululand

Obaa, B., Mutimba, J., Semana, A.R. 2005. Prioritizing farmers' extension needs in a publicly funded contract system of extension: a case study from Mukono district, Uganda. *Agricultural Research and Extension Network Paper 147*. [London]: DFID.

Ocholla, D.N. 1999. Insights into information seeking and communication behaviour of academics. *International Information and Library Review* 31:119-143.

Omekwu, C.O. 2003. National agricultural information management system in Nigeria: a conceptual framework. *Library Review* 52:9: 444-451.

Opara, U.N. 2008. Agricultural information sources used by farmers in Imo state, Nigeria. *Information Development* 24:4:289-295.

Ozcatalbas, O., Brumfield, R.G. and Ozkan, B. 2004. The agricultural information system for farmers in Turkey. *Information Development* 20:2:97-104.

Panneerselvam, R. 2004. *Research methodology.* New Delhi: Prentice-Hall of India.

Pazvakavambwa, S.C., Hakutangwi, M.B.K. 2006. *Agriculture extension*. In: Rukuni, M., Tawonezvi, P., Eicher, C., Munyuki-Hungwe, M., Matondi, P. Eds. Zimbabwe's agricultural revolution revisited. Harare: University of Zimbabwe Publications. pp 217- 234.

Peterson, W. 1997. The context of extension in agricultural and rural development. In: B.E. Swanson, R.P. Bentz, and A.J. Sofranko Eds. *Improving agricultural extension: a reference manual.* Rome: FAO. pp. 21-26.

PROTA. 2011. *Plant resources of tropical Africa*. Available: http://www.prota.co.ke/en/home Accessed: 02/04/2011.

Rajasekaran, B., Martin, R.A. and Warren, D.M. 1994. A framework for incorporating indigenous knowledge systems into agricultural extension organisation for sustainable agricultural development in India. *Journal of International Agricultural and Extension Education*, 1:2:25-31.

Rao, V.L.N. and Ramana, G.V. 2007. Indigenous knowledge, conservation management of natural resources among primitive tribal groups of Andhra Pradesh. *Anthropologist* (Special issue), 3:129-134.

Rea, L.M. and Parker, R.A. 2005. *Designing and Conduction Survey Research: a comprehensive guide*. 3rd ed. San Francisco: Jossey-Bass.

Reddy, D.E. 2008. Holistic view of agricultural information transfer systems. [Paper presented at the] World Library and Information Congress: 74th IFLA General Conference and Council, 10-14 August 2008, Quebec, Canada. Available: http://www.ifla.org/IV/ifla74/index.htm Accessed: 28/02/2011.

Rees, D. 2000. Agricultural knowledge and information systems in Kenya: implications for technology dissemination and development. *Agricultural Research and Extension Network Paper 107*. [London]: DFID.

Renkow, M. and Byerlee, D. 2010. The impacts of CGIAR research: a review of recent evidence. *Food Policy*, 35:5:391-402. Available: http://www.sciencedirect.com/science/journal/03069192/35/5 Accessed 02/02/2011.

Rhoe, V., Oboh, V. and Shelton, P. 2010. *The role of libraries in supporting agricultural policy research: evidence from selected university and research institute libraries in Nigeria*. Abuja: IFPRI. Available: http://www.ifpri.org/sites/default/files/publications/nsspbp14.pdf Accessed: 02/12/2011

Rivera, W.B. 2000. The changing nature of agricultural information and the conflictive global developments shaping extension. *Journal of Agricultural Education and Extension*, 7:1:31-41.

Rivera, W.B. and Cary, J.W. 1997. Privatising agricultural extension. In: B.E. Swanson, R.P. Bentz, and A.J. Sofranko Eds. *Improving agricultural extension: a reference manual.* Rome: FAO. pp. 203-212.

Rivera, W.M. 2000. Changing nature of agricultural information and the global development in shaping extension. *J. Agric. Ext.* 7:1:31-41.

Robson, C. 1993. *Real World Research: a resource for social scientists and practitioner researchers.* Oxford: Blackwell.

Rogers, E.M. 1983. *Diffusion of innovations*. 3rd ed. New York: The Free Press.

Rogers, E.M. 1995. *Diffusion of innovations*. 4th ed. New York: The Free Press.

Rosenfeld, L. and Morville, P. 2002. *Information architecture for the World Wide Web.* 2nd ed. Sebastopol (Calif.): O'Reilly Media.

Rukuni, M. 2006. *The evolution of agricultural policy: 1890- 1990.* In: Rukuni, M., Tawonezvi, P., Eicher, C., Munyuki-Hungwe, M., Matondi, P. Eds. Zimbabwe's agricultural revolution revisited. Harare: University of Zimbabwe Publications. pp 29-61.

SADC. 2008. *Implementation and Coordination of Agricultural Research and Training (ICART) in the SADC Region: Situation Analysis of Agricultural Research and Training in the SADC Region*. Gaborone: FARN Directorate, SADC Secretariat.

Saha, A. and Mukhopadhyay, S.B. 2003. *Agricultural knowledge information system: an emerging approach for sustainable development*. Available: http://www.agropedia.iitk.ac.in/openaccess/sites/default/files/CSAP%2052.pdf Accessed: 17/03/2010.

