COMPARATIVE STUDY OF PERI-URBAN AND RURAL AGRICULTURAL KNOWLEDGE MANAGEMENT: A CASE STUDY OF SMALLHOLDER HORTICULTURAL PRODUCERS IN DAGORETTI AND MBOONI DISTRICTS, KENYA

DORINE ADHIAMBO ODONGO (A56/65560/2010)

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR MASTER OF SCIENCE DEGREE IN AGRICULTURAL INFORMATION COMMUNICATION AND MANAGEMENT OF THE UNIVERSITY OF NAIROBI

Department of agricultural economics

Faculty of agriculture

University of Nairobi

May, 2013

Declaration

I hereby declare that this thesis is my original work and has not been presented for any degree at any other university.

Signed:…………………………………Date: ……………………………………………..

Dorine Adhiambo Odongo, A56/65560/2010

This thesis has been submitted for examination with the approval of the following as university supervisors

Signed:…………………………………Date: ……………………………………………..

Dr. Fred Mugivane

Department of Agricultural Economics

University of Nairobi

Signed: …………………………………Date: ……………………………………………..

Prof. Florence Olubayo

Department of Plant Science and Crop Protection

University of Nairobi

Acknowledgement

me going. I am grateful for my son Joe for his support albeit unknowingly, he has always given me a reason to work harder.

Lastly but not least, I thank the almighty God for His care, protection and provision.

Dedication

I dedicate this thesis to my son Joe Bolo Ochieng.

Table of Contents

List of Tables

List of Figures

List of Acronyms and Abbreviations

AgGDP- Agricultural Gross domestic Product

ASDS-Agricultural Sector Development Strategy

EPZA- Export Processing Zones Authority

FAO-Food and Agriculture Organisation

FARA-Forum for Agricultural Research in Africa

FBO-Faith Based Organisation

FGDs-Focused Group Discussions

GDP-Gross Domestic Product

GoK-Government of Kenya

HCDA- Horticultural Crops Development Authority

HDC-Horticultural Development Council

ICT-Information and Communication Technologies

IM-Information management

KARI-Kenya Agricultural Research Institute

KDLC- Kenya Development Learning Centre

KHCP-Kenya Horticulture Competitiveness Project

KM-Knowledge management

MoA- Ministry of Agriculture

NAEP-National Agriculture Extension Policy

NALEP-National Agriculture and Livestock Extension Program

NASEP-National Agricultural Sector Extension Policy

NGO-Non-governmental Organisation

SRA-Strategy for Revitalization of Agriculture

UPA- Urban and peri-urban Agriculture

UPAL-Urban and peri-urban Agriculture and Livestock

USAID-United States Agency for International Development

Abstract

Farmers continuously acquire and gather new knowledge to keep with the emerging trends and technologies in the sector to realise increased outputs, and they also store and share this knowledge. This study investigated these processes in the smallholder farmer set up and extent of ICT usage for these processes and compared the peri-urban and rural settings in Kenya. A semi-structured questionnaire was administered to a sample of 200 smallholder farmers obtained using the simple random technique in Dagoretti and Mbooni districts. Two focus group discussions were held in each district comprising between 10 to 20 farmers each. 16 extension agents were interviewed in both settings. Data was subjected to analysis using the IBM-SPSS software version20 to obtain descriptive and inferential statistics, statistical significance set at 5%. There are eight main sources of knowledge for the farmers in both settings; there is a significant difference in percentage of farmers using each of these sources, as influenced by the specific information needs. These sources include government extension agents, NGO extension agents, farmer associations, input suppliers, private commercial companies, neighbours, farmer magazines and tacit knowledge. The main approaches used by extension agents for knowledge dissemination include face to face interaction and mobile phones. ICT usage for knowledge management differs significantly in Dagoretti and Mbooni for specific ICT types including radio, mobile phones, television and internet. Radio is the ICT type used by most farmers in both settings to acquire agricultural knowledge, while Television and internet use are more popular in the peri-urban setting than in the rural setting. A significant percentage of farmers cite inconsistency and inconvenient timing of programmes as one of the reasons hindering their access to the radio programmes. Use of mobile phones for knowledge acquisition is still low despite the development of mobile based technologies which enable knowledge acquisition, due to lack of information about the technologies. Setting, based on types of crops grown, information needs and infra-structure

are important factors which influence use of ICT for knowledge management among the small holder farmers. Despite the increased use of mobile phones across Kenya, the results reveal that farmers in Mbooni and Dagoretti districts mostly use their mobile phones just for sharing purposes as opposed to acquisition of advisory services. There is need to create more awareness and training in ICT use, to enable successful adoption and use of the technologies.

Key words: Knowledge management, Information and communication Technologies, horticultural smallholders

CHAPTER ONE

INTRODUCTION

1.1 Agricultural production in Kenya

The agricultural sector in Kenya comprises six subsectors which include industrial crops, food crops, horticulture, livestock, fisheries and forestry. The agricultural sector development strategy (ASDS 2010-2020) records that Kenya's agriculture is largely small-scale farming, with farm sizes averaging between 0.2 and 3ha. The small-scale production accounts for 75% of total agricultural output and 70% of marketed agricultural produce (Government of Kenya; GoK, 2010). Agriculture is the mainstay of the Kenyan economy and currently represents 24 per cent of the Gross Domestic Product (GDP). More than one-third of Kenya's agricultural produce is exported, and this accounts for 65 per cent of Kenya's total exports. The agricultural sector accounts for 18 per cent of total formal employment in the country (GoK, 2005).The ASDS 2010-2020 records that there are more than 5 million smallholder farmers engaged in different types of agricultural activities in the country.

Despite the central role agriculture plays in the Kenyan economy, the sector continues to face challenges which include delivery of extension services. Access to extension services plays a vital role in sharing knowledge, technologies, agricultural information and linking the farmer to other actors in the economy. According to the national development blue-print (Kenya vision 2030), the current national average is one agricultural extension officer per 1,093 farm households (GoK, 2005). Due to this challenge, evidently government extension is no longer an adequate way of getting the agricultural knowledge to the famers. The government of Kenya through the Ministry of Agriculture has embarked on an effort to promote a pluralistic

system of extension as described by the new policy on extension[1]. This system advocates for collaboration between government and non-government agencies as well as other private players, in the provision of extension services to the farmers. The district agricultural reports indicate the existence of other stakeholders involved in extension services and these include NGOs, seed companies, farmer associations, and other private companies.

According to the Strategy for Revitalization of Agriculture (SRA), GoK, 2004, the government policy is to move farmers from subsistence to commercial agriculture. This position has also been emphasised in ASDS, 2010-2020. However, many small scale farmers in Kenya continue to depend on subsistence farming systems characterized by low levels of productivity. This is despite continuous efforts of research, extension and development programmes to promote the generation and use of new knowledge in agricultural production and value addition. Numerous studies have been carried out in Kenya, evident from the number of agricultural research institutions operating in the country. Some of these institutions such as the Kenya Agricultural Research Institution (KARI) have the national mandate to carry out agricultural research in the country. The SRA (2004) accounts that there are 28 agencies that engage in agricultural research which fall under different categories and may be grouped as captured in table 1 below:

---

[1] The National Agricultural Sector Extension policy (NASEP) is among the key reforms in the ministry and aims at giving Extension a sector-wide dimension and representation. Its purpose is to guide and regulate the provision of agricultural extension service in the country. NASEP implementation framework is at its final stage of development.

Table 1: Organisations engaged in agricultural research in Kenya

Public-funded institutions	Commodity-funded institutions	International research institutions
Kenya Agricultural Research Institute (KARI) Kenya Forestry Research Institute (KEFRI)	Coffee Research Foundation (CRF)	International Centre for Insect Physiology and Ecology (ICIPE)
Kenya Marine and Fisheries Research (KEMFRI)	Tea Research Foundation (TRF)	International Livestock Research Institute (ILRI)
The University of Nairobi	Kenya Sugar Research Foundation (KESREF)	International Centre for Research in Agro-Forestry (ICRAF)
Egerton University,		International Maize and Wheat Improvement Center (CIMMYT)
Jomo Kenyatta University of Agriculture and Technology		

(Source: SRA, 2004)

Urban and Peri-urban agriculture has equally gained popularity in Kenya over the recent past, with the Government of Kenya embarking on a project to improve the growth and productivity of the Urban and Peri-urban Agriculture and Livestock Sector (GoK, 2010). In the year 2010, a draft national policy on Urban and Peri-urban agriculture and Livestock (UPAL) was introduced (GoK, 2010); this document outlines the policy interventions to address constraints in the sector, and improve its growth. According to the Food and Agriculture Organisation (FAO, 2012), urban and peri urban agriculture (UPA) contributes to food availability, particularly of fresh produce, provides employment and income and can contribute to the food security and nutrition of urban dwellers. (Olima 2010) argues that there is general recognition of the importance or urban and peri-urban agriculture in most countries

in Eastern and Southern African region. However, there are some constraints that face UPA including; limited access to agricultural inputs and post production services; and inadequate technical knowledge of urban agricultural practices

1.2: Horticultural Production in Kenya

Horticulture is a branch of agriculture which deals with aspects of production and utilisation of fruits, flowers and vegetables. The Kenyan Government has identified horticulture as a major sub-sector in realizing the country's "Vision 2030" which envisages Kenya as middle income earner economy and semi-industrialized country (GoK, 2005). This reveals the importance of the horticultural sector to the Kenyan economy and thus the need to focus knowledge management among small holder farmers in the sector. Small-holder families constitute more than half of the national population but despite their substantial and increasing contribution to the national food supply and to agricultural GDP, these small-holder families nonetheless constitute more than half of the nation's totals of hungry and poor (Singh *et al.*, 2002). A report by the Kenya Development Learning Centre (KDLC) 2002 reveals that up to 80% of horticultural production in Kenya is under taken by smallholder farmers.

Horticulture is the most vibrant subsector in Kenya's agricultural sector and contributes immensely to the socio-economic development of the country. The horticulture industry in Kenya is based on both a domestic market with production nationwide and an export market, based largely in Eastern and Central Provinces (Adekunlle *et al.,* 2012). The ASDS records that horticulture is the largest subsector contributing 33% of the Agricultural Gross Domestic Product (AgGDP) and 38% of export earnings. The importance of horticulture in Kenya is equally emphasised by the Horticultural Crops Development Authority (HCDA) through its

annual report (HCDA, 2010) which records that the Horticultural sub sector is the fastest growing industry within the agricultural sector, recording an average growth of 15% to 20% per annum. It contributes positively to wealth creation, poverty alleviation, and gender equity especially in the rural areas.

The industry contributes to the Kenyan economy through generation of income, creation of employment opportunities for rural people and foreign exchange earnings, in addition to providing raw materials to the agro processing industry. The sub sector employs approximately 4.5 million people countrywide directly in production, processing, and marketing, while another 3.5 million people benefit indirectly through trade and other activities. According to a report by the Export Processing Zones Authority (EPZA, 2005), the horticulture sub-sector of agriculture in Kenya has grown in the last decade to become a major foreign exchange earner, employer and contributor to food needs in the country and is ranked third in terms of foreign exchange earnings from export after tourism and tea.

Horticulture in Kenya is mainly rain fed though a number of farms, especially the ones growing horticultural crops for export, also use irrigation. As stipulated in the 2010 Horticulture Validated Report (HCDA, 2010), the sub-sector is characterised by a tremendous diversity in terms of farm sizes, variety of produce, and geographical area of production. Farm sizes range from large-scale estates with substantial investments in irrigation and high level use of inputs, hired labour and skilled management to small-scale farms, usually under one acre.

1.3: Why Agricultural knowledge management?

According to the Kenya Vision 2030 (GoK, 2005), Kenya intends to become a knowledge-led economy wherein, the creation, adaptation and use of knowledge will be among the most critical factors for rapid economic growth. This can only be achieved if knowledge

management is embraced in both the formal and informal sectors. Some scholars (World Bank, 2011) describe the creation and passing of information between the various actors along the agricultural value chain as knowledge brokering, a concept which they argue to be critical to innovation and increased productivity. Hartwich *et al.,* (2007) view knowledge management in agriculture as an aspect concerned with knowledge exchange and sharing. They further argue that lack of exchange of knowledge among and between farmers, and those who produce farm-relevant knowledge is the key issue in pro-poor agricultural development. The ASDS 2010-2020 lists various opportunities and advantages which can be exploited to build a robust and dynamic agricultural sector (GoK, 2010) including human resources. Knowledge as is discussed in this study is embedded in systems and is also embodied in persons. This is evidence that there is availability of knowledge in the Kenyan agricultural sector. Sustainable agriculture is knowledge intensive and Juma (2011) articulates that for this to happen, key functions like extension and commercialisation including research and teaching needs to be closely integrated. This implies success in KM, managing the knowledge available from the various institutions and actors.

Knowledge is fast gaining popularity across many disciplines as a very important asset and key resource in organizations. Uriarte (2008) recognizes that knowledge is now the new strategic imperative of organizations, and states that knowledge is an essential asset that has become more important than land, labour or capital in today's economy. A report by the World Bank on 'enhancing agricultural innovation' further recognises that agricultural development depends to a great extent on how successfully knowledge is generated and applied (World Bank 2007). Knowledge that farming communities are typically interested in includes cultural management practices, new agricultural technologies, market information

on inputs and sales, diagnostic information about plant and animal diseases (Hartwich *et al.,* 2007).

Review of existing literature reveals that there exist multiple definitions of knowledge. This study borrows the definition of knowledge from the works of Tiwana (2000), where knowledge is referred to as "information, skills and expertise gained through sharing, experience or learning when applied for the right action in the right format, at the right time and place, for decision making". This definition is based on decisions made and actions taken as a result of knowledge, and emphasizing on the context in terms of time and appropriateness. As Davenport and Prusak (1998) argue, decisions and actions form the basis of evaluating knowledge.

Multiple definitions of KM exist as put forward by various scholars. For the purposes of this study, knowledge management is considered to be a concept which includes elements of knowledge creation and acquisition, knowledge storage and retrieval, knowledge transfer and sharing; done at the right time and context. Brooking (1996) stipulates that KM involves accumulating knowledge assets and using them effectively to gain competitive advantage. It has been pointed out that a large part of knowledge is not explicit but tacit (Schreiber et al., 1999). This is true for knowledge in agriculture where practices are transferred without being well documented. Ha *et al.,* (2008) stipulates that KM has already begun to show its prominence in the management of exogenous and indigenous knowledge in developing countries. However, the application of KM is still in its infancy in most developing countries and more recognition is given to KM in formal organizational settings as opposed to informal settings.

This study looked at KM as a concept which is very vital in the agricultural sector, and it sought to investigate the knowledge sources available to the small holder farmers, the status of knowledge management and the extent to which Information and Communication Technologies (ICTs) have been applied in Knowledge Management within the small holder famer context under different settings in rural and peri-urban areas. An e-sourcebook on ICT and agriculture by the World Bank (2011) emphasises on the importance of ICTs in connecting smallholders to knowledge networks and institutions. ICTs empower individuals and institutions to create, access and use knowledge and to communicate (World Bank, 2011). Empirical evidence (World Bank, 2011) suggests that ICTs have various functions in KM including provision of access to information, documentation of knowledge, and connecting people and networking. Based on these reports, the study sought to investigate the use of ICTs in KM and the extent to which they are used in the peri-urban and rural smallholder settings.

Knowledge creation and acquisition, dissemination and sharing, storage and retrieval are elements in a broader theme which is knowledge management (KM). Farmers need to continuously acquire and gather new knowledge to keep up with new emerging trends or technologies in the sector, in order to realise increased outputs. They also need to store this knowledge for future reference, and as they interact with fellow farmers share and transfer knowledge in the process. According to Long and Villareal (1994) knowledge dissemination and creation should be considered or placed in a social context involving specific actors and interacting individuals who become inter-related through networks of interest and through the sharing of certain knowledge frames.

The importance of knowledge management is similarly emphasised by Allen and Thomas (2000) who argue that "having knowledge is one thing, knowing what to do with it is

another" and they stipulate that knowing how to manage the different types of knowledge is key. Empirical evidence (World Bank, 2007) shows that the context for agricultural knowledge generation and use is changing rapidly (Table 2). Consequently, the process of knowledge generation and use has been transformed; first, agricultural knowledge and information as well as technologies are increasingly being generated, diffused and applied through the private sector, and secondly the knowledge structure of the agricultural sector in many countries is changing markedly, with increased overall agricultural education in many countries. The question is how participatory and inclusive are these processes, to involve the small holder farmers? Is the small holder farming community involved in documenting, representing and communicating their knowledge as well as that disseminated to them by other actors along the agricultural value chain?

Table 2: The changing process of knowledge generation and use

From	To
The knowledge elite	The knowledge society
Paper used to store and share knowledge	Digital media and the web used to store and share knowledge
Research as the key tool to generate knowledge	Research and Consultation to generate knowledge
The linear model: research knowledge adaptation use of technology	The interactive model: innovations arise from a learning-based process that combines problem recognition and knowledge generation

(Source: World Bank Report 2007)

This study presumed that farmers are already engaged in knowledge management in their daily activities. The study sought to identify the different knowledge sources and how they disseminate the knowledge to the end user, and what role Information and Communication Technologies (ICTs) plays in the knowledge management processes. With the widespread use of mobile phones especially in Kenya, voice and short messaging services have gained more popularity and they offer easy accessibility. According to an inventory of innovative farmer advisory services using ICTs (FARA, 2009), traditional forms of ICT such as radio and televisions have become more prevalent in advisory service provision, with more radio and television stations giving airtime for agricultural programmes or information. With this consideration, the study considered ICTs to include radios, televisions, mobile phones, as well as computers and use of internet. This study was carried out in two different settings; peri-urban and rural to compare the status of knowledge management between the farmers within proximity of the city with those in the rural areas.

1.4: Problem statement

Information, communication and knowledge have always mattered in agriculture, with farmers continuously seeking information, communicating with each other and sharing knowledge on new agricultural technologies. Extension services improve the knowledge base of farmers through a variety of means, such as demonstrations, model plots, specific training and group meetings. The Kenyan government has shifted to a policy of pluralistic extension provision, involving other actors in the provision of extension services. The question is what are sources of knowledge to the farmers? How accessible are these sources? What are the different approaches used to disseminate knowledge and how different are these approaches in peri-urban and rural settings? What is the extent of ICT usage in knowledge dissemination by extension agents, and the extent of ICT use in acquisition, sharing and storage by the small

holder farmers? All these questions need to be addressed in order to assist the government as it plans outreach to farmers, and the private sector which provides ICT infra-structure. This compared knowledge management (acquisition, sharing, storage and retrieval) amongst smallholder horticultural farmers in rural and peri-urban settings, and established the tools and approaches used by the extension agents, and the collaborative arrangements in place. The study further investigated the use and application of Information and Communication Technologies (ICTs) in accessing, sharing and disseminating knowledge, as well as storage of this knowledge.

1.5: Objectives

The overall objective of this study was to carry out a comparative assessment of Knowledge Management among the small holder famers in peri-urban and rural settings.

The specific objectives of the study were:

   i.   To identify the knowledge sources for the farmers

   ii.   To identify the tools and approaches used by extension agents for knowledge dissemination to farmers

   iii.   To compare the types and extent of ICTs usage in knowledge acquisition, sharing and storage by peri-urban and rural smallholders farmers

   iv.   To compare the ease of access of the knowledge sources and ICT types used by farmers in peri-urban and rural settings

1.6: Research Questions

To address objective one and two, the following research questions were used respectively:

- What are the sources of knowledge available for smallholder farmers in peri-urban and rural settings?

- What are the tools and approaches used for knowledge dissemination by the extension agents?

1.7: Hypotheses

To address objective three and four, the following hypotheses were formulated:

H_o: There is no significant difference in the types and extent of ICTs used by farmers in peri-urban and rural settings for knowledge management

Ho: There is no significant difference in the ease of access of different knowledge sources and ICT types in peri-urban and rural settings

1.8: Scope of the Study

The study was carried out in Dagoretti and Mbooni West districts. In Dagoretti district, the study covered Waithaka division, in which most of the agricultural activities are dominant, while in Mbooni West district, two divisions were covered namely: Tulimani and Mbooni divisions.

Data collection was carried out over a period of two months in February and March 2012.

1.9: Justification

Research and extension are some of the most knowledge intensive elements of agricultural innovation systems. With the entry of other players in the extension and advisory services like NGOs and other private agents, it is evident that there are multiple sources of knowledge to the small holder famers. To date there have been few studies to establish what knowledge sources are available to the farmers, ease of access to these sources, and the level of ICT use in knowledge management. It is necessary to document these sources and investigate their accessibility to the farmer. It is also important to investigate the channels employed by

smallholder farmers to obtain knowledge, how they use information and communication technologies (ICTs) to share, store and retrieve this knowledge, and the extent of ICT usage by these knowledge sources in disseminating the knowledge to the famers. All these are aspects of knowledge management and, therefore, the concept needs to be investigated in the agricultural sector within the small holder set up, to identify opportunities and challenges that should be addressed to help the small holder farmers gain competitive advantage. The results of this study will go a long way in establishing the situation of knowledge management, and it will give an insight on what impact the pluralistic approach of extension has on the small holder farmers, in terms of what difference it has brought and how effective it is in addressing the issue of knowledge dissemination. The study compared the concept of knowledge management in peri-urban and rural settings so as to find out what role and how proximity to urban centres influences knowledge flow.

1.10: Definition of terms

- **Information and Communication Technologies (ICTs)**- ICTs as used in this study refers to an umbrella term that includes anything ranging from radio to satellite imagery to mobile phones or electronic money transfers (World Bank 2011), used to obtain, share or store knowledge

- **Knowledge sources**- As used in this study, knowledge sources refer to the non ICT-based options for knowledge acquisition, including organisations and individuals who provide farmers with agricultural information and knowledge

- **Knowledge**- In this study, knowledge is used to describe information, skills and expertise gained through sharing, experience or learning

- **Knowledge management**- Knowledge management here is used to describe a concept which includes elements of knowledge creation and acquisition, knowledge storage and retrieval, knowledge transfer and sharing

- **Smallholder Horticultural farmers**- In this study, these were farmers who cultivate vegetables and fruits on parcels of land measuring between 0.125 acres and 3 acres, with the aim of selling

1.11: Organisation of the Thesis

This thesis is organised into five chapters as follows:

- Chapter one gives the background information of the study, the problem statement and its justification, the objectives of the study with their respective research questions and hypotheses, and the definition of terms.

- Chapter two discusses the literature review including the knowledge management concept *vis a viz* information management. It also discusses the theoretical basis upon which the study was built

- Chapter three gives the methodology used to carry out the study including the conceptual basis of the study

- Chapter four gives the results of the study and discusses the results. These are presented according to the objectives, with results for each objective in its own section.

- Chapter five finally gives the conclusions and recommendations based on the results of the study.

<div align="center">**CHAPTER TWO**</div>

<div align="center">**LITERATURE REVIEW**</div>

2.1 Knowledge management concepts and definitions

Definitions of knowledge reveal that Knowledge has different meanings depending on the discipline where it is used and it emerges that there is relationship between knowledge and information, which is also closely related to data. For managers and information specialists, these terms have distinct meanings (Lucey 1998). Davenport and Prusak (1998) articulate that although knowledge is related to both data and information, it is neither data nor information, and the differences between these terms are often a matter of degree. Data is a set of discrete, objective facts about events. Data describes only a part of what happened; it provides no judgment or interpretation and no sustainable basis of action. Data says nothing about its own importance or relevance. According to Lucey (1998), data are the input raw materials from which information is produced. Davenport and Prusak (1998) however notes that, data turns into information as soon as it is given meaning. It is crucial to convert raw data into information, and both receiving and applying information are central aspects of the generation of knowledge (Allen and Thomas 2000). Allen and Thomas (2000) further note that information creates knowledge, but knowledge is also needed to create information. They further emphasise on the relationship between knowledge and information when they argue that knowledge helps in: accessing information, by knowing where to find and how to use the information sources, how to assess information and judge its value, how to apply information by adapting to particular needs and circumstances.

Turning raw data into useable information is a process described by Allen and Thomas (2000) as the information chain consisting of 'Four As' as shown in figure 1
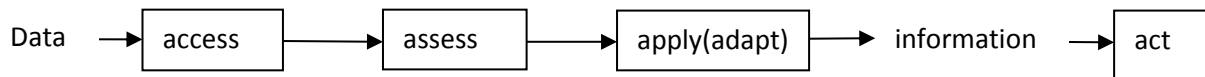
Figure 1: Four As' model of the information chain (Source: Allen and Thomas, 2000)

Bellinger *et al.,* (2004) also agrees that there are connections between data, information and knowledge, and brings in two other concepts of wisdom and understanding. As shown in the figure 2, Bellinger *et al.,* (2004) argues that there are transitions from data, to information, to knowledge, and finally to wisdom, and understanding is what supports the transition from each stage to the next.
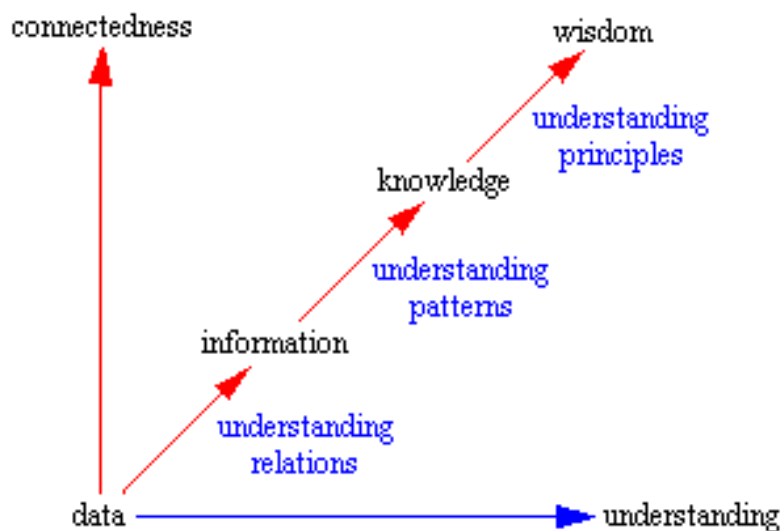
Figure 2: Transitions from data to wisdom (Source: Bellinger *et al.,* 2004)

According to Bellinger *et al.,* (2004), data represents a fact or statement of event without relation to other things. Information embodies the understanding of a relationship of some sort, possibly cause and effect. Knowledge represents a pattern that connects and generally provides a high level of predictability on what is described or what will happen next. Wisdom

embodies more of an understanding of fundamental principles embodied within the knowledge, which are essentially the basis for the knowledge being what it is.

Uriarte (2008) also agrees that there is a conceptual progression from data to knowledge, and brings in the concept of understanding. According to Uriarte (2008), data is described as a number or word or letter without any context and further argues that what makes a collection of data information, is the understanding of the relations between the pieces of data. Uriarte (2008) notes that when information is further processed, it has the potential of becoming knowledge and maintains that information is further processed when one finds a pattern or relation existing among data and information and thus this collection becomes knowledge.

The relationship between information and knowledge is further emphasised by Hoffmann *et al.,* (2009), who state that information is a prerequisite of knowledge. Hoffmann *et al.,* (2009) stipulated that knowledge links information with action and information is built on data. They further describe this relationship by arguing that knowledge can be acquired through learning and internalizing information, and that it can be passed on by teaching and externalizing it as information, thus describing knowledge as conceptualized information, interpreted, evaluated and interlinked.

Since knowledge is an important asset, there is need to properly manage it and the concept of knowledge management (KM).

2.1.1 Knowledge types:

Understanding the different forms that knowledge can exist in, and thereby being able to distinguish between various types of knowledge, is an essential step for knowledge management (KM). Boisot (1987) distinguishes between three types of knowledge; Personal knowledge, Public knowledge and common sense knowledge and categorises knowledge as

codified or un-codified, diffused or un-diffused. Personal knowledge is un-codified and un-diffused and is embedded in persons for example experiences, perceptions, views, ideas; Public knowledge is codified and diffused for example books, newspapers; Common sense knowledge is relatively diffused and un-codified and can gradually develop through the process of socialization and externalisation.

Knowledge has been largely categorised as tacit or explicit, the former being that which is embedded in individuals and is difficult to code while explicit knowledge can be codified and easily shared (Nonaka and Takeuchi, 1995). Explicit knowledge is formalized and codified, and is sometimes referred to as know-what (Brown and Duguid 1998). It is therefore fairly easy to identify, store, and retrieve (Wellman 2009). According to Frost (2010) from a managerial perspective, the greatest challenge with explicit knowledge is that it is similar to information. It involves ensuring that people have access to what they need; that important knowledge is stored; and that the knowledge is reviewed, updated, or discarded. Explicit knowledge is found in: databases, memos, notes, documents. (Botha *et al.,* 2008)

Tacit knowledge was originally defined by Polanyi in 1966. It is sometimes referred to as know-how (Brown and Duguid, 1998) and refers to intuitive, hard to define knowledge that is largely experience based. Because of this, tacit knowledge is often context dependent and personal in nature. It is hard to communicate and deeply embedded in action, commitment, and involvement (Nonaka 1994). Tacit knowledge is also regarded as being the most valuable source of knowledge, and the most likely to lead to breakthroughs in the organization (Wellman, 2009). Gamble and Blackwell (2001) link the lack of focus on tacit knowledge directly to the reduced capability for innovation and sustained competitiveness. Tacit knowledge is found in: the minds of human stakeholders. It includes cultural beliefs, values, attitudes, mental models, as well as skills, capabilities and expertise (Botha *et al.,* 2008).

They further point out that tacit and explicit knowledge should be seen as a spectrum rather than as definitive points. Therefore in practice, all knowledge is a mixture of tacit and explicit elements rather than being one or the other.

Frost (2010) distinguishes another type of knowledge known as embedded knowledge. Embedded knowledge refers to the knowledge that is locked in processes, products, culture, routines, artefacts, or structures (Horvath, 2000, Gamble and Blackwell 2001). Knowledge is embedded either formally, such as through a management initiative to formalize a certain beneficial routine, or informally as the organization uses and applies the other two knowledge types. Embedded knowledge is found in: rules, processes, manuals, organizational culture, and codes of conduct, ethics, and products.

Allen and Thomas (2000) identified four types of knowledge which they argue are more relevant to technology and development: a) Know-how and know-why; acquiring technology and engaging in its adaptation, b) knowledge of quality; applies to both technological processes and products and involves adapting knowledge to improve on existing knowledge, c) knowledge of social, cultural and economic contexts; examining the contexts within which knowledge is embedded and the social and cultural influences, and d) knowing how to learn; learning while doing, and use the knowledge generated to develop technologies further.

2.1.2 Knowledge Management versus Information Management

The distinction between knowledge management and information management is most often unclear to most people. This arises from the confusion between the two terms knowledge and information. As demonstrated by the definitions and discussions in this thesis, the two terms are related and one gives rise to the other, but they mean different things in different contexts. Thus, the concepts of knowledge management and information management are different but

with a very thin line. It is necessary to make this distinction in this study so as to fully comprehend the area of concentration in this study. Hartwich *et al.,* (2007) distinguishes between first generation and second generation knowledge management. The main goal of first generation KM is getting the right technological information to the right people at the right time, while second generation KM emphasises collaboration in the management of knowledge. First generation KM in this case is concerned only with storing the knowledge for easier retrieval, a concept similar to the goal of information management as discussed here.

Kakabadse *et al.,* (2001) argue that information and data management are important pillars of knowledge management but knowledge management encompasses broader issues and, in particular, creation of processes and behaviours that allow people to transform information into the organization and create and share knowledge. According to Wilson (1989), Information Management is the management of the information resources of an organization and involves the management of information technology. Choo (1998) considers information management as entailing five steps which include: identification of information needs, information acquisition, information organization and storage, information distribution and information use. Each step requires the planning, the organization, the coordination and the control of a number of activities supported by information technology. According to Choo (1998), IM is necessary for sustaining knowledge creation and application in organizations and should lead to the 'intelligent organization'.

For knowledge management on the other hand, the core issue is knowledge sharing and exchange (Davenport and Prusak, 1998; Borghoff and Pareschi, 1998; Kakabadse *et al.,* 2001; Davidson and Voss, 2002; Hartwich *et al.,* 2007, Hoffmann *et al.,* 2009). The systematic sharing of knowledge is assuming a larger role in all kinds of organizations around

the world (World Bank, 1998a; Luen and Al-Hawamdeh, 2001). The World Bank (1998a) perceives knowledge management as critical for economic development and as an important next step going beyond the dissemination of information (Mac Morrow, 2001). Martensson also argues that the success of an IM project is achieved when the preservation and the retrieval of information is guaranteed while the success of a KM program ultimately depends on the sharing of knowledge (Martensson, 2000). Bouthillier and Shearer (2002) argue that while both IM and KM require a high degree of human involvement, their objectives are often very different. The ultimate goal of IM is to ensure that information is stored and retrievable, while the ultimate purpose of KM is tied more closely to organization outcomes.