Savolainen, R. 2009. Information use and information processing: comparisons and conceptualizations. *Journal of Documentation*, 65:2:187-207.

SeedCo. 2012. *Seed Company of Zimbabwe Ltd.* Available: http://seeds.seedco.co/research Accessed: 01/03/2012.

Shajahan, S. (2005). *Research methods for management (text and cases)* 3rd ed. Mumbai: Jaico Publishing House.

Shannon, C.E. 1948. A Mathematical theory of communication. Reprinted with corrections from Bell *System Technical Journal* 27, 379-423 and 623-656 (July and October). Available: http://www2.research.att.com/~njas/doc/shannon1948.pdf Accessed 15.09/2010.

Stamoulis, K.G. 2001. *Current and emerging issues for economic analysis and policy research*. Rome: FAO.

Stefano, L.A. 2005. Printed information needs of small-scale organic farmers in KwaZulu-Natal *Libri*, 55:56–66

Stephenson, G. 2003. The somewhat flawed theoretical foundation of extension service. Journal of Extension, 41:4. Available: http://www.joe.org/joe/2003august/a1.php Accessed: 04/03/2012

Sunding, D. and Zilberman, D. 2000. The agricultural innovation process: research and technology adoption in a changing agricultural sector. Available: http://are.berkeley.edu/~zilber/innovationchptr.pdf Accessed: 09/11/2010

Swanson, B. E. 1997. *Strengthening research - extension - farmer linkages*. In: Swanson, Burton E., Bentz, Robert P., Sofranko, Andrew J. Eds. Improving agricultural extension: a reference manual. Rome: FAO. pp 171-178.

Swanson, B. E. and Rajalahti, R. 2010. *Strengthening agricultural extension and advisory systems: procedures for assessing, transforming, and evaluating extension systems.* Washington, DC: The International Bank for Reconstruction and Development/World Bank.

Tabor, S.R. 2001. Globalisation: planning agricultural research in an open market economy. In: G. Gijsbers *et al.* Eds. *Planning agricultural research: a sourcebook.* Wallingford (Oxon): CABI in association with ISNAR. pp. 7-16.

Talja, S. 2000. *Constituting "Information" and "User" as research objects: a theory of knowledge formations as an alternative the information man-theory*. Available: http://comminfo.rutgers.edu/~tefko/Courses/612/Articles/Talja.pdfAccessed: 20/09/2010.

Tanni, M. and Sormunen, E. 2008. A critical review of research on information behaviour in assigned learning tasks. *Journal of Documentation* 64:6:893-914.

Tawonezvi, P.H. and Hikwa, D. 2006. *Agricultural Research Policy*. In: Rukuni, M., Tawonezvi, P., Eicher, C., Munyuki-Hungwe, M., Matondi, P. Eds. Zimbabwe's Agricultural revolution revisited. Harare: University of Zimbabwe Publications. pp.197-214.

Taylor, B., Sinha, G., and Ghoshal, T. 2006. *Research methodology: a guide for researchers in management and social sciences.* New Delhi: PHI Learning.

Taylor, R.S. 1968. Question negotiation and information seeking in libraries. *College & Research Libraries*, 29:3:178-194.

Tevera, D.S. and Crush, J. 2003. The new brain drain from Zimbabwe. (Southern Africa Migration Project). Idasa: Cape Town. Available: http://www.equinetafrica.org/bibl/docs/TEVrights.pdf Accessed: 26/08/2011

Thapisa, A.P.N. 1997. A quest for an agricultural information programme for Southern Africa. *Library Management* 18:4:196-204.

Tikai, P. and Kama, A. 2004. *A study of indigenous knowledge and its role to sustainable agriculture in Samoa.* Available: http://www.mnre.gov.ws/documents/forum/2004/11%20Kama.pdf Accessed: 18/02/2011

Timmers, C.F. and Glas, C.A.W. 2009. Developing scales for information-seeking behaviour. *Journal of Documentation* 66:1:46-69.

Tobacco Industry Marketing Board. 2010. *TIMB*. Available: http://www.timb.co.zw/ Accessed: 13/07/10

Tobacco Research Board. 2010. Available: http://www.kutsaga.co.zw/ Accessed: 13/07/2010.

Topouzis, D. 2003. Addressing the impact of HIV/AIDS on ministries of agriculture: focus on eastern and southern Africa. Rome: FAO/UNAIDS. Available: http://www.eldis.org/vfile/upload/1/document/0708/DOC12627.pdf Accessed: 17/11/2011

Turner, D. 2010. Orally-based information. *Journal of Documentation*. 66:3:370-383.

Umali-Deininger, D. and Schwartz, L.A. 1994. *Public and Private Agricultural Extension: beyond traditional frontiers.* Washington, D.C.: World Bank Publications.

Umrani, R. and Jain, C.K. 2010. *Agricultural extension: worldwide innovations.* Jaipur: Oxford Book Company.

Van den Ban, A. W. and Hawkins, H.S. 1996. *Agricultural extension*. 2nd ed. Oxford: Blackwell.

Vickery, B.C. and Vickery, A. 1992. *Information science in theory and practice*. 2nd ed. East Grinstead (West Sussex): Bowker-Saur.

Warren, D.M. 1991. *Using indigenous knowledge in agricultural development*. World Bank Discussion Paper No. 127. Washington, D.C.: The World Bank.

Wejnert, B. 2002. Integrating models of diffusion of innovations: a conceptual framework. *Annual Review of Sociology.* 28: 297-326.

Welman, J.C., Kruger, F. and Mitchell, B. 2005. *Research methodology*. 3rd ed. Oxford: Oxford University Press.

Wennink, B. and Heemskerk, W. (Eds). 2006. *Farmers' organisations and agricultural innovation: case studies from Benin, Rwanda and Tanzania.* Amsterdam: Royal Tropical Institute (KIT).

Wesseller, G. and Brinkman, W. 2003. Bridging information gaps between farmers, policymakers, researchers and development agents. Paper presented at the regional conference on *Agroforestry impacts on livelihoods in Southern Africa:*

*Putting research into practice A*ventura Warmbaths, South Africa, 20–24 May 2002. Wagingen: CTA.

Willis, J.W. 2000. *Foundations of qualitative research: interpretive and critical approaches.* Thousand Oaks: Sage.

Wilson, T.D. 1997. Information behaviour: an interdisciplinary perspective. *Information Processing and Management,* 33:4:551-572.

Wilson, T.D. 1999. Models in information behaviour research. *Journal of Documentation.* 55:3:249-270.

Wilson, T.D. 2006. On user studies and information needs. *Journal of Documentation.* 62:6:658-670.

Women's University in Africa. 2010. *About us*. Available: http://www.wua.ac.zw/ Accessed: 29/06/2010.

World Bank. 2007. *World Bank Assistance to Agriculture in Sub-Saharan Africa: an IEG Review.* Washington DC: The World Bank.

World Bank. 2008. *World Development report 2008: agriculture for development*. Washington DC: The World Bank.

Yin, R.K. 1994. *Case study research: design and methods*. London: Sage

Yoon, K. and Nilan, M.S. 1999. Toward a reconceptualisation of information seeking research: focus on the exchange of meaning. *Information Processing & Management* 35:871-890.

Zaborowski, B.A. 2008. Identifying the information-seeking behaviours of students, the expectations of faculty, and the role of librarians in writing assignments that require students to use information sources in selected Pennsylvania Community colleges: a model for instruction. Ph.D. Thesis (Unpublished). University of Pittsburgh. Available: http://www.pittsburgh.edu

Zikmund, W.G. 2003. *Business research methods*. 7th ed. Mason (Ohio): South-Western.

The Zimbabwe Mail .17 January 2012. US$30 million worth of 'Presidential Input Scheme' looted. Available: http://www.thezimbabwemail.com/zimbabwe/10221-us-30-million-presidential-input-scheme-looted.html Accessed: 19/01/2012

The Zimbabwe Mail. 19 January 2012. Dishonest farmers cost the agricultural sector. Available: http://www.thezimbabwemail.com/zimbabwe/10254-dishonest-farmers-cost-agric-sector.html Accessed: 19/01/2012

The Zimbabwean. Monday, 25 July 2011. Slow recovery for tobacco harvest. Available: http://www.thezimbabwean.co.uk/business/agriculture/51186/slow-recovery-for-tobacco-harvest.html Accessed: 22/01/2012

The Zimbabwean. Wednesday, 5 October 2011. "*99 leases can be cancelled: Government*". Available: http://www.thezimbabwean.co.uk/news/zimbabwe/53418/99-year-leases-can-be.html Accessed: 19/01/2012.

Zumbika, N. 2006. *Agricultural finance: 1990-2004*. In: Rukuni, M., Tawonezvi, P., Eicher, C., Munyuki-Hungwe, M., Matondi, P. Eds. Zimbabwe's agricultural revolution revisited. Harare: University of Zimbabwe Publications. pp. 339-354.

APPENDICES

Appendix A: Questionnaire for researchers and extension workers

Most questions require you to tick the answers as they apply to you. A few questions will need you to fill in short answers.

SECTION ONE: PERSONAL INFORMATION

1. Indicate your location by name:

Province: ....

District: ....

Ward (Extension workers only): ....

Research Institute: ....

Head Office: ....

Other, please specify: ....

2 Indicate your:

a. Department: AGRITEX [ ] DR&SS [ ]

b. Division/ Section: ....

3. Please indicate your occupation

Agricultural extension worker: [ ]

Agricultural researcher: [ ]

4. Position/ Designation:

Director [ ]

Deputy Director [ ]

Chief Agricultural Specialist [ ]

Agricultural Specialist/ Snr/ Principal [ ]

Provincial AGRITEX Officer [ ]

AGRITEX Specialist/ Snr/ Principal [ ]

District Agricultural Extension Officer [ ]

AGRITEX Officer/ Snr/ Principal [ ]

AGRIC Extension Supervisor [ ]

AGRIC Extension Worker [ ]

Other, specify: ....