2.2 Theoretical Basis

In addressing the objectives of the study, this study adopted two knowledge management models: the 'ba' model by Nonaka *et al.,* (2000) and the Just In Time (JIT) model by Steyn and du Toit (2009). Nonaka and Takeuchi (1995) through their knowledge management model known as the 'SECI' model describe four ways or processes through which knowledge is created, shared, and converted. Knowledge creation involves developing new content or replacing existing content within the organization's tacit and explicit knowledge. These four modes of knowledge creation are: Socialization, Externalisation, Combination and Internalisation. Socialisation refers to transfer of tacit knowledge from one person to tacit knowledge in another person through sharing, face to face interaction of individuals. Externalisation on the other hand is the conversation of tacit knowledge to explicit knowledge in a repository; Internalisation involves the conversion of explicit knowledge to tacit knowledge as needed; and combination is the conversion of explicit knowledge to explicit knowledge by combining different bodies.

Knowledge storage and retrieval ensures that the knowledge is easily obtained when needed, it helps in avoiding duplication of work, and it facilitates decision making. Stein and Zwass (1995) refer to Knowledge storage and retrieval in an organisation as organisational memory. Organizational memory includes knowledge residing in various component forms, including written documentation, structured information stored in electronic databases, codified human knowledge stored in expert systems, documented organizational procedures and processes and tacit knowledge acquired by individuals and networks of individuals (Tan *et al.,* 1999). Transfer occurs at various levels: transfer of knowledge between individuals, from individuals to explicit sources, from individuals to groups, between groups, across groups, and from the group to the organization

Nonaka *et al.,* (2000) further built on the SECI model and developed a KM model known as the ba model, which emphasises on knowledge creation as consisting of three elements that interact with each other to form a knowledge spiral that creates knowledge. These elements are the knowledge conversion processes (SECI), the context-specific knowledge and the moderator. While the SECI process assumes that knowledge is created by converting it between tacit and explicit knowledge through socialization, externalization, combination and internalization processes; the 'ba' model focuses on the shared context which provides a platform for knowledge creation, and the moderator grows and shifts through the continuous knowledge conversion processes. The moderator provides inputs for the conversion process, and gets outputs from it. These inputs and outputs are the knowledge assets. According to Nonaka et.al (2000), knowledge is dynamic, since it is created in social interactions amongst individuals and organisations, and knowledge is context-specific, as it depends on a particular time and space.

Another model is by Steyn and du Toit (2009) the Just in Time (JIT) approach in Knowledge management. According to Steyn and du Toit (2009), JIT knowledge management is an endeavour to provide the right knowledge at the right time to the right person. The JIT model requires insight into the knowledge demand and supply process as well as the time horizon applicable to the knowledge required. In their JIT model, they bring in the concepts of demand-side knowledge management and supply-side knowledge management. They stipulate that the supply side of knowledge management is associated with the 'delivery oriented' assumptions that valuable knowledge exists within the enterprise and that it is the task of management to find it, codify it and place it into a repository. This is then followed by an approach which 'decrees' and determines how it is to be distributed and to whom. Demand-side knowledge management is initiated through an approach requiring a view of where valuable knowledge exists within the enterprise and how knowledge can be used to the enterprise's competitive advantage. Thus according to Steyn and du Toit, (2009) JIT knowledge management is an endeavour to optimise the supply of knowledge to the demand for knowledge, with the aim focusing on relevance, such that the relevant knowledge would be supplied as reflected in the demands. Hence, knowledge creation and generation will be based on the knowledge needs. This study borrowed from the two models because whereas the 'ba' model emphasises on the shared context among the moderators and the knowledge assets, the JIT model complements it by focusing on the essence of time and relevance of the knowledge, so that knowledge can be applied for the right purpose at the right time.

CHAPTER THREE

METHODOLOGY

This chapter is broken down into two major sections: the conceptual framework, and the empirical framework. Section 3.1 shows the conceptual framework and illustrates the concept of agricultural knowledge management as influenced by various factors in the different settings. Section 3.2 gives the empirical framework upon which the study was carried out.

3.1 Conceptual framework

Figure 3 illustrates the conceptual model as conceived in this study. The figure 3 illustrates that Knowledge management in the two settings is influenced by a number of variables which include the contextual factors such as the demographics, geography, resources, education; extension actors who include the public/government agents, private sector and input suppliers, NGOs, CBOs, and FBOs; various tools and approaches used in dissemination and also access and use of ICT facilities. With the increased use of Information and Communication Technologies (ICTs), the study was conducted to determine the extent ICTs are being employed by these actors in knowledge management, whether for knowledge dissemination by the extension agents, or knowledge acquisition, storage and retrieval and application by the farmers. The term ICTs here is used to refer to hardware, software, networks and media for collection, storage, processing, transmission and presentation of information in the formats of voice, data, text and images (World Bank, 2008).
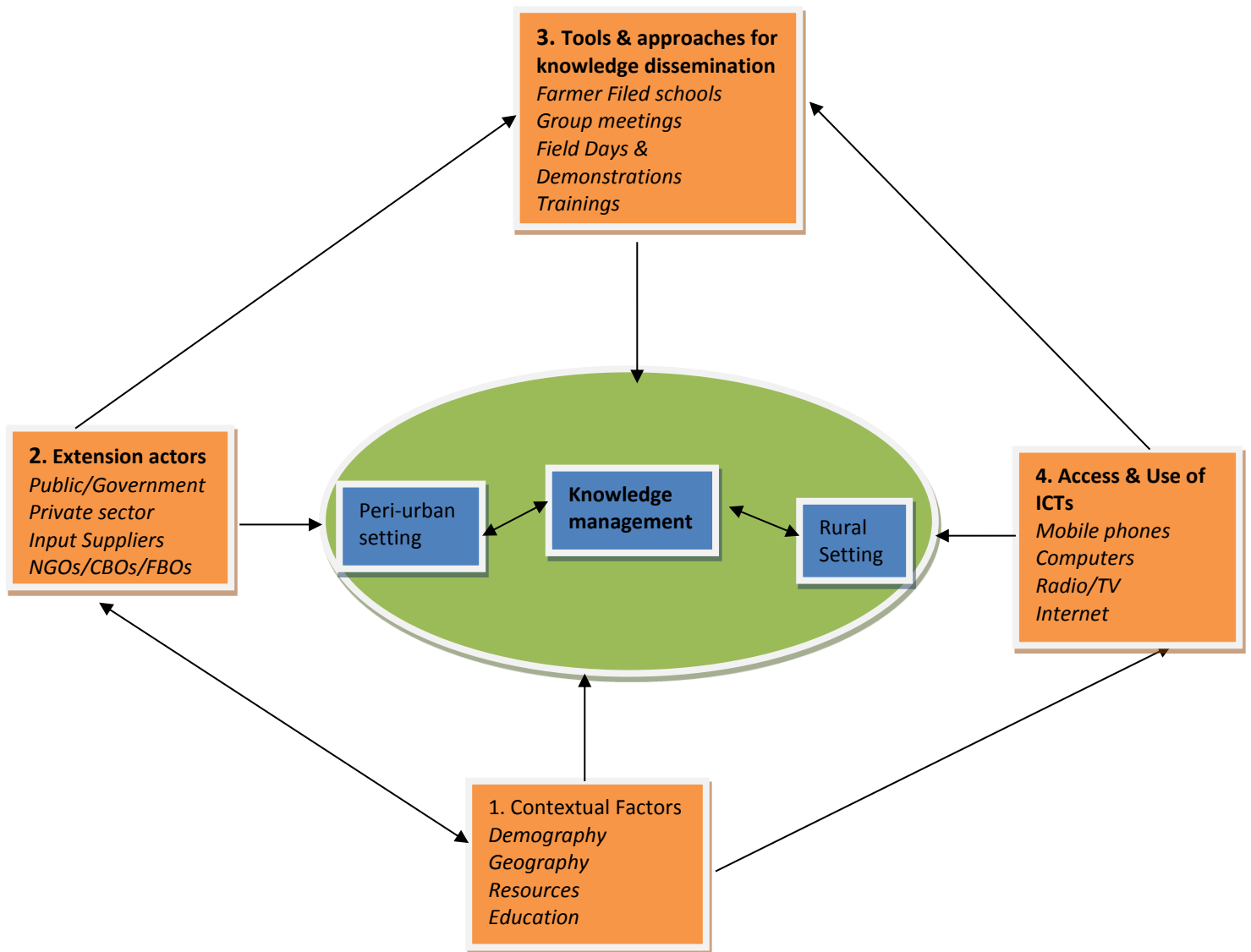
Figure 3: Conceptual model (Source: author)

As articulated by Nyirenda-Jere (2010), the primary purpose of ICTs is to provide an enabling environment for the generation of ideas, their dissemination and use. Through ICTs, the diffusion and sharing of knowledge is enabled through open access to information and better co-ordination of knowledge.In this study, the ICTs considered included mobile phones, televisions, radios, computers and LCDs, internet as identified in the districts.

3.2: Empirical model

3.2.1: Sources of agricultural knowledge for farmers in Dagoretti and Mbooni Districts

To determine the sources of knowledge for small holder farmers in Dagoretti andMbooni districts, both qualitative and quantitative research designs were used. Collection of quantitative data involved personal administration of a questionnaire to the farmers face to face, by making farm visits (Appendix 1). A draft questionnaire was pre-tested in both districts to establish the effectiveness of this tool in achieving the objectives of the study. Five farmers were randomly selected in each district interviewed using the questionnaire to find out if the questions were properly framed and were clearly understood by the respondents. The questionnaire was adjusted and corrected accordingly to improve its understanding as well as the administration process

The approach used to administer the questionnaire was determined by the literacy level (ability to read and write clearly) of the farmers. In cases where they could read and write, the questions were explained while they filled in the questionnaire. In cases where they could not read and write, the questions were explained and enumerators filled in the questionnaire according to their responses. This was the approach applied especially in the rural setting. A total of 200 farmers were reached, 103 farmers in Dagoretti district and 97 farmers in Mbooni district. The farmers were selected based on division cluster; there are two divisions in each of the two districts (Kawangware and Waithaka division in Dagoretti; Mbooni and tulimani divisions in Mbooni district).

Collection of qualitative data involved use of Focused group discussions (FGDs). The FGDs were structured and were held using a checklist to give an in-depth understanding of the famers' opportunities, challenges and specific settings that influence their agricultural knowledge management practices and reasons behind these practices. The FGDs were

26

intended to give support to the quantitative data collected through questionnaires, and give this data a context. The groups were comprised of between 10 to 20 farmers who were selected using the snow-ball technique, and a total of four discussions were held, two in each district. All discussions were audio-taped using an audio recorder with consent from the participants and transcribed.

3.2.2: Tools and approaches used by extension agents for knowledge dissemination

To identify the tools and approaches used by extension agents in Dagoretti and Mbooni districts for knowledge dissemination, a qualitative research design which involved use of interviews was used. Key informant interviews with the extension service providers in each district were conducted using a checklist (Appendix 2). These interviews were focused on two key issues: i) to establish the tools and approaches used in disseminating knowledge to the farmers and ii) understanding the collaborative arrangements in place among all the actors present in each district. The interviews were recorded with consent from the interviewee and transcribed. Seven interviews were conducted in Dagoretti district, four representing the government extension agents and three representing the non government extension agents. In Mbooni district, nine interviews were conducted, five representing the government actors and four representing the non government actors.

3.2.3: Types and extent of ICTs usage for knowledge management

To compare the types of ICTs used and the extent to which they are used for knowledge acquisition, sharing and storage by the small holder farmers in peri-urban and rural areas, similar methodology for objective one (refer to section 3.3.1 above) was used.

3.2.3.4: Ease of access of knowledge sources and ICT types used

To compare the ease of access of the knowledge sources and ICT types used by farmers in peri-urban and rural settings, the study used a quantitative approach which involved use of questionnaires.

3.3: Study Area

The study area was purposively selected to include small holder horticulture farmers in peri-urban and rural areas. The study was carried out in Dagoretti and Mbooni West Districts in Kenya to represent peri-urban and rural settings, respectively. Mbooni West is situated in rural Eastern Kenya about 160 km from Nairobi city (See figure 4). Its geographical coordinates are 1° 62' 0" South, 37° 47' 0" East and it boarders Makueni district to the west and south, Mbooni East to the East and Machakos district to the north. The district consists of hilly masses of Mbooni and lowlands of Tulimani and Kalawani, and it lies within the arid and semi arid zones of the country. Each year the District experiences two main rains seasons. The long rains of March/May and the short rains of October/December. The hill masses generally experience cool temperature of 9º C (cold nights of June/July)-26ºC(Hot days of September/October) and 800mm-1200mm of rainfall per year, while the lower parts are hot and dry and receive between 350mm-900mm of rainfall per year.

Some parts of the District experience high temperatures during the day and low temperatures at night. During the May-October dry season, extreme heat is experienced in the low-lying parts of the District causing high evapo-transpiration, while the high-altitude areas experience cool temperatures. The short rains season is normally the more reliable of the two seasons. Rain failure is quite common in the area occurring in a cyclic pattern in every 5 years.

The district is served by five more or less permanent rivers namely Kikumu, Thwake, Syuni, Utangwa, and Mwea Rivers. The rivers in the upper part of Mbooni West holds water for a longer duration hence there is normally some reliable irrigation. On the lower part of the district, that covers the larger part of Tulimani division, the climate is characterized by prolonged hot, windy, dry spells leading to low productivity for both crops and Livestock. Mbooni West covers an area of 267.6km^2, it has a population of 97,309 of which 46,435 are males and 50,874 are females. There are 20,317 households, 18,066 farm families with the average household size being six to seven. The size of farm holdings ranges between 0.75 and 5 acres. The ministry of agriculture technical staff to farmer ratio is 1:1290.The main enterprises in the districts are maize and beans production, but there are approximately 300 farmers engaged in horticulture production especially along the five main permanent rivers in the area. The major horticultural crops grown in Mbooni include French beans, kales, tomatoes, macadamia nuts, and mangoes.

Figure 4: Map showing Mbooni West district (Source: Ministry of Agriculture, 2011)

Dagoretti district is on the outskirts of Nairobi County about 11.9 km from Nairobi City, it covers an area of 38.5 km^2 (Figure 5), and it is bordered by Kiambu district, Westlands district and Lang'ata district. Its geographical co-ordinates are 1° 18' 0" South, 36° 46' 0" East. There are three main rivers in the district: Nairobi River, Nyongera River, and Kabuthi River. Dagoretti district has a population of 329,577 of which 166,391 are males and 163,186 are females. There are 103,818 households, where 14,500 are farm families and the number of farms is 8,000 with the average farm size being 0.22 ha. The ministry of agriculture staff to farmer ratio is 1:1318.The main agricultural enterprise in Dagoretti district is horticultural production, which is done throughout the year.
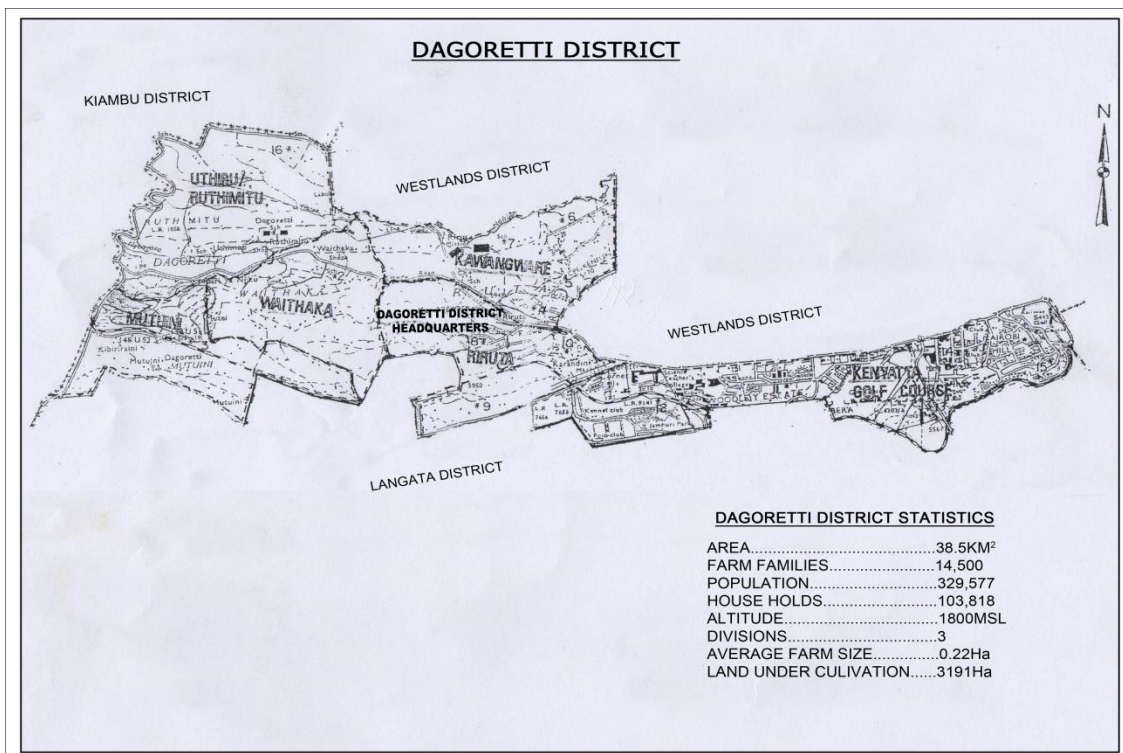
Figure 5: Map showing Dagoretti district (Source: Ministry of Agriculture, 2011)