5. For how many years you have worked as a researcher or extension worker?

1 - 5 [ ] 6-10 [ ] 11-15 [ ] 16 -20 [ ] 21-25 [ ] 26 years and above [ ]

6. Indicate number of years in current position:

1 - 5 [ ] 6-10 [ ] 11-15 [ ] 16 -20 [ ] 21-25 [ ] 26 years and above [ ]

7. Indicate your highest qualification:

Certificate [ ] Diploma [ ] Bachelor's degree [ ]

Post-graduate diploma [ ] Master's degree [ ] DPhil/PhD [ ]

8. Age: 20 – 29 [ ] 30 – 39 [ ] 40 – 49 [ ] 50 years and above [ ]

9. Gender: Male [ ] Female [ ]

SECTION TWO INFORMATION NEEDS AND INFORMATION SEEKING

Part A. <u>Information requirements and type:</u>

10. What type of information do you require as an extension or research worker? (Select all options applicable to you)

Soil fertility	[ ]	Horticulture	[ ]
Soil classification	[ ]	Agricultural economics	[ ]
Irrigation and drainage	[ ]	New seed varieties	[ ]
Plant breeding	[ ]	Poultry	[ ]
Plant pathology	[ ]	Dairy farming	[ ]
Plant diseases and pest	[ ]	Post-harvest technology	[ ]
Animal health	[ ]	Tobacco culture	[ ]
Animal breeding	[ ]	Agroforestry	[ ]
Agronomy	[ ]	Range management	[ ]
Crop protection	[ ]	Agricultural engineering	[ ]
Farm mechanisation	[ ]	Climate change	[ ]
Policy developments	[ ]	Advisory information	[ ]

Other, specify: ....

11. For what purposes do you seek the above information? (Select all options applicable to you)

To conduct research [ ]

General awareness [ ]

When assisting extension workers [ ]

When assisting researchers [ ]

When assisting farmers [ ]

Other, specify: ....

12. When in need of information, who do you consult first?

Library [ ] Internet [ ] Colleagues [ ] Personal collection [ ] Departmental collection [ ]

Other, please specify: ....

13. When in need of information, which sources do you consult first?

Print sources [ ] Electronic sources [ ]

14. How important are the following sources of information in keeping up-to-date with scientific developments in agricultural research and extension (your related field)?

Scale: 1= very important 2 = important; 3 = not important

Information Source	**Relative importance**
Journal articles	
Review articles	
Conference abstracts and proceedings	
Books	
Professional meetings/ workshops	
Sources of contents (content pages)	
Indexing and abstracting journals	
Research reports/ patents	
Technical reports	
Fact sheets	
Pamphlets/ leaflets	
Internet sources	
Theses and dissertations	
Newsletters	
Library catalogue	
Face-to-face conversations/ discussions with colleagues	
Email/ list serve/ discussion forums	
Librarian/ library staff	
Consult knowledgeable person in the field/ supervisor	

15. How often do you consult the following information sources? (Use scale below)

Scale: 1= Very often 2= Often 3= Sometimes 4= Never

Information Source	**Frequency of access**
Journal articles	
Review articles	
Conference abstracts and proceedings	
Books	
Professional meetings/ workshops	
Sources of contents (content pages)	
Indexing and abstracting journals	
Research reports/ patents	
Technical reports	
Fact sheets	
Pamphlets/ leaflets	
Internet sources	
Theses and dissertations	
Newsletters	
Library catalogue	
Face-to-face conversations/ discussions with colleagues	
Email/ list serve/ discussion forums	
Librarian/ library staff	
Consult knowledgeable person in the field/ supervisor	

16. How do you become aware of other less recent books and journal articles? (Select all options applicable to you)

Citations at end of journal articles [ ]

Citations at end of book chapters [ ]

Browsing through older volumes [ ]

From the librarian/ library staff [ ]

Other, specify: ....

17. List at least two (2) journal titles that you are familiar with in your area of work

i. ....

ii. ....

18. Women constitute the majority of rural farmers. Do you feel that their information needs are adequately addressed in the current research and extension setup?

Yes [ ] No [ ]

19. If No, how can this anomaly be addressed?

....

Part B: <u>Interaction between researchers and extension workers</u>

(Questions 20-21 to be answered by agricultural researchers only)

20. How often do you interact with agricultural extension officers?

Weekly [ ] Monthly [ ] Quarterly [ ] Never [ ]

21. What nature of problems do you usually communicate with extension personnel? (For what purposes?)

....

(Questions 22-23 to be answered by agricultural extension workers only)

22. How often do you interact with agricultural researchers?

Weekly [ ] Monthly [ ] Quarterly [ ] Never [ ]

23. What nature of problems do you usually communicate with agricultural researchers? (For what purposes?)

....

24. Are you satisfied with the level of communication between researchers and extension workers with regards to the dissemination of agricultural information and technologies?

Yes [ ] No [ ]

25. If No, indicate why

....

26. What suggestions would you provide to improve this linkage?

....

Part C: <u>Impact of land reform programme on agricultural research and extension</u>

27. Do you feel that the land reform programme has changed the way you conduct your work as a researcher/ extension worker?

Yes [ ] No [ ]

28. If yes, indicate how

....

29. What are the information challenges posed by the land reform programme? (List)

....

30. What information needs do you feel that farmers need to adequately address their challenges? (*Select all options applicable to you*)

Soil fertility	[ ]	Horticulture	[ ]
Soil classification	[ ]	Agricultural economics	[ ]

Irrigation and drainage	[ ]	New seed varieties	[ ]
Plant breeding	[ ]	Poultry	[ ]
Plant pathology	[ ]	Dairy farming	[ ]
Plant diseases and pest	[ ]	Post-harvest technology	[ ]
Animal health	[ ]	Tobacco culture	[ ]
Animal breeding	[ ]	Agroforestry	[ ]
Agronomy	[ ]	Range management	[ ]
Crop protection	[ ]	Agricultural engineering	[ ]
Farm mechanisation	[ ]	Herbicides application	[ ]
Climate and weather conditions	[ ]	Early warning reports	[ ]
Market information (of harvested crops) [ ]			
Advisory information	[ ]	Policy developments	[ ]

Other, specify: ....

31. In your view, do the information needs of farmers follow a particular pattern of the farming seasons?
Yes [ ] No [ ]

32. If Yes, when is information most sought?

During land preparation period	[ ]
During the planting period	[ ]
During the harvesting period	[ ]
During the post-harvesting (marketing and storage)	[ ]

Other, specify: ....

Part D: <u>Communicating agricultural information to farmers</u>

33. Which methods do you use to communicate agricultural information to farmers? (*Select all options applicable to you*)

33.1 Media:

Radio [ ] Television [ ] Video Units [ ] Newspapers

Other specify: ....

33.2 Organisation-based:

Publications (e.g. pamphlets, posters) [ ] Internet based (e.g. email) [ ] Community

Radio [ ]

Other, specify: ....

33.3. Public gatherings:

Agricultural shows [ ] Field days [ ] Community meetings [ ]

Farmers' organisations' meetings [ ]

Other, please specify: ....

34. How often do you use the mass media (television, radio, newspapers) to communicate agricultural information to farmers?

Very often [ ] Often [ ] Sometimes [ ] Never [ ]

35. If you utilise the media and publications above, please indicate the radio, television programmes and publications which you use.

....

36. How often do you visit farmers in their fields?

Very often [ ] Often [ ] Sometimes [ ] Never [ ]

37. What factors affect your visits to the farmers?

Transport (Mobility) [ ] Poor road network [ ] Time [ ]

Other, specify: ....

38. In what language is most of the material written in?

English [ ] Vernacular [ ]

39. Do you translate material into other minority languages?

Yes [ ] No [ ]

Part E: <u>Library collection and services</u>

40. Do you have access to a library or information resource centre/ information kiosk in your work environment or community? Yes [ ] No [ ]

41. If Yes, how often do you visit the library?

Daily [ ] Weekly [ ] Fortnightly [ ] Monthly [ ] Never [ ]

42. If No, how do you access information?

....

43. What type of materials do you seek from your library?

Books [ ] Journals [ ] Newspapers [ ] Government publications [ ]

Reference Books [ ] Patents [ ]

Other, specify: ....

44. How often do you request for assistance for information gathering from library staff?

Very often [ ] Often [ ] Sometimes [ ] Never [ ]

45. Do you always find the information you are looking for from the library?

Yes [ ] No [ ]

46. Does your library request material for you from other libraries?

Yes [ ] No [ ]

47. Do you consult other libraries other than your organisational/ institutional library?

Yes [ ] No [ ]

48. If Yes, indicate which ones:

....

49. How would you rate your library or information centre, in terms of its collection of books, journals and services offered?

Very good [ ] Good [ ] Fair [ ] Poor [ ]

SECTION THREE ICT ACCESS AND UTILISATION

50. Do you have access to a computer in the office? Yes [ ] No [ ]

51. If yes, state the functions you use it for.

Word processing [ ] Spread sheet (Excel) [ ] Storing documents [ ] Internet access [ ]

Other, specify: ....

52. How would you rate your ICT skills/ competencies?

Very good [ ] Good [ ] Fair [ ] Poor [ ]

53. What other ICT resources do you have access to in the office/ organisation? (*Select all options applicable to you*)

ICT RESOURCES AND SERVICES	AVAILABILITY	
	YES	NO
Computers		
Printers		
Telephone		
Fax		
Television		
Radio		

Mobile/Cell phone		
Video recorder		
Internet		
E-mail		
Electronic journals (Online)		
CD-ROM Databases (e.g. TEEAL Database)		
Storage/Server		
Information management		

Other, please specify: ....

54. For what purposes do you use the above ICT resources and services? (*Select all options applicable to you*)

To communicate with agricultural extension workers [ ]

To communicate with agricultural researchers [ ]

To communicate with farmers [ ]

Professional communication with colleagues [ ]

Personal communication with friends, etc [ ]

To disseminate agricultural information [ ]

For purposes of research [ ]

For educational purposes [ ]

To communicate with publishers [ ]

55. Which ICT resources and services do you find efficient in disseminating/ communicating agricultural information?

ICT RESOURCES AND SERVICES	Very effective	Effective	Less effective	Not effective
Computers				
Printers				
Telephone				
Fax				
Television				
Radio				
Mobile phone/ cell phone				
Video recorder				
Internet				
E-mail				
Electronic journals (Online)				
CD-ROM Databases (e.g. TEEAL Database)				
Storage/ server				
Information management				

56. How often do you use mobile phones/ cell phones in communicating agricultural information?

Quite often [ ]   Often [ ]   Sometimes [ ]   Never [ ]

57. With whom do you communicate agricultural information using mobile phones/ cell phones? (*Select all options applicable to you*)

Farmers [ ]

Extension workers [ ]

Researchers [ ]

Colleagues [ ]

*Agribusiness companies [ ]

*(seed, fertiliser, equipment manufacturers, etc)

Other, specify: ....