3.4: Sampling Procedure

The sample was comprised of smallholder farmers as well as agricultural advisory service providers and extension agents in each of the two districts. Christopolos (2010) defined extension as systems that facilitate the access to knowledge and information by farmers, their organizations and other market actors; Extension also facilitates farmers' interaction with partners in research, education, agribusiness, and other relevant institutions; and assists them to develop their own technical, organizational and management skills and practices. According to Anderson (2007), the terms agricultural advisory services and agricultural extension refer to the entire set of organizations that support and facilitate people engaged in agricultural production to solve problems and to obtain information, skills and technologies to improve their livelihoods. Based on these arguments, this study sought to look at agricultural knowledge with respect to knowledge sources which included the agricultural extension and advisory service providers in the districts, including the government extension workers from the ministry of Agriculture (MoA), private companies operating in the districts, non-governmental organisations involved in agricultural activities and input suppliers[2]. The sampling technique used to obtain the sample for this target population involved purposive and snow-balling technique. The district headquarters in each district were visited, where the contacts of all the key organisations involved in agricultural activities in the district were obtained and a contacts list for the key informant interviews was compiled. The study also targeted small holder horticultural farmers and the sample was obtained using a simple random sampling procedure. In order to compile a sampling frame for this target group, the

---

[2] The choice of these categories of extension service providers was informed by the fact that a pluralistic situation in the provision of agricultural extension has now emerged in the country (NASEP-IF, 2008)

Ministry of Agriculture offices in each district was visited from where the list of horticulture farmers[3] was obtained and used to construct the sampling frame for the small holder farmers. The unit of analysis in this study was the small holder farmers engaged in horticulture production. In this study the small holder farmer was used to refer to those farmers who cultivate between 0.2 and 3.0 hectare of land. The target small holder farmers in this study were those who produce vegetables and fruits with the aim of selling, whether they target or are able to reach the local market or the export market.

Having obtained the sampling frame for the small holder farmers, the sample size was arrived at using the Yamane formula (Yamane, 1967). The confidence level was set at 95% and the level of precision was set at ±7%.

$$n = \frac{N}{1 + N(e)^2}$$

Where n is the sample size, N is the population size, and e is the level of precision.

In Dagoretti district, there were 200 active horticultural small holder farmers[4] and this translated to an actual sample size of 101 farmers. In Mbooni district, there were 180 small holder horticultural farmers, which translated to an actual sample size of 92 farmers.

3.5: Data Analysis

The quantitative data was coded and subjected to both descriptive and inferential statistics, using the statistical package for social sciences (SPSS) version 20.0 software. Comparison of

---

[3] The list from the MoA was considered because it was the only available list also used by other non-governmental organisations.

[4] Active horticultural small holder farmers refer to those who cultivate less than two acres of land regularly and are in the MOA's database.

information between the two districts was done using the chi-square tests and Mann-Whitney tests for ranked scales and categorical values. Statistical significance was set at $p<0.05$

The qualitative data was transcribed, categorised to allow for thematic and comparative analysis. Qualitative analysis took place throughout the data collection. The details of the findings are presented under the chapters dealing with the results and discussions.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

This chapter is arranged as follows: Section 4.1 to 4.4 gives the results of objective one, two, three and four respectively.

4.1 Sources of Agricultural Knowledge

In order to identify the sources of agricultural knowledge used by the farmers, the respondents were first asked to indicate which type of knowledge they considered more important for their production activities, to be able to understand the farmers' information needs. Majority of the farmers in Mbooni district (50%) regarded 'input prices and availability' as the most important knowledge while only 10% of the farmers in Dagoretti district considered this as an important type of knowledge. This was in contrast to the situation in Dagoretti district where 68% of the farmers consider 'Agronomic package for production' as the most import type of knowledge for their agricultural production, which was identified by 44% of the farmers in Mbooni district. The other knowledge type considered to be more important were market prices and availability identified by 40% and 36% of the farmers in Mbooni and Dagoretti respectively; pest control techniques by 32% of farmers in Mbooni and 14% of those in Dagoretti and finally post harvest handling and availability, identified by 11% of the farmers in each district. (Figure 6)
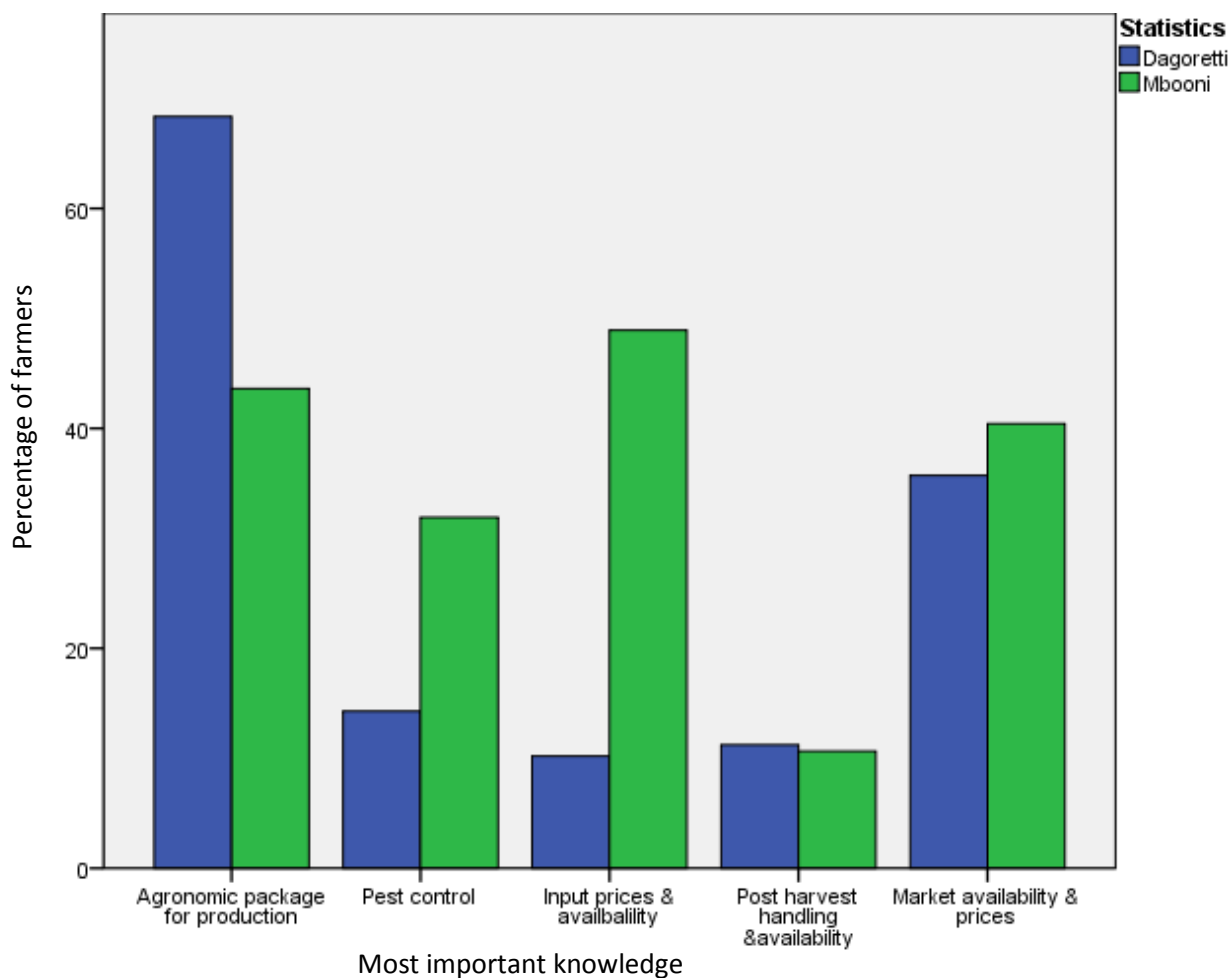
Figure 6: Important types of agricultural knowledge as considered by farmers in Dagoretti and Mbooni districts

This difference observed in terms of the farmers' information needs with respect to the different knowledge types was found to be significantly different for 'agronomic package for production' (p=0.002), 'pest control (p=0.003)' and 'input prices and availability' (p=0.000). For 'post harvest handling' and 'market availability', the difference was not statistically significant.

An inventory on innovative farmer advisory services using ICTs by FARA (2009) records that the basic information needs for farmers are market information prices, weather forecasts, transport facilitates and information on storage facilities. This study records a slight deviation from the findings of this inventory, with the identification of other different information

needs. This could be explained by the different context of the study, an observation which is equally recorded by the inventory (FARA 2009) which notes that there is a level of farmers' information needs which is more context and local specific.

Eight main sources of knowledge were identified from the study. These include government extension agents, NGO extension agents[5], Farmer associations, input suppliers, Neighbours, Farmer magazines, Private Companies, and self (tacit) knowledge. These sources fall under different stakeholder categories as summarised in table 3. They include: government, Faith Based Organisations (FBOs), Non-governmental Organisations (NGOs), Donor Organisations, Private Companies.

Table 3: Organisations providing agricultural advisory services in Dagoretti and Mbooni West Districts

District	Stakeholder Category				
	Government	Faith based Organisation (FBO)	Nongovernmental organisation (NGO)	Donor Organisation	Private Commercial Companies
Dagoretti	Ministry of Agriculture	World Vision	Service for Peace Hand in Hand	-	-
Mbooni	Ministry of Agriculture Horticultural Crops Development Authority (HCDA)	Ukambani Christian and Community Services(UCCS)	-	The U.S. Agency for International Development (USAID)	Syngenta Kenya Fresh Limited

(Source: author)

---

[5] NGO extension agents were considered in the study to include all nongovernmental organisations that offer extension and advisory services to the farmers including faith based organisations, but excluding private profit making companies

In Dagroetti district there is one governmental stakeholder, one faith based organisation (FBO) and two Nongovernmental organisations (NGOs). In Mbooni district there are two governmental organisations, one Donor Organisation, one FBO and two private companies. While majority of farmers in Dagoretti (88.3%) use government extension agents as their knowledge source, that same source is used by 54.6% of farmers in Mbooni. Private companies are used by only 1% of farmers in Dagoretti in contrast to 35.1% of those in Mbooni who rely on private companies as a source of knowledge. Figure 7 shows each of the sources and the percentage of farmers who consider it a main source of knowledge.
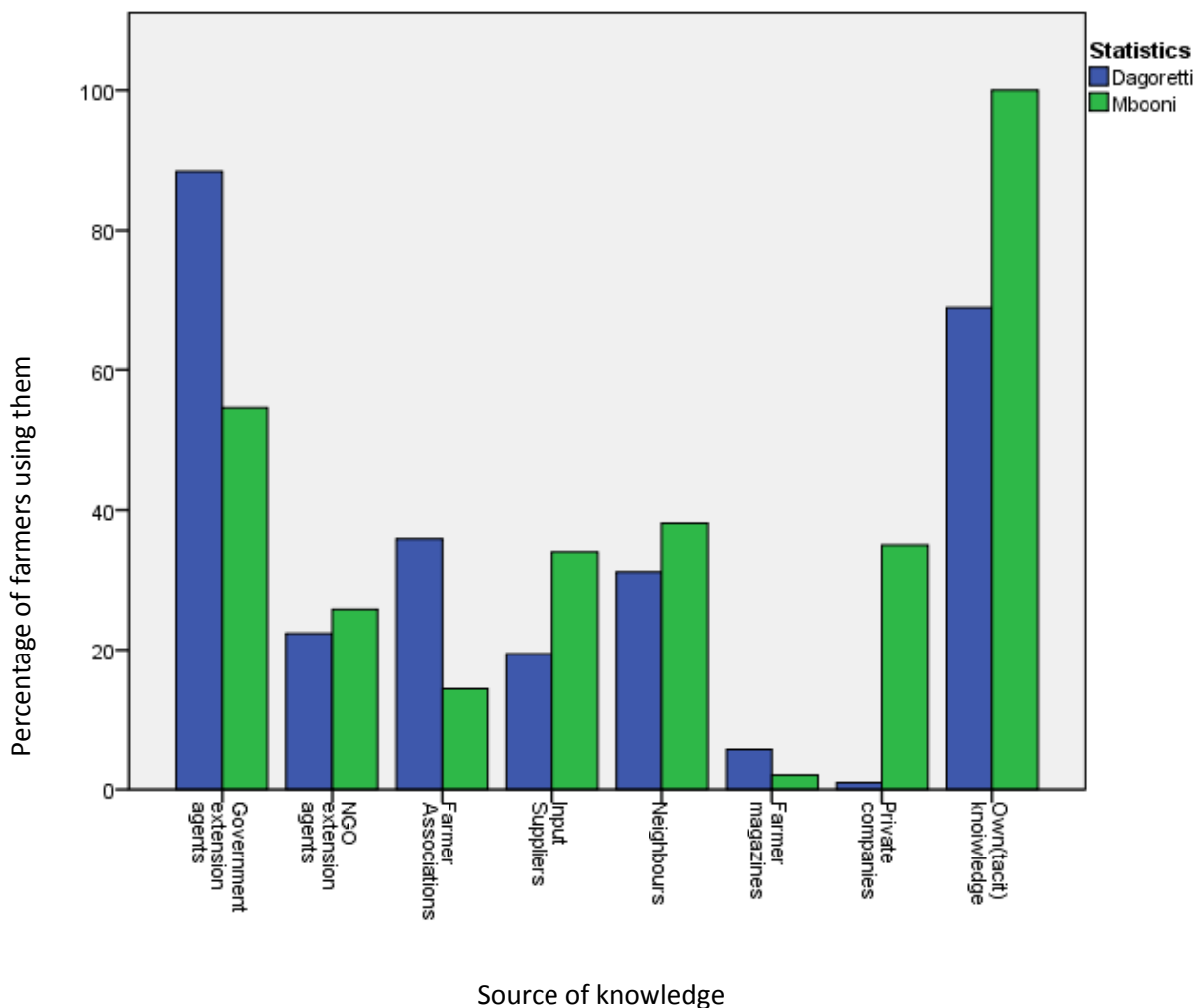
Figure 7: Sources of knowledge as identified by farmers in Dagoretti and Mbooni districts

This finding on various sources of knowledge for the farmers has equally been noted by Bertolini (2004) who articulates that most farmers in Africa rely on intermediaries such as non-governmental organisations (NGOs), extensionists and producer organisations to access and exchange information. An inventory of innovative farmer advisory services using ICTs by FARA (2009) equally records that most farmers' information is provided by either extension workers or via websites.

As seen in the figure, it was established that there was a difference in the percentage of farmers using each of the different knowledge sources in both districts. This difference was found to be significant for five of the sources reflected in the figure: government extension agents (p=0.000), farmer associations (p=0.001), input suppliers (p=0.020), private companies (0.000) and own/tacit knowledge (p=0.000).

The study further sought to establish the sources used most often among the eight identified in each district. While government extension agents were the source used most often in both districts, a chi-square test revealed that the percentage of farmers using them was significantly different (p=0.010) between the two settings. In the peri-urban setting (Dagoretti district), 76.7% of farmers use government extension agents more often, compared to 28.9% of farmers in the rural setting (Mbooni). Contrary to the situation in the peri-urban setting where none of the farmers identified private companies as a source they use most often, a significant percentage of farmers in the rural setting (26.8%) preferred to use the private companies most often as a source of obtaining agricultural knowledge.

Table 4: Sources of agricultural knowledge used most often by farmers in Dagoretti and Mbooni West districts

District	Source used most often							
	government extension agents	NGO extension agents	farmer associations	input suppliers	neighbours	own knowledge	farmer magazine	private companies
Dagoretti	76.7%	1.0%	4.9%	2.9%	5.8%	7.8%	1.0%	0.0%
Mbooni	28.9%	1.0%	3.1%	10.3%	12.4%	17.5%	0.0%	26.8%

From the results, it is clear that there are various stakeholders and organisations which provide agricultural knowledge to the farmers in both peri-urban and rural settings. There is a relationship between the sources of knowledge present in each setting, and the type of agricultural knowledge the farmers in that particular setting consider most important. This explains the higher percentage of farmers in peri-urban setting (76.7%) who use government extension agents most often, compared to only 28.9% of those in rural setting.

Use of neighbours and own (tacit) knowledge as main sources of knowledge is significant in both settings, a finding which emphasises the importance of face to face interaction of individuals in knowledge acquisition and sharing, and further emphasises the importance of implicit knowledge in agricultural production. Thus, farmers' information needs has a significant influence on the source of knowledge used. FARA (2009) equally notes that ther is a level of farmer information needs that is more context and local specific and requires the direct interface between the extension worker and the farmer.

4.3: Tools and approaches used by extension agents for knowledge dissemination

The different extension agents employ various tools and approaches to disseminate knowledge to the farmers (Table 5). This finding is also reflected by Munyua (2008) who argues that farmers in Africa have been able to get agricultural information through the use of

traditional communication methods, which include the use of demonstration plots and cultural events.

The different approaches used as established in this study, fall into two broad categories:

- Face to face approach- involves use of various models which include group meetings, individual home visits, trainings, demonstrations, field days, exhibitions, office consultations, and farmers' tours.

- Use of ICTs- two types of ICTs used are: mobile phones and radio programmes mainly in vernacular fm stations.

Table 5: Dissemination Approaches used by extension agents in Dagoretti and Mbooni west districts

Organisation	Dissemination approach
Ministry of Agriculture	- Individual farm targeting- home visits - Group approach/group visits- Field visits to farmer groups - Trainings/Field days /Exhibitions/ On-farm demonstrations - Chief's barazas/ Information desks - Farmers tours/exchange visits - Office consultation/ Use of mobile phones
HCDA	- Group visits / individual farm visits - Trainings - Mobile phones
World Vision	Exhibitions/ Field days
UCCS	- Group trainings - Demonstrations.
USAID	On-farm demonstrations
Syngenta	- Radio programmes in vernacular fm stations - On-farm demonstrations/ farm visits - Exhibitions organised by the MoA, - Trainings in collaboration with other stakeholders. - Mobile phones
Kenya Fresh	- Individual farm visits/Group meetings - Mobile phones
Service for Peace	- On-farm demonstrations/ Field days - Mobile phones
Hand in Hand	Group meetings

The face to face approaches are the mostly used as shown in figure 8 which illustrates the percentage in use of these approaches as used by the extension agents.
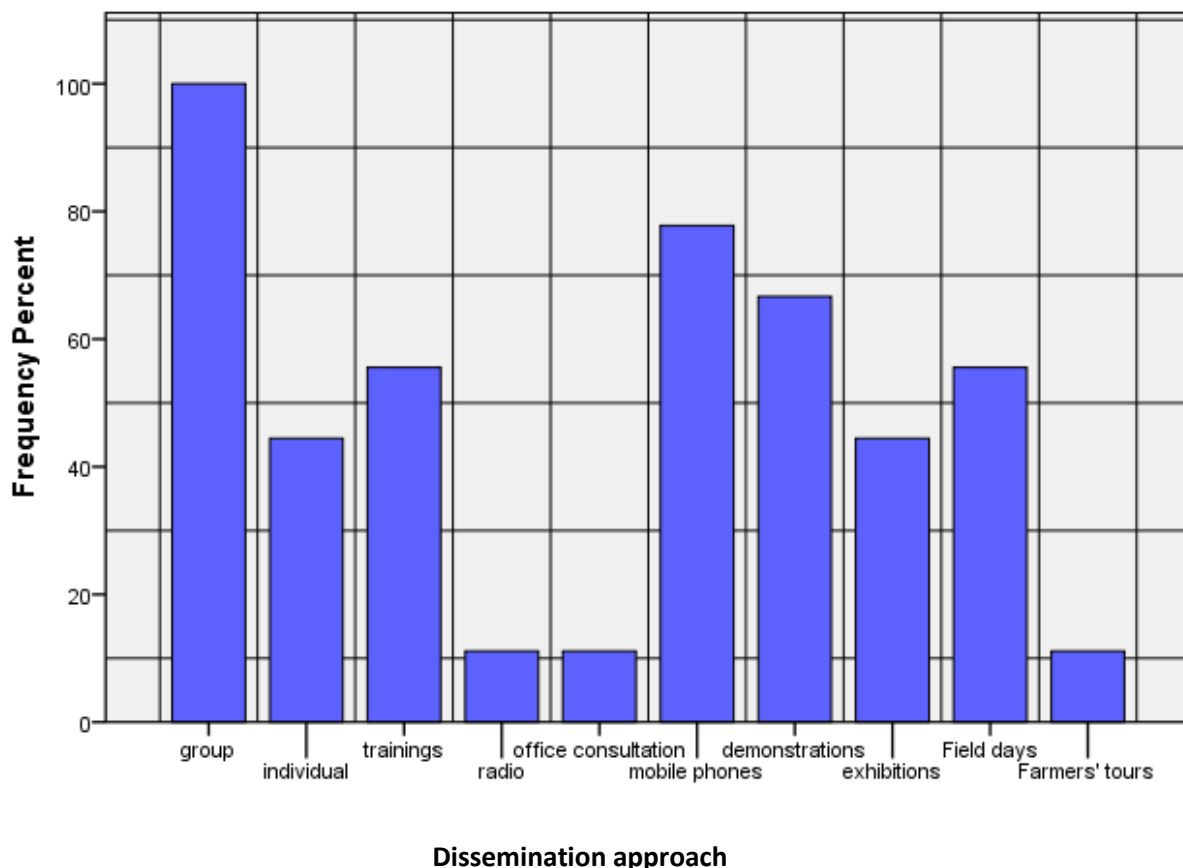
Figure 8: Frequency of use of various dissemination approaches by extension agents in Dagoretti and Mbooni districts

Group meetings are the most popular model used by all the extension agents (100%), followed by mobile phones at 77.8% and demonstrations at 66.7%. Trainings and field days came in fourth used by 55.6% of the extension agents, followed by individual home visits used by 44% of the extension agents. Radios, office consultations and farmers' tours were models used by only 11 % of the extension agents reached. There are strong collaborative

arrangements among all the stakeholders in agriculture facilitated by the new extension policy (NASEP) which introduced stakeholder meetings held annually in each district, for all the stakeholders to forge a working relationship with 'like-minded' stakeholders.

These results clearly show that socialisation is a major process through which knowledge is created, shared and converted within the small holder set up, with the main models used for knowledge dissemination involving the face to face interaction between the farmers and the extension agents. The presence of inputs supplying company indicates that there is provision of advisory services by input supply firms (such as Syngenta) described by Swanson and Rajalati (2010) as 'one-on-one advisory services provided by private sector/input supply firms to farmers who purchase production inputs from these firms. Swanson and Rajalati (2010) note that this model is dominant in most industrially developed countries due to its win-win arrangement but according to this study, the model is fast picking up in Kenya with Syngenta confirming that they not only work in Mbooni district , but the whole of Eastern region of Kenya. The results show that whereas different extension agents are present in both peri-urban and rural settings, their spread is different with more non-government actors working in the rural setting compared to the peri-urban setting.

4.4: Types and extent of ICTs usage in knowledge acquisition, sharing, and storage

4.4.1: Knowledge acquisition

In this age of rapid developing technology, it is important to recognize that ICTs play a role in knowledge acquisition and dissemination. As Nyirenda-Jere (2010) stipulates, through ICTs, the diffusion and sharing of knowledge is enabled through open access to information and better co-ordination of knowledge. The study sought to investigate the percentage of farmers using specific types of ICTs as sources of knowledge in each district and the results

indicate that 71.8% and 68% of farmers in Dagoretti and Mbooni respectively use ICTs to acquire knowledge, with only 28.2% and 32% in Dagoretti and Mbooni respectively saying they do not use ICTs for knowledge acquisition (Table 6).

Table 6: Use of ICTs for knowledge acquisition by farmers

District		Yes	No	Total
Dagoretti	Count	74	29	103
	%	71.8%	28.2%	100.0%
Mbooni	Count	66	31	97
	%	68.0%	32.0%	100.0%
Total	Count	140	60	200
	%	70.0%	30.0%	100.0%

A cross tabulation of the types of ICTs and number of farmers in each district (Table 7) shows that the most popular type of ICT used as a source of knowledge was the radio, with 87.8% of farmers in Dagoretti saying they rely on radio programmes to obtain agricultural knowledge and 90.6% of those in Mbooni saying the same. In Dagoretti, the second ICT that was mostly used by the farmers was the television, with 58.1% of farmers saying they use them to acquire knowledge followed by internet used by 25.7% of the farmers and lastly the mobile phones used by 23% of the farmers. This was in contrast to Mbooni where the cross tabulation show that the second ICT type used by farmers in Mbooni was the mobile phones used by 39.1% of the farmers followed by television (17.2% of farmers) and internet (4.7% of farmers) respectively.

Table 7: Different types of ICTs as used by farmers in Dagoretti and Mbooni West

District		types of ICT used to acquire knowledge			
		Radio	Television	Mobile phones	Internet
Dagoretti	Count	65	43	17	19
	% within district	87.80%	58.10%	23.00%	25.70%
Mbooni	Count	58	11	25	3
	% within district	90.60%	17.20%	39.10%	4.70%
Total	Count	123	54	42	22
	% of Total	89.10%	39.10%	30.40%	15.90%

43

A chi-square test conducted to compare the use of these ICT types for farmers in Dagoretti and Mbooni shows that there is no statistically significant difference in use of radio (p=0.633) and mobile phones (p=0.109), but there is a statistically significant difference in use of television (p=0.000) and internet (p=0.000). In addition to use of ICTs and extension agents to acquire knowledge, the study further sought to investigate the percentage of farmers who attend various agricultural events and fora to acquire knowledge and it was established that there was a significant difference between the two settings (p=0.000). As shown in table 8, majority of the farmers in Dagoretti district attend these events, compared to the farmers in Mbooni district.

Table 8: Farmers' attendance of agricultural fora and events in Dagoretti and Mbooni West districts

District		Seminars/workshop	Field days	Agricultural shows	Chief's barazas
Dagoretti	Count	82	84	88	81
	%	80.40%	82.40%	86.30%	79.40%
Mbooni	Count	44	47	38	81
	%	49.40%	52.80%	42.70%	91.00%
Total	Count	126	131	126	162
	%	66.00%	68.60%	66.00%	84.80%

Percentages and totals are based on respondents.
a. Dichotomy group tabulated at value 1.

Farmers who did not attend these events cited various reasons; 37% of farmers in Mbooni and 19% of those in Dagoretti cited lack of information about these events as the reason for not attending (Figure 10), and while 6% of the farmers in the rural setting cited long distance as one of the reasons hindering their attendance and participation, none of the farmers in Dagoretti cited this reason. Some farmers also cited lack of interest, lack of time and lack of resources as reasons for not attending.
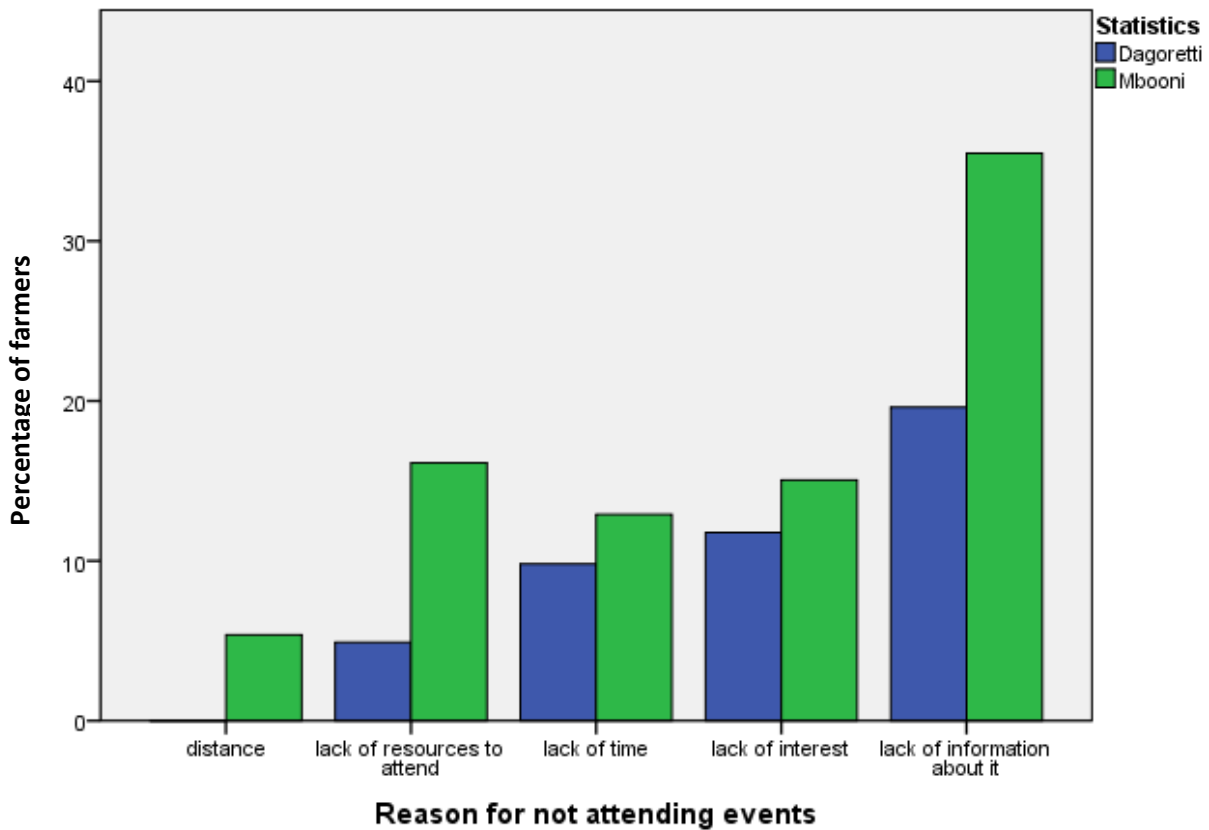
Figure 9: Reasons for not attending the agricultural events as given by farmers in Dagoretti and Mbooni districts

The study investigated the channels used to obtain information about these events in both districts and sought to compare the percentage farmers using them in both districts. As illustrated in figure 11, while 'extension agents' is the widely used channel (78.6%) in Dagoretti, only 34.8% of the farmers used it in Mbooni district. The widely used channel in Mbooni was 'fellow farmers' by 54.3% of the farmers. Radio was the second widely used channel used by 64.1% of the farmers in Dagoretti and 40.2% of farmers in Mbooni. While 52.4% of farmers in Mbooni use televisions as channels for obtaining information, only 3.3% of farmers depend on this channel to obtain information.
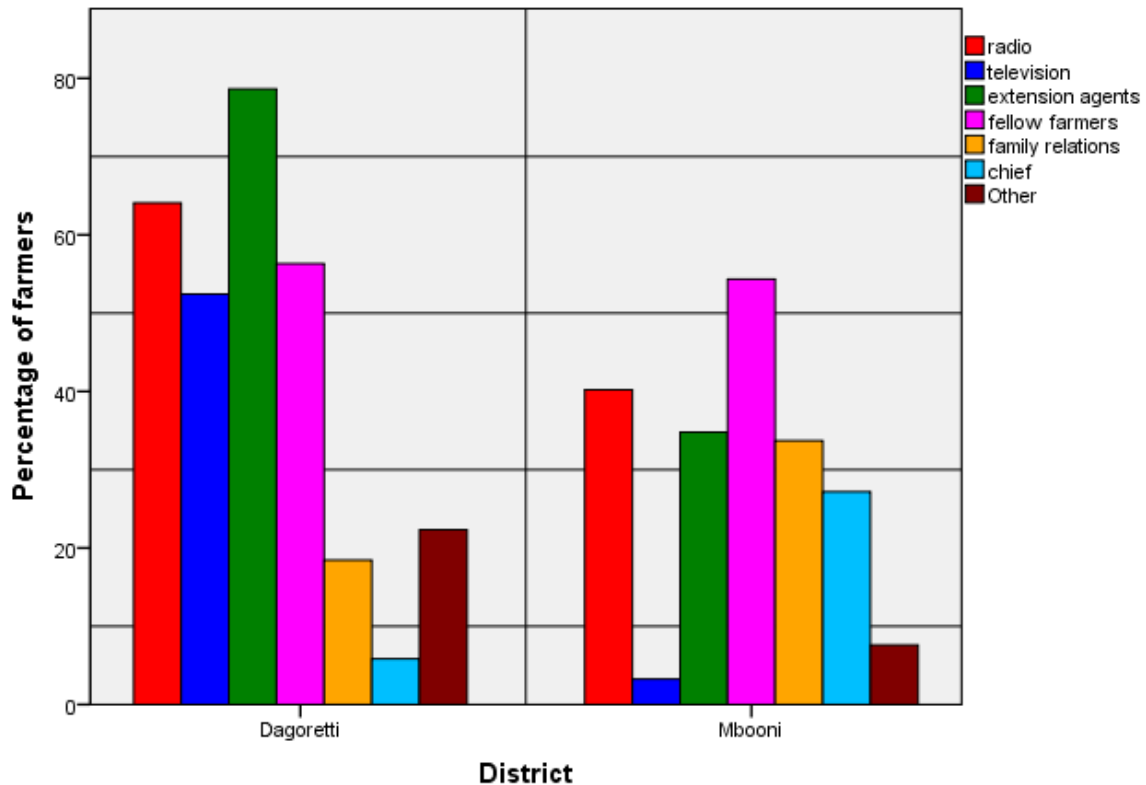
Figure 10: Channels used by farmers to obtain information on agricultural events in Dagoretti and Mbooni districts

To establish if this difference in percentage of farmers using the various channels to obtain information is statistically significant, a chi-square test was carried out. As shown in table 9, the results revealed that there was a statistically significant difference ($p < 0.05$) in both districts for six out of the nine channels identified in the study. These are: Television, internet, family relations, church, chief and posters. For the three of the channels which include radio, extension agents and fellow farmers, there was no significant difference statistically. These three were the widely used channels used for knowledge acquisition and dissemination in both rural and peri-urban settings and also seen to be more popular.