58. How would you rate the ICT infrastructure of your office/ department?

Very good [ ]   Good [ ]   Poor [ ]

59. Which ICTs and services would you require to improve your job performance?

Computer (Desktop) [ ]   Laptop [ ]   Printer [ ]   Internet [ ]   E-mail [ ]

Access to databases [ ]

Other, specify: ....

<u>ICTs and Information management</u>

60. How does your division/ department manage information generated from research and extension services?

Copies are kept in the library [ ]

Records are kept in a central database [ ]

Copies are retained by individual researchers/ extension workers [ ]

Copies are sent to the Research Council of Zimbabwe [ ]

Copies are kept in departmental collections [ ]

Other, specify: ....

61. Is this information readily accessible to users, from within and outside the division/ department?
Yes [ ]   No [ ]

62. Would you say that all the information generated by divisions and departments is captured by DR&SS or AGRITEX?   Yes [ ]   No [ ]

63. If No, what suggestions would you propose to improve the management of information generated by the departments/ divisions?

....

SECTION FOUR: INDIGENOUS KNOWLEDGE[9] SYSTEMS IN AGRICULTURAL RESEARCH AND EXTENSION

64. Do you utilise indigenous knowledge in the generation of agricultural information/ innovations?
Yes [ ] No [ ]

65 How often do you utilise indigenous agricultural knowledge?

Very often [ ] Often [ ] Sometimes [ ] Never [ ]

66. What are your sources of indigenous agricultural knowledge?

Personal experience	[ ]	Books	[ ]
Social gatherings	[ ]	Conferences/ workshops	[ ]
Village leaders/ elders	[ ]	Agricultural shows	[ ]
Village meetings	[ ]	Farmers' groups	[ ]
Demonstration and observation	[ ]	Colleagues	[ ]

Other, specify: ....

67. What type of indigenous agricultural knowledge do you obtain from the sources above?

Soil fertility	[ ]	Horticulture	[ ]
Soil classification	[ ]		
Plant breeding	[ ]	Poultry	[ ]
Plant pathology	[ ]	Dairy farming	[ ]
Plant diseases and pest	[ ]	Crop protection	[ ]
Animal health	[ ]	Tobacco culture	[ ]
Animal breeding	[ ]	Weather patterns	[ ]
Crop harvesting and storage	[ ]	Crop varieties	[ ]

Other, specify: ....

SECTION FIVE: RESEARCH AND EXTENSION COLLABORATION

68. Do you collaborate with private research and extension organisations nationally?

---

[9] *Indigenous knowledge is defined here as knowledge and skills that people in a particular geographic area possess and which enables them to get the most out of their environment*

Yes [ ] No [ ]

69. If Yes, indicate areas of collaboration.

Staff exchange programmes	[ ]	Research publications	[ ]
Research facilities	[ ]	Research results	[ ]
Joint research projects	[ ]	Funding	[ ]
Extension projects	[ ]	Extension publications	[ ]
Zonal/ geographic distribution of projects	[ ]	Training	[ ]
Technical advice	[ ]		

Other, please specify: ....

70. Do you collaborate with research and extension organisations internationally?

Yes [ ] No [ ]

71. If Yes, indicate areas of collaboration.

Staff exchange programmes	[ ]	Research publications	[ ]
Research facilities	[ ]	Research results	[ ]
Joint research projects	[ ]	Funding	[ ]
Extension projects	[ ]	Extension publications	[ ]
Training	[ ]	Technical advice	[ ]

Other, specify: ....

72. Do you liaise with farmers' organisations locally?

Yes [ ] No [ ]

73. What would you say is the role played by farmers' organisations in the research and extension processes?

Provide farmers with information on inputs	[ ]
Provide farmers with information on markets	[ ]
Provide legal advice to farmers	[ ]
Participatory research (on-farm trials)	[ ]
Re-packaging information for farmers	[ ]
Funding research and extension programmes	[ ]

Other, specify: ....

SECTION SIX: KNOWLEDGE GAPS, CONSTRAINTS AND RECOMMENDATIONS

You may use additional paper to answer the following questions

74. What would you say are the factors that inhibit access to information and literature on agricultural research and extension?

....

75. What would you say are the major constraints facing agricultural research and extension in Zimbabwe?

....

76. What is your opinion on charging farmers for research and extension services? (Fee-for-extension service)

....

77. What recommendations would you propose to improve the communication of agricultural research and extension information in Zimbabwe?

....

Thank you for taking time to complete the questionnaire.

Appendix B: Interview Schedule for Key Informants (Policy Makers)

Date: ....

1. Background information

i. Division: ....

ii. Department: ....

iii. Name of official: ....

iv. Designation: ....

2. Could you please highlight your division's major responsibilities and in what ways it is contributing to the national agricultural system?

3. Agricultural research organisations have to adapt themselves continuously to changing demands for new agricultural technology and knowledge. How would you say that current research/ extension systems are responding to this? (Enhanced production and productivity: primary goals for most African research, food security, incomes, pressure on land, HIV-Aids)

4. What changes (if any) can be identified in terms of research technologies, methodologies, and approaches in the last ten year period?

5. Do you feel that the Central Library and other information services are adequately equipped to support the needs of researchers, extension workers and other stakeholders in the Ministry?