Table 9: Chi-square test results for channels used to obtain information on events by farmers in Dagoretti and Mbooni districts

	Radio	TV	Internet	Extension agents	Fellow farmers	Family relations	Church	Chief	Posters
Chi-Square	.246[a]	36.980[b]	188.180[b]	3.380[b]	1.280[b]	50.000[b]	127.040[a]	95.220[b]	172.980[b]
Df	1	1	1	1	1	1	1	1	1
P value	0.62	0.000	0.000	0.066	0.258	0.000	0.000	0.000	0.000

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 99.5.
b. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 100.0.

4.4.2: Knowledge Sharing

The study sought to establish the channels employed by the farmers in sharing knowledge with one another. Table 10 shows the cross tabulation of the channels with farmers using them in each district.

Table 10: Channels used by farmers in Dagoretti and Mbooni districts for sharing knowledge

District		channels for sharing knowledge[a]		
		face to face	mobile phone	internet
Dagoretti	Count	96	25	3
	% within district	98.0%	25.5%	3.1%
Mbooni	Count	82	15	1
	% within district	95.3%	17.4%	1.2%
Total	Count	178	40	4
	% of Total	96.7%	21.7%	2.2%

As reflected in the results in table 10, the study found out that a big percentage of farmers used the face to face channel for sharing knowledge (98% and 95.3% of farmers in Dagoretti and Mbooni respectively), while 25.5% of farmers in Dagoretti and 17.4% in Mbooni used mobile phones as a channel for sharing knowledge among themselves. Only 3.1% of farmers

in Dagoretti and 1.2% of those in Mbooni use internet as a channel for sharing knowledge among them.

4.4.3: Knowledge Storage

To get an insight on knowledge storage methods and techniques used by the farmers in the two settings, the findings established that there was a significant difference between the two settings (p=0.000), with 88.3% of farmers in the peri-urban setting indicating they find it necessary to store the knowledge in a physical location and 11.7% store in their memory, compared to 68% and 32% of farmers in the rural setting. The widely used form of storage is the paper file, used by 77.7% of farmers in Dagoretti and 51.6% of those in Mbooni (Table 11), followed by memory used by 32% and 47.4% of farmers in Dagoretti and Mbooni respectively.

Table 11: Forms of agricultural knowledge storage as used by farmers in Dagoretti and Mbooni districts

District		forms of knowledge storage[a]				
		Paper file	Computer	Compact disc	Notebook	Memory
Dagoretti	Count	80	9	2	14	33
	% within district	77.7%	8.7%	1.9%	13.6%	32.0%
Mbooni	Count	49	2	0	20	45
	% within district	51.6%	2.1%	0.0%	21.1%	47.4%
Total	Count	129	11	2	34	78
	% of Total	65.2%	5.6%	1.0%	17.2%	39.4%

Percentages and totals are based on respondents.
a. Dichotomy group tabulated at value 1.

An independent t-test revealed that the difference in percentage of farmers using the various forms of storage in peri-urban and rural settings was statistically significant for three out of the five forms of storage: Paper file, p=0.000, computer, p=0.039, memory, p=0.043.

The study established there was a relationship between attained education level and knowledge storage in both districts. As shown in figure 12, out of the farmers with no formal education in Dagoretti, none of them found it necessary to store knowledge in a physical form/location, unlike in Mbooni where some the farmers with no formal education (22%) found it necessary to store the knowledge acquired, while 45 % did not. All the farmers with university education in Dagoretti stored knowledge in a physical location.
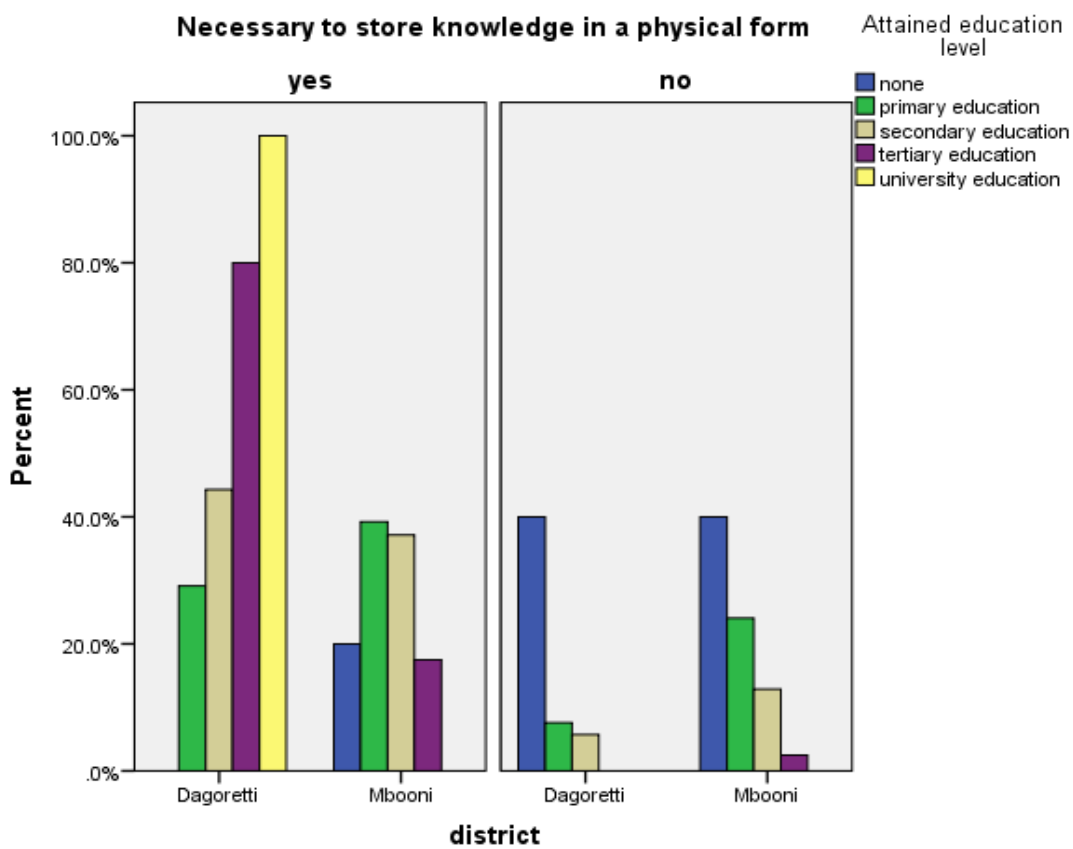
Figure 11: Knowledge storage by farmers in Dagoretti and mbooni districts based on their education levels

The influence of education levels on knowledge storage was found to be significant at 5%, based on a correlation analysis (Table 12).

Table 12: Significance of influence of education level on knowledge storage by farmers in Dagoretti and Mbooni districts

			Attained education level	use ICT to acquire knowledge
Spearman's rho	Attained education level	Correlation Coefficient	1.000	-.233[**]
		P-value	.	.001
		N	199	199
	use ICT to acquire knowledge	Correlation Coefficient	-.233[**]	1.000
		P- value	.001	.
		N	199	200

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

The results clearly show that farmers in both peri-urban and rural settings use different ICT types but despite this general finding, there is a significant difference in the use of the different ICT types by farmers in the two settings. Radio is the type of ICT used to acquire agricultural knowledge that is mostly used by farmers in peri-urban and rural settings in this study. Television and internet use are more popular in the peri-urban setting than in the rural setting. Poor infra structure is one of the major reasons behind this significant difference in use of television and internet; while radios can use the lowest form of technology and energy like the battery cells, the latter requires a higher form of technology and energy like electricity or stronger cells of higher voltage. These are expensive, thus out of reach for most farmers. Technologies involving use of short messaging services with the mobile phones have been developed in Kenya for instance the kuzadoctor technology developed by Back pack Farm (www.backpackfarm.org). However, these results show that even with the increasing use of mobile phones across Kenya and the increasing development of mobile based technologies, most of the farmers in Dagoretti and Mbooni do not use them as a means of acquiring new knowledge regarding agricultural innovations. The widely used channel for knowledge sharing among the farmers is the face to face interaction, which play a very important role in knowledge sharing especially in informal settings (Juma, 2011). Juma

emphasises the role and importance of social interactions in knowledge and information sharing, and further argues that "informal social interactions and institutions play a central role in building trust and interpersonal relationships which in turn increases the speed and frequency of knowledge, resource and information sharing" This argument could be used to explain the widespread use of face to face interaction as the major channel of knowledge sharing in the small holder set up as shown by the results of this study. These results further show consistency with Schreiber *et al.,* (1999) argument that a large part of knowledge is implicit and is mainly converted and shared through face to face interactions. The results clearly show that agricultural knowledge largely exists in tacit form with a significant percentage of farmers in this study storing their knowledge in a tacit form and further rely on this knowledge for production.

4.5: Ease of access of knowledge sources and ICT types used

The ease of access of the different sources of knowledge and the reason behind each case in each setting, for five of the sources (government extension agents, NGO extension agents, farmer associations, input suppliers and private companies) was sought through ranking. Figure 13 shows that in Dagoretti district, 71.8% of the farmers found government extension agents very easy to access, with only 6.8% of the farmers reporting that they find it impossible to access them. This was in contrast to the case in Mbooni district where only 29.9% of the farmers found it very easy to access the government extension agents.
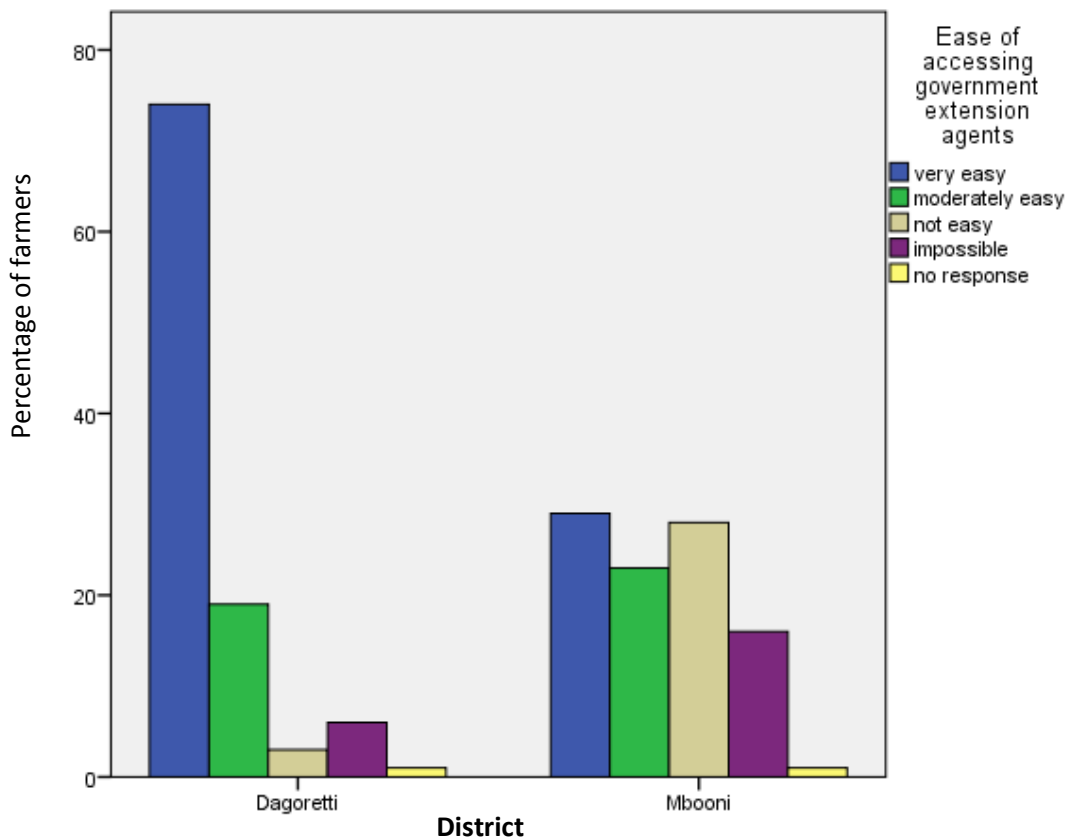
Figure 12: Ease of accessing government extension agents for farmers in Dagoretti and Mbooni districts

A cross tabulation was carried out, between reason given for ease of access and number of farmers in each district. Results in table 13 revealed that the government extension agents were readily available for 64.1% of the farmers in the peri-urban setting (Dagoretti) while for 21.4% of farmers, the offices are within their proximity. The situation was statistically significant in Mbooni (p=0.001) where only 24.7% of the famers reported that the government extension agents are readily available to them, with majority (41.2%) of them reporting that the government extension agents are located within long distances from their homes and hence not very easy to access. Only 2.9% of the farmers in the peri-urban setting cited long distance as a reason behind their given ease of access of the government extension agents.

Table 13: Reasons given by farmers on ease of accessing government extension agents in Dagoretti and Mbooni districts

District		readily available	proximity of offices	long distance	use mobile phone	don't know where to get them	don't know about them
				Reason for answer in Government extension agents			
Dagoretti	Count	66	22	3	3	7	2
		64.1%	21.4%	2.9%	2.9%	6.8%	2.0%
Mbooni	Count	24	10	40	2	10	11
		24.7%	10.3%	41.2%	2.1%	10.3%	11.3%

Through focused group discussions (FGDs) the study sought to get a deeper understanding of the reasons behind the ease of access of the various sources of knowledge. From the FGDs held in Dagoretti district, the study established that most of the farmers were in touch with the government extension workers, they made frequent visits to their offices or vice versa, and they had the mobile phone contacts of the extension agents and hence could get in touch with them any time. A visit to the ministry of Agriculture divisional offices in Dagoretti district revealed that indeed the mobile phone numbers of the two extension workers in each of the two divisions were displayed on the door for any farmer with queries to call. This was in contrast to the situation in Mbooni where the FGDs revealed that the extension workers used to make farm visits many years in the past (more than ten years ago), but not anymore. It emerged that the extension agents and the farmers in this district mainly rely on chief's gatherings (baraza) to meet and get more information and unlike in the peri-urban setting, the mobile phone numbers of the government extension workers are not displayed for the public to contact.

With respect to the non-governmental extension agents, the study found out that they were not very popular with the farmers in both districts, with 7.8% and 2.1% of the farmers in

Dagoretti and Mbooni respectively indicating that they found them very easy to access, and 40.8% and 49.5% of the farmers in Dagoretti and Mbooni respectively found it impossible to access them. Another 26.2% and 25.2% of farmers in Dagoretti found them moderately easy and not easy to access respectively. 29.9% of the farmers in Mbooni district found it moderately easy to access them, while 18.6% found them not easy to access. This difference in ease of accessing NGO extension agents is not statistically significant at 5% (p=0.255).

Ease of accessing farmer associations and private companies was established to be significantly different at 5%, while ease of accessing input suppliers was not statistically significant. Table 14 shows the cross tabulation between ease of accessing farmer associations, input suppliers and private companies with number of farmers in each district

Table 14: Ease of accessing farmer associations, input suppliers and private companies by farmers in Dagoretti and Mbooni districts

Knowledge source	Dagoretti		Mbooni	
Farmer Associations	Frequency	Percent	Frequency	Percent
Very easy	23	22.30%	9	9.30%
Moderately easy	20	19.40%	10	10.30%
Not easy	31	30.10%	5	5.20%
Impossible	29	28.20%	73	75.30%
Input suppliers				
Very easy	17	16.50%	31	32%
Moderately easy	35	34%	23	23.70%
Not easy	20	19.40%	12	12.40%
Impossible	31	30.10%	31	32%
Private Companies				
Very easy	2	1.90%	31	32%
Moderately easy	0	0%	1	1%
Not easy	3	2.90%	2	2.10%
Impossible	98	95.10%	63	64.90%

An independent samples Mann Whitney U-test carried out to compare the ease of access of these knowledge sources in the two districts showed that there was no statistically significant difference in ease of access of input suppliers (p=0.188), but there was a statistically significant difference in ease of access of farmer associations (p=0.000) and private companies (p=0.001) between the two districts, with farmers in Mbooni having easier access to private companies than those in Dagoretti, while those in Dagoretti had easier access to farmer associations.. The study established that this was due to the presence of private commercial companies in Mbooni district, and thus they were readily available to most of the farmers who engaged in cultivation of French beans in the district through weekly farm visits, as well as through mobile phone communications. As such, they were the preferred source of knowledge to the farmers who mainly cultivate French beans in the district. Further, the companies served as a link between the farmers and the export market. This was in contrast to the situation in Dagoretti district where the private commercial companies are not present and majority of the farmers (74.8%) reach the local market and the rest (24.3%) sell at their farm gates. However, Dagoretti district recorded a significant percentage of farmers (p=0.001) who rely on farmer associations, where 22.30% find them very easy to reach, compared to 9% of farmers in Mbooni, and only 28% find farmer associations impossible to reach, unlike in Mbooni where a majority of farmers (75%) find it impossible to reach farmer associations.

The study sought to establish the frequency of extension agent visits to the farmers (farms) and a cross tabulation of the frequency of extension agents' visits with the number of farmers (Table 16) revealed that there was a significant difference between the two settings (p=0.000). While majority of the farmers in Dagoretti (45.1%) are visited by extension agents every month followed by quarterly visits to 19.6% of the farmers, majority of those in

Mbooni district (40.2%) are visited every quarter, followed by weekly visits to 22.7% of the farmers. There is relationship between the frequency of the extension agents' visits to the farmers, and their spread within the two settings, and this is influenced by the presence of an office within the district. Although the rural setting records the highest presence of the non government agricultural stakeholders, the study established that most of them have their offices situated either in the Capital city (Nairobi), or in the County headquarters. Out of all the extension agents working in the rural setting, only the government extension agent (Ministry of Agriculture) has an established office within the district and their staffs are therefore able to make monthly visits to the farmer's farms.[6]. The rest of the stakeholders operate in the district but they have offices in Nairobi, Machakos and Kibwezi for Syngenta, HCDA, USAID and UCCS respectively. The study established that they operate in Mbooni district by hiring field officers to work in the district and established contacts with specific farmers. For this reason, they are not able to make monthly visits to the farms because the work in other districts compared to the ministry of Agriculture which has established offices in each district.

Table 15: Frequency of extension agents' visits to farmers in Dagoretti and Mbooni districts

District		Frequency of extension agents' visits						
		Weekly	monthly	quarterly	never	when requested	when need arises	they used to come in the past
Dagoretti	N	12	46	20	12	10	1	1
	%	**11.8%**	**45.1%**	**19.6%**	**11.8%**	**9.8%**	**1.0%**	**1.0%**
Mbooni	N	22	16	39	16	0	2	2
	%	**22.7%**	**16.5%**	**40.2%**	**16.5%**	**0.0%**	**2.1%**	**2.1%**
Total	N	34	62	59	28	10	3	3
	%	17.1%	31.2%	29.6%	14.1%	5.0%	1.5%	1.5%

---

[6] The study established that the performance contracts signed by the ministry of Agriculture staff, requires them to reach a certain number of farmers every year.

Farmers were further asked to give their experience on ease of accessing the different ICT types for agricultural knowledge acquisition and give reasons. Table 16 shows the ease of accessing mobile phone technologies, radio and television agricultural programmes and internet.

Table 16: Ease of accessing different ICT types in Dagoretti and Mbooni districts

ICT type	Dagoretti		Mbooni	
Radio Programmes	Frequency	Percent	Frequency	Percent
Very easy	56	54.40%	51	52.60%
Moderately easy	28	27.20%	19	19.60%
Not easy	11	10.70%	9	9.30%
Impossible	8	7.80%	18	18.60%
Television programmes				
Very easy	45	43.70%	6	6.20%
Moderately easy	27	26.20%	7	9.70%
Not easy	10	9.70%	11	11.30%
Impossible	21	20.40%	73	75.30%
Mobile phone services				
Very easy	26	25.20%	21	21.60%
Moderately easy	12	11.70%	14	14.40%
Not easy	14	13.60%	8	8.20%
Impossible	51	49.50%	54	55.70%
Internet				
Very easy	20	19.40%	3	3.10%
Moderately easy	6	5.80%	0	0%
Not easy	7	6.80%	7	7.20%
Impossible	70	68%	87	89.70%

A cross tabulation of ease of access of these different ICT types with the number of farmers in each district (Table 16) show that more than half of the farmers in both districts found it very easy to access the agricultural/farmer programmes on radio as a source of agricultural knowledge (54.4% and 52.6% of farmers in Dagoretti and Mbooni districts respectively).

57

While 43.7% of the farmers in the peri-urban setting have very easy access to agricultural/ farmer programmes on televisions, only 6.2% of those in the rural setting have very easy access to televisions with the majority of the farmers in this setting (75.3%) finding it impossible to access the television programmes. With respect to the mobile phone services, majority of the farmers in both settings find them impossible to access (49.5% and 55.7% of the farmers in Dagoretti and Mbooni, respectively). Internet records the highest number of farmers who find it impossible to access, with 68% of farmers in Dagoretti and 89.7% of those in Mbooni district. Only 3.1% of farmers in Mbooni and 19.4% of those in Dagoretti have very easy access to internet. The difference in ease of access to the different ICT types in the two settings is statistically significant at 5% for the television programmes (p=0.000) and internet (p=0.000), while there is no statistical significant difference in ease of access of radio programmes (p=0.348) and mobile phone services (p=0.470) between the two settings.

This study further sought to investigate why different farmers in the different settings have different experiences in ease of accessing the various ICT types for agricultural knowledge acquisition. Farmers were asked to give reasons behind their experiences in ease of access. A cross tabulation of reasons with number of farmers in each district show that even though majority of farmers in both settings (67% and 66.7% in Dagoretti and Mbooni, respectively) say that the radio and the programmes are readily available to them, a significant percentage (p=0.000) of farmers (28.1% in Dagoretti and 20.8% in Mbooni) cite inconsistency and inconvenient timing of the programmes as the major reason hindering their access to the radio programs (figure 14).

Figure 13: Reasons influencing farmers' access of agricultural radio programmes in Dagoretti and Mbooni

The case in television programmes is different in both settings (Figure 15); while for 60.8% of farmers in Dagoretti the television and the programmes are readily available; this is only true for 13% of the farmers in Mbooni. A majority of these farmers in Mbooni (52.7%) do not know about any agricultural programmes aired on television, and 15% do not have television sets. 20.6% of the farmers in Dagoretti cited inconsistent and inconvenient timing as one of the reasons hindering their access to the agricultural/farmer programmes aired on television.
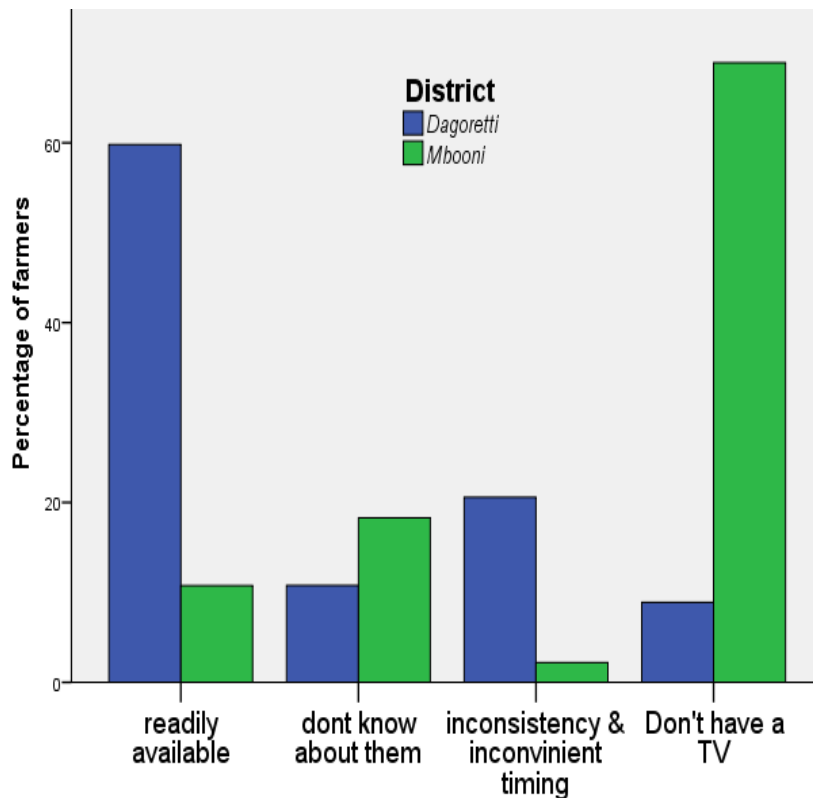
Figure 14: Reasons influencing farmers' access of Television-based agricultural programmes in Dagoretti and Mbooni

The difference in the reasons as reflected in figure 15 was found to have a statistical significance (p=0.000).

With respect to reasons influencing farmers' access of mobile-based agricultural technologies in Dagoretti and Mbooni West districts, the difference observed was did not a statistical significance (p=0.368). As reflected in figure 16, mobile phone services are readily available to 29.1% and 30.9% of the farmers in Dagoretti and Mbooni respectively, while a simple majority of the farmers in both districts (48.5% and 45.8%) for Dagoretti and Mbooni respectively do not know about them.
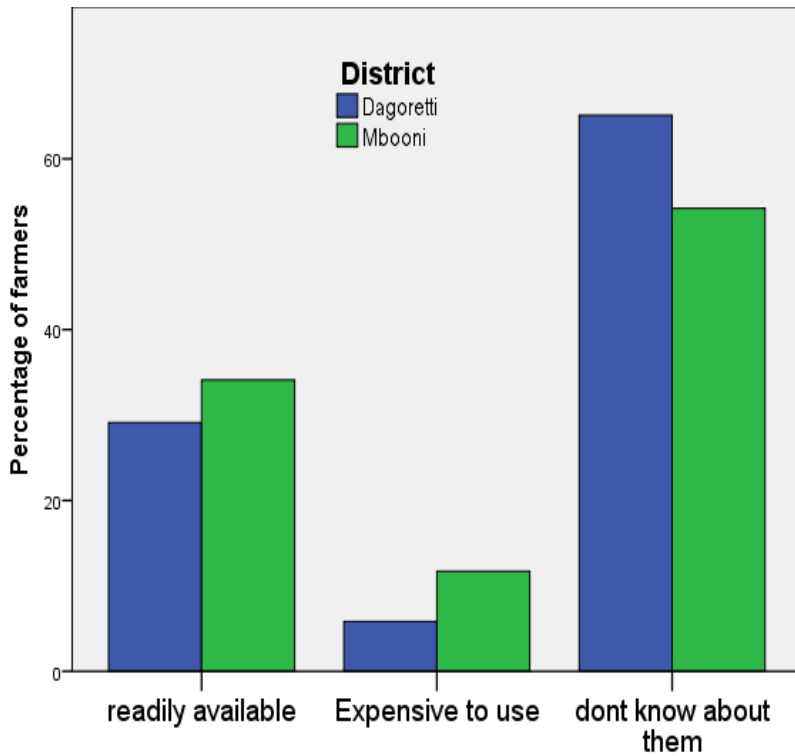
Figure 15: Reasons influencing farmers' access of mobile-based agricultural technologies in Dagoretti and Mbooni

Internet access and reasons influencing access of internet-based agricultural technologies equally registered a significant difference (p=0.023) in Dagoretti and Mbooni. Whereas 21.4% of the farmers in Dagoretti have readily available internet access, only 3% of the farmers in Mbooni have the same experience (Figure 17). A larger percentage of the farmers in this rural setting do not know about internet (59.8%) and of the ones who know, 19.6% do not know how to use internet facilities or applications.
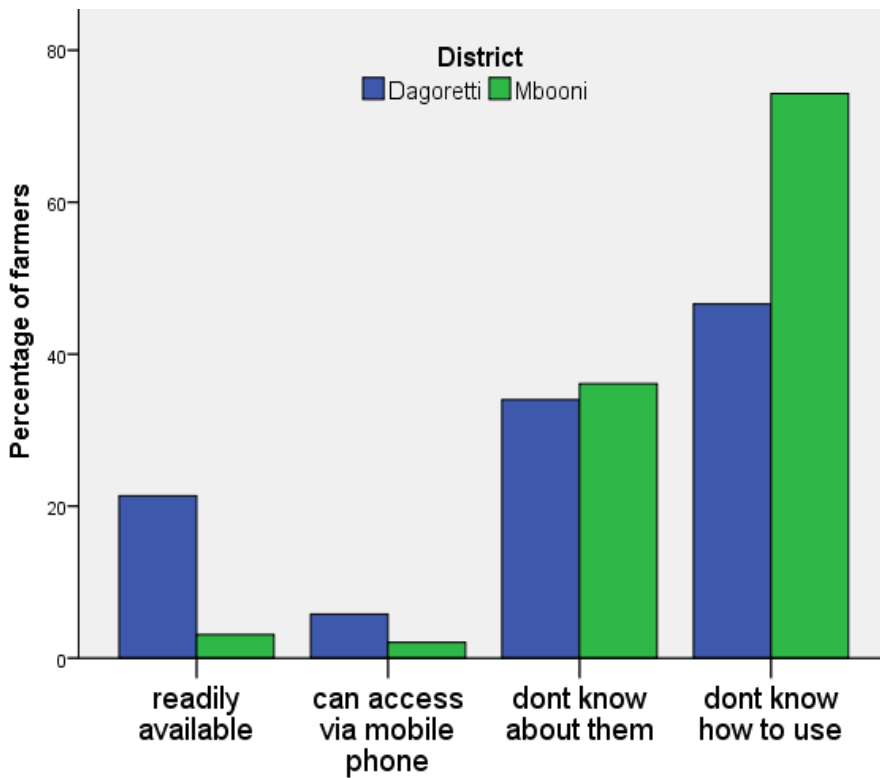
Figure 16: Reasons influencing farmers' access of internet-based agricultural technologies in Dagoretti and Mbooni

Even though the government extension agents have a nation-wide representation through the Ministry of Agriculture, farmers' ease of accessing them differs significantly in peri-urban and rural settings. In the peri-urban settings, there are readily available forms of transport with most of the offices located close to the main roads, as compared to the rural setting where infra structure is a challenge with the main mode of transport being the motorcycles and are expensive for the farmers. This difference in ease of access is also influenced by the context and the demand for specific knowledge based on the farmers' information needs and types of crops grown; whereas the private companies are more prominent and easier to access in the rural setting than in the peri-urban setting, due to the export oriented nature of business in the rural setting. Majority of farmers in Mbooni district grow French beans with a high

demand in the export market compared to Dagoretti district where main vegetables cultivated are have demand only in the local market.

Even though radio is widely use by most farmers and traditional forms of ICT such as radio have become more prevalent in advisory service provision with more radio stations giving airtime for agricultural programmes or information (Nyirenda-Jere, 2010), only a simple majority, 54.4% and 52.2% of farmers in peri-urban and rural setting, respectively have easy access to these programmes. This is because of inconsistency and inconvenience in the timing of the programmes. With the widespread use of mobile phones especially in Kenya, voice and short messaging services have gained more popularity and they offer easy accessibility. However, these results show that the mobile based technologies are not easily accessible to most farmers in Mbooni and Dagoretti districts, mainly due to lack of information about these technologies. This finding is equally echoed by FARA (2009) who notes that despite the many initiatives on ICTs and small-scale farmers in Africa, information on the different initiatives are not easily accessible.