6. What type of information is generated by researchers and extension workers?

7. What policies are in place for managing information generated by the DR&SS and AGRITEX?

8. How is information generated by the research system disseminated to the extension system, and how is this reciprocated?

9. Are you satisfied with the level of communication between researchers and extension workers with regards to the dissemination of agricultural information and technologies?

10 What type of information is requested the most by farmers and what methods are used in disseminating agriculture information?

11. How are priorities for research and extension services determined?

12. Farmers are seen as seen as major beneficiaries of agricultural research/ extension. What would you say there role is?

i. In problem identification and priority setting

ii. During implementation and evaluation

13. What would you say have been the trends in financing agricultural research and extension?

14. What are your views on the issues concerning charging for research and extension services?

16. Privatisation of agricultural research/ extension has been a feature of commercial and export oriented agriculture. What are your views on privatising agricultural research and extension services?

17. To what extent do you utilise ICTs in the generation and communication of agricultural information?

18. Comment on the ICT infrastructure and whether there are plans to spread and adopt ICTs among agricultural researchers and extension workers?

19. Agricultural research/ extension organisations have to interact with a diverse number of players (involved in the generation, diffusion, and application of agricultural knowledge/ innovations). How would you say you have responded to this notion?

20. Which of these organisations are you partnering nationally and internationally and what would you say has been the major benefits/ drawbacks?

21. In which areas are you partnering with NGOs and private research and extension organisations?

22. What mechanisms has the government, through the ministry, put in place to capacitate agricultural research and extension services in order to adequately address the needs of the new farming dispensation?

23. What recommendations would you propose to improve the communication of agricultural research and extension information in Zimbabwe?

Thank you for participating in the survey.

Appendix C: Interview schedule for librarians

Date: ....

1. Background information

   i. Division: ....

   ii. Department: ....

   iii. Name of official: ....

   iv. Designation: ....

2. What are the library's opening and closing times?

3. What is the membership of library patrons/ users?

4. Does the library allow membership from non-governmental users?

5. Comment on the library's sitting, shelving and office space.

6. Which category of patrons/ users would you say frequent the library most?

7. What type of material is mostly used and in which subject areas?

8. Could you please comment on the type of materials held in the library?

   - Number of books
   - Number of journal titles
   - Research reports
   - Multimedia collection, etc.

9. How current would you say the collection is?

10. What is the library's annual budget?

11. How many titles do you add to the collection per year?

12. Does the library receive donations of books and other materials?

13. Who participates in the selection of library materials (books, journals etc)? Does the library have a Library Committee? If so, what is its membership?

14. How would you say the library supports extension workers in the MOAMID?

15. How would you say the library supports agricultural researchers in the MOAMID?

16. Does the library provide any current awareness services to users?

17. Does the library provide any user education programmes to patrons?

18. Which ICTs does the library have?

19. Are the services fully automated?

20. Does the library have Internet connection?

21. Doe the library have a webpage that gives information to remote users?

22. How many computers are there in the library and how many are available to users/ patrons?

23. Does the library subscribe to electronic resources/ journals (e.g. TEAL and Lan-TEAL)?

24. Does the library provide access to Access to Global Online Research in Agriculture (AGORA) database which is available free of charge to libraries in Zimbabwe?

25. Does the library participate in the CTA Annual Call for Support in Library Books and LAN-TEAL subscriptions?

26. Is the library aware of the INASP/ PERI initiative on subsidised access to electronic resources coordinated by ZULC through the University of Zimbabwe Library?

27. Does the library provide access to Open Source resources available on the Internet?

28. As the Central Library, what are your responsibilities with regards to other Ministry of Agriculture libraries, including those of colleges of agriculture?

29. Does the library collaborate with other libraries/ information centres nationally and internationally?

30. If Yes, state areas of collaboration.

31. What would you say are the library' strengths and challenges?

32. What recommendations would you propose in improving service delivery to library patrons?

Thank you for participating in the survey.

Appendix D: Observation guide of libraries

Purpose:

To give an assessment of the library in terms of:

A. physical location

B. size, lighting

C. shelving and sitting space

D. office space

E. library guides

F. availability of computers and other ICTs

G. collection outlook and usage (browse date stamps)

Appendix E: Letter of introduction

University of Zululand

Department of Information Studies

P. Bag X1001

KwaDlangezwa

3886

01/6/2011

Dear respondent

RE: Research Questionnaire Assistance

My name is Tinashe Mugwisi and I am a PhD student in the Department of Information Studies, University of Zululand. I am seeking your assistance in this survey. I am researching "The information needs and challenges of agricultural researchers and extension workers in Zimbabwe."

The information you supply will be treated with the strictest of confidence. Data will only be presented in the aggregate, and responses will not be attributed to individuals. Please kindly assist by completing the attached questionnaire.

Thanking you in advance.

Yours truly

Tinashe Mugwisi

Appendix F: Permission to carry out the study

13 College Road

New Alexandra Park

Harare

Ph. 744475 / 0912772417

The Permanent Secretary

Ministry of Agriculture

Ngungunyana Building

P. Bag 7701

Causeway

Dear Sir

RE: PhD Studies: Agricultural Knowledge and Information Systems (AKIS)

I write to seek permission to carry out my doctoral studies in Agricultural Knowledge and Information Systems within the Ministry of Agriculture, Government of Zimbabwe.

I have applied and been accepted by the University of Zululand, South Africa, on the basis of my proposed topic:

"An investigation into the information needs of agricultural researchers and extension workers in Zimbabwe"

As a contribution to the on-going agrarian reform, this study will help identify the information needs and constraints faced by farmers, in particular, the newly resettled ones, as observed by the agricultural extension officers. It will also highlight constraints faced by DR&SS and AGRITEX officials and agricultural researchers in the dissemination of agricultural information.

I have attached a copy of my CV with this application.

Thanking you in advance.

Yours truly,

Tinashe Mugwisi

13 College Road

New Alexandra Park

Harare

Ph. 744475 / 0912772417

The Permanent Secretary

Ministry of Agriculture

Ngungunyana Building

P. Bag 7701

Causeway

Harare

Attention: Dr N.R. Gata

Dear Madam

RE: PhD Studies: Agricultural Knowledge and Information Systems (AKIS)

I write to submit a draft copy of my doctoral research proposal on the above subject. The delay was caused by unforeseen circumstances.

As we had discussed earlier, I hope that my recommendation and support letter have since been submitted to you by the University of Zululand. Please find attached a draft copy of my research proposal, and my initial application for permission to carry out the study sent to the Permanent Secretary.

Thanking you in advance.

Yours truly,

Tinashe Mugwisi

AGRITEX Letter

All correspondence should be addressed to the Director
Department of Agricultural Technical and Extension Services

AGRITEX

MINISTRY OF AGRICULTURE, MECHANISATION AND IRRIGATION DEVELOPMENT

Head office
No. 1 Borrowdale road
Ngungunyana bldng

P.O. Box CY 2505, Harare, Zimbabwe Tel & Fax: (+263) 04-790319

Harare

Ref:

DEPARTMENT OF AGRITEX
2011 -02 02
P.O. BOX CY 2505, CAUSEWAY
ZIMBABWE TEL. 791365/6

02 February 2011

All Provincial Agricultural Extension Officers
All District Agricultural Extension Officers
All Heads of Branches

Re: RESEARCH IN INFORMATION NEEDS AND CHALLENGES AS IT RELATES TO PROVIDES OF RESEARCH AND EXTENSION SERVICES.

This serves to advice you that Mr Tinashe Mugwisi (a PhD student with University of Zululand) is currently working on a study on Research and Information Needs as it relates to Departments of Research and Extension. This study will feed into the SADC Study on Information Needs and Challenges. Eventually this information will be used by Research and Extension Departments in the SADC countries.

Mr Mugwisi will be approaching your offices seeking information related to the study. May you please support this initiative by availing whatever information he may require.

J. Gondo
Principal Director
AGRITEX

/lm

DR&SS Letter

MINISTRY OF AGRICULTURE, MECHANISATION AND IRRIGATION DEVELOPMENT

All Communications to be addressed to
"THE PRINCIPAL DIRECTOR"

Telephone: 263-04-797406
E-mail address:
Fax: 263-04-734646

DEPARTMENT OF RESEARCH AND SPECIALIST SERVICES (DR&SS)

Fifth Street Extension
P O Box CY 594, Causeway
Harare, Zimbabwe

Ref:

30 June 2011

All Heads of Institutes/Branch Heads

All Research Officers

Re: RESEARCH IN INFORMATION NEEDS AND CHALLENGES AS IT RELATES TO PROVIDES OF RESEARCH AND EXTENSION SERVICES.

This serves to advise you that Mr. Tinashe Mugwisi (a PhD student with University of Zululand) is currently working on a study on Research and Information Needs as it relates to Department of Research and Extension. This study will feed into the SADC Study on Information Needs and Challenges. Eventually this information will be used by Research and Extension Departments in the SADC countries.

Mr. Mugwisi will be approaching your offices seeking information related to the study. May you please support this initiative by availing whatever information he may require.

for J. L. N. Sikosana (Mr.)

Acting Principal Director.
<u>Department of Research and Specialist Services</u>

Appendix G: Work plan

Item	Activity	Timeline												
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
1	Registration													2010
2	Development of RP													2010
3	Submission & Approval of RP													2010
4	Devt, submission and correction of Chpt 1: Introduction and background to the study													2010
5	Development & delivery of Chpt 2: Agriculture in Zimbabwe: contextual setting													2010
6	Development and submission of Chpt 3: Conceptualising information, information needs, information seeking and information use													2010
6	Development and submission of Chpt 4: Diffusion of Innovation theory													2010
7	Development and delivery of Chpt 5: Perspectives on agricultural knowledge and information systems (AKIS)													2011
8	Development, correction & submission of Chpt 6: Research methodology													
9	Compilation of instruments for field research													2011
10	Field research													2011
11	Development, correction and submission of Chpt 7: Data analysis and presentation													2011
13	Development, correction and submission of Chpt 8: Discussion of findings													2011
14	Development, correction and submission of Chpt 9: Summary, recommendations & Conclusion													2011
15	Submission & correction of draft dissertation													2012
16	Submission of final dissertation for examination													2012
17	Examination of dissertation													2012
18	Corrections based on examiner's report													2012
19	Submission of final bound dissertation to examination section													2012
20	Graduation													2013