The government of Kenya through its National Agricultural and Livestock Programme (NALEP) has developed a web based technology (National Farmers Information Service – NAFIS) aimed at disseminating information and knowledge to farmers as a way of embracing technology (www.nafis.go.ke). However, only a small percentage of farmers know about internet and its use, with a smaller percentage able to access the technology. Most of the farmers in the rural setting (Mbooni district) do not know about this technology, they either do not know about internet, or do not know how to use and where to get access. For this reason, only a handful of the farmers in Mbooni district use internet in accessing and sharing information.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Despite a general finding showing the use of eight main sources for knowledge acquisition in both peri-urban and rural setting, the ease of their accessibility varies significantly. Farmers in the peri-urban setting have easier access to Government extension agents than those in the rural setting; farmers in the latter setting have easier access to private companies. The study established that this difference is influenced by the context and the information needs. Private companies are more prominent in the rural setting due to the export oriented nature of farming in Mbooni west district. Majority of farmers grow French-beans with a high demand in the export market, compared to Dagoretti district where the main vegetables cultivated are for consumption in the local market.

Use of ICT is influenced by the setting based on nature of business with respect to types of crops grown, information needs and infra-structure.

- Therefore, the study rejects the null hypotheses because there is a significant difference in knowledge management processes in both settings based on the following key findings:

- There are more agricultural stakeholders of different categories offering extension and advisory services in the rural setting compared to the peri-urban setting and hence the farmers in both settings have access to different sources of knowledge.

- The entry of non-government stakeholders in the extension and advisory services sector has increased the farmers' sources of knowledge and made it easier for them to access knowledge whenever needed. In addition, the new agricultural extension policy (NASEP) has created opportunities for strengthening this system, by putting in place opportunities and systems for collaboration among the various stakeholders. These

64

stakeholders reach out to farmers based on their demand and response from the activities held to initiate demand

- With respect to use of ICTs to acquire knowledge, there is no significant difference in use of radio and mobile phones in the two settings. However, the use of television and internet differs significantly between rural and peri-urban settings. Television and internet use is more widespread in the peri-urban setting compared to the rural setting. Education level influences use of ICT in KM, with a bigger percentage of farmers with higher education levels using ICTs, than those with lower education level.

- The extent of use of specific ICT types for knowledge acquisition in peri-urban and rural settings differs between the two settings with a higher percentage of farmers in the peri-urban setting using radio and television to acquire information and knowledge compared to the rural setting. In knowledge sharing, majority of the farmers in both settings using face to face interactions to share knowledge among themselves, other than ICT. The main medium used to store acquired knowledge is use paper files and notebooks in both peri-urban and rural settings, with the use of ICT for this process being very minimal.

- There is a difference in the channels used to obtain information about the various agricultural and farmer oriented events: Farmers in the peri-urban setting rely on the extension agents and radio, while those in the rural setting rely largely on fellow famers and the district administration (chiefs).

One of the limitations that the study faced was that most of the farmers who were available for the FGDs were women, compared to men.

5.2: Recommendations

- Establish the reason behind the difference in spread of agricultural stakeholders and what impact the difference has on the different farming systems and settings.

- Create more awareness among the farmers regarding the newly developed mobile and web based technologies to promote increased use of these technologies. In addition, training the farmers and the extension workers on ICT usage to promote the adoption of these technologies

- The organisations and actors behind the radio-based and television-based agricultural programmes need to ensure consistency in timing and airing of these programmes for maximised uptake and use of the innovations

- Further surveys to establish the situation in different peri-urban and rural areas, with respect to adoption levels of the ICT-based innovations for knowledge acquisition and dissemination; these would be useful to assist the government as it plans outreach to farmers, and to the private sector which provides ICT infra-structure.

REFERENCES:

Adekunlle A A, Ellis-Jones J, Nyikal R a, Bangali S, Fatunbi O and Ange A. (2012). *Agricultural Innovation in Sub Saharan Africa: Experiences from Multiple Stakeholder Approaches.* Accra: Forum for Agricultural Research in Africa (FARA).

Alavi M and Leidner D. (1999). Knowledge Managment System: Issues, Challenges and Benefits. *Communications of the Association for Information System, 1*(7), 2 to 41.

Allen T and Thomas A. (2000). *Poverty and Development into the 21st Century.* London: The Open University and Oxford University Press.

Annderson, J. R. (2008). Agricultural Advisory Services: A background paper for Innovating through Science and Technology. In W. Banl, *World Development Report.* Washington D C: World Bank.

Awad M E and Ghaziri M H. (2001). *Knolwedge Management.* New Jersey: Prentice Hall.

Beckman T, J. (1999). The Current State ofKnolwedge Management. In J. Liebowitz, *Knowledge Management Handbook* (p. 22). CRC Press.

Bellinger G, Castro D and Mills A. (2004, November 01). *Data, Information, Knowledge and Wisdom: The way of Systems Thinkning*. Retrieved May 25, 2011, from http://www.systems-thinking.org/dikw/dikw.htm

Bertolini R. (2004). *Strategi thinking: making information and communication technologies work for food security in Africa.* IFPRI publications.

Boisot, M. (1987). *Information and Organisations: The manager as an anthropologist.* London: Fontana/Collins.

Borghoff, M U and Pareschi R. (1998). *Information Technology forKnowledge Management.* Berlin Heidelberg: Springer-Verlag.

Botha, A. K. (2008). *Coping with continous Change in Business Environment, Knowledge management and knowledge management technology.* Chandice Publiching Ltd.

Bouthillier, F and Shearer, K. (2002). Understanding Knowledge Management and Information Management:The need for an empirical perspective. *Journal of Information Research, 8*(1). Retrieved from http://InformationR.net/ir/8-1/paper141.html

Brooking, A. (1996). *Intellectual Capital.* London: Thompson Press.

Brown, J S and Duguid P. (1998). Organising Knowledge. *Carlifornia Management Review, 40.*

Choo, C. (1998). *Information Management forthe Intelligent Organisation:the art of scanning the environment.* Medford, NJ: Information Today.

Christopolos, I. (2010). *Mobilising the potential of Rural and Agricultural Extension.* Neuchatel Group.

Davenport T H and Prusak L. (1998). *Working Knolwedge: How Organisations Manage What They Know.* Boston: Harvad Business School Press.

Davidson C and Voss P. (2002). *Knowledge Management: An introduction to creating competitive advantage from intellectual Capital.* New Delhi: Vision Books.

Export Processing Zones Authority (EPZA). (2005). *Horticultural Subsector Report.* Nairobi: EPZA.

FAO. (2012). Urban Agriculkture Stakeholders' Network Creation Workshop. *Urban Agriculkture Stakeholders' Network Creation Workshop.* Addis-ababa: FAO.

FARA, (Forum for Agricultural Resarch in Africa). (2009). *Inventory of Innovative Farmer Advisory Services using ICTs.* Accra: FARA.

Frost, A. (2011, April 09). *KMT*. Retrieved from A KM Resource site: http://www.knolwedge-management-tools.net/

Gamble P R and Blackwell J. (2001). *Knowledge Management: A state of the Art Guide.* Kogan Page Ltd.

Gok,. (2010). *Agricultural Sector Development Strategy (ASDS) 2010-2020.* Nairobi: Government Printers.

GoK. (2002). *National Agricultural Extension Policy(NAEP).* Nairobi: Government Printers.

GoK. (2004). *Strategy for Revitalisation of Agriculture (SRA 2004-2014).* Nairobi: Government Printers.

GoK. (2005). *Kenya Vision 2030.* Nairobi: Government Printers.

GoK. (2008). *National Agricultural SectorExtension Policy (NASEP).* Nairobi: Government printers.

GoK. (2010). *Urban and Peri-urban Agriculture and Livestock (UPAL) draft policy.* Nairobi: Government Printers.

GoK. (2011). *Ministry of Agriculture, Ministry of Livestock Development; Report on Training Needs Assesment: National Agricluture and Livestock Extension Programme.* Nairobi: Government Printers.

GoK. (2012, March 15). *What is NAFIS*. Retrieved from NAFIS: http://www.nafis.go.ke

Ha L, Okigbo R N Igboaka P. (2008). Knolwedge Creation and dissemination in sub-Saharan Africa. *Journal of Management Decision, 46*(3), 392-405.

Hartwich, F M. Monge Perez, L. Ampuero Ramos and Soto, J L. (2007). Knowledge Management for agricultural innovation: Lessons form networks in the Bolivian Agricultural Technology System. *Knowledge Management for Development Journal, 3*(2), 21-37.

Hoffman V, Gerster-Bentaya M, Christinck A and Lemma M. (2009). *Handbook: Rural Extension Extension Volume 1, Basic Issues and Concepts.* Margaf Publishers GmbH, Scientifc Books.

Horticultural Crops Development Authority (HCDA). (2010). *Horticulture Validated Annual Report 2010.* Nairobi: HCDA.

Juma C. (2011). *Teh New Harvets: Agricultural Innovation in Africa.* New York: Oxford University Press.

Kakabadse N. K, Kouzmin A and Kakabadse A. (2001). From Tacit Knowledge to Knowledge: Leveraging invisible assets. *Knowledge and Process Management*, 137 to 154.

Kenya Development Learning Centre (KDLC). (2010). *Smallholder Farmers' Involvement in Commercial Horticulture:Kenya's Perspective.* Nairobi: KDLC.

Long N, and Villareal M. (1994). The Interweaving of Knolwedge and Power in Development Interfaces. In S. I. J, *Beyond Farmer First: Rural People's Knwoledge,*

agricultural research and exension practice (p. 49). London: Intermediate Technology Publications Ltd.

Lucey, T. (1998). *Management Information Systems.* New Delhi: BPB Publications.

Luen T W and Al-Hawamdeh S. (2001). Knowledge Management in the public sector: Principles and practices in police work. *Journal o fInformation Science*, 311-318.

MacMorrow, N. (2001). Knowledge Management: an introduction. *Annual Review of Information Science and Technology*, 381-422.

Martensson, M. (2000). A critical review of Knowledge Management as a management tool. *Journal of knowledge management, 4*, 204-216.

Munyua H. (2008). *ICTs and Smallscale Agriculture in Africa- A scoping study.* The International Development Research Centre (IDRC).

Nonaka I. (1994). Theory of Organisational Knowledge Creation. *Journal of Organisational Science, 5*(1).

Nonaka, I and Takeuchi, K. (1995). *The Knolwedge Creating Company: How Japanese Companies Create the Dynamics of Innovation.* Oxford: Oxford University Press.

Nonaka, I Toyama, R and Konno, N. (2000). SECI, ba and Leadership: a unified model of dynamic knolwedge creation. *Journal of Long Range Planning, 33*, 5-34.

Nyirenda-Jere, T. (2010). Unlocking the promise of ICTs for Transforming Agriculture in Africa. Retrieved from CTApublications.

O'Dell C and Grayson C, J. (1998). Only we knew what we know: identification and transfer of internal best practices. *Carlifornia Management Review, 40*(3), 154-174.

Olima W. (2010). *Urban Agriculture in Kenya: Experiences and challenges.* Nairobi: University of Nairobi.

SchreiberG, McCaul M R, Anjewierden A, De Hoog R, Shadbolt R N, Van de Velde W and Wellinga B J. (1999). *Knowledge Engineering and Management: The common KADS methodology.*

Singh R B,Kumar P, and Woodhead T. (2002). Small Holder Farmers in India:Food Security and Agricultural Productivity. New Delhi.

Stein, E W and Zwass, V. (1995). Actualizing Organizational Memory with Information Systems. *Information Systems Research, 6*(2), 85-117.

Steyn, P.D. and du Toit A.S.A. (2010). Investigating the potential for the development of a just-in-time knowledge managment model. *South African Journal of Business Management, 41*(2).

Swanson, B and Rajalati R. (2010). Strengthening Agricultural Extension and Advisory Systems:Procedures for Assessing, Transforming and Evaluating Extension Systems. *Agriculture and Rural Development Discussion Paper 45*.

Tiwana, A. (2000). *The Knolwedge Management Toolkit.* Upper Saddle River, New Jersey: Prentice Hall.

Uriarte, F. A. (2008). *Introduction to Knowledge Management: A brief Introduction to the basic element of knowledge management for non practitioners interested in understanding the subject.* Jarkata: ASEAN Foundation.

Wellman, J. L. (2009). *Orgnaisational Learning.* Palgrave Macmillan.

Wenger E, McDermott R and Snyder W. (2002). *Cultivating communities of Practice: a guide to managing knowledge.* Harvard Businmess School Press.

World Bank. (1998a). *What is knowledge management?* Retrieved from worldbank publications: http://www.worldbank.org/ks/html/pubs_what.html

WorldBank. (1998b). *Knowledge for Development.* New York: Oxford University Press.

World Bank. (2007). *Enhancing Agricultural Innovation: How to go beyond the strengthening of research systems.* Washington: The World Bank.

World Bank. (2011). *ICT in agriculture e-sourcebook.* The World Bank.

Yamane Taro. (1967). *Statistics: an introductory analysis* (2nd ed.). New York: Harper and Row.

APPENDICES

Appendix 1: Questionnaire

**COMPARATIVE STUDY OF PERI-URBAN AND RURAL AGRICULTURAL
KNOWLEDGE MANAGEMENT: A CASE STUDY OF SMALL HOLDER
HORTICULTURAL PRODUCERS IN DAGORETTI AND MBOONI DISTRICTS**

By Dorine A. Odongo (University of Nairobi)

Survey questionnaire

A) **Background Information**
   1. Information on respondent

Gender	Age	District	Size of land (in acres)	Attained education level	Alternative source of income	Ever been formally employed	Years engaged in farming
1=Male	1=15-30	1= Dagoretti	1=below 0.125	1=none	1=self employed	1=yes	1=1to 5
2=Female	2=31-45	2=Mbooni West	2=0.125 to0.5	2=primary	2=casual labourer	2=no	2=6 to10
	3=46-65		3=0.5 to 1	3=secondary	3=Formally employed		3=11 to 15
	4=0ver 66		4=1 to 2	4=tertiary	4=none		4= more than 15
			5=more than 2	5=university			

   2. Household demographic information

Size of household	1=1 to5, 2=6 to10, 3=11 to 15, 4=more than 15
Gender of household head	1=male, 2=female
Number of members below 18years	1= none 2=)1 to 5, 3=6 to 10, 4= more than 11
Number of people above 18 years	1=none 2= 1 to 3, 3= 4 to 6, 4= 7 to 10, 5= more than 11
Number of adults with formal education	1=none 2= 1 to 5, 3= more than 5

   3. Crop production

Type of crops grown	Source of labour	Source of water for production	Market for sale
1= Fruits	1= family labour	1= rainfall	1=local market
2= Vegetables	2= casual labourers	2= irrigation	2=outside market
3= other (please specify	3=permanent employee		3=export market
			4=other (please specify)

B) Knowledge creation and acquisition

4. Which type of agricultural knowledge do you consider more important?
      1=Agronomic package for production
      2=Pest control
      3=Input prices and availability
      4=Post harvest handling and availability
      5=Market availability and prices
      6=other (please specify)

5. What are your main sources of agricultural knowledge?
      1=Government Extension agents
      2=NGO extension agents
      3=Farmer Associations
      4=Input suppliers
      5=Neighbours
      6=Other (Please Specify) ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

6. Which of the above sources do you use most often?
      1=Government extension agents
      2=NGO extension agents
      3=Farmer Associations
      4=Input suppliers
      5=Neighbours
      6=Other (please specify)

7. Do you use ICT tools to acquire knowledge?
      1=yes 2=No

8. If yes for 7above, which of the following ICT tools do you rely on as a source of agricultural knowledge?
      1=Radio programmes
      2=Television programmes
      3=Mobile phones
      4=Internet
      5=other (please specify) ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

9. How often do extension agents visit to disseminate knowledge?
      1= Weekly   2= Monthly   3= Quarterly 4=Never   5=Other

10. Please rank the following sources of knowledge according to ease of access whenever needed, according to the scale given (1= very easy, 2= moderately easy, 3= not easy, 4= impossible)

Source of knowledge	1	2	3	4
Government extension agents				
NGO extension agents				
Farmer Associations				
Input suppliers				
Radio programmes				
Television programmes				
Mobile phone services				
Internet				
Other (please specify)				

11. Give reason for your answer in 10 above, as per the scale given (1= readily available, 2=proximity of offices, 3=long distance, 4=use of mobile phones, 5= don't know where to get them, 6=don't know about them, 7= other (please specify)

Source of knowledge	1	2	3	4	5	6	7
Government extension agents							
NGO extension agents							
Farmer Associations							
Input suppliers							
Radio programmes							
Television programmes							
Mobile phone services							
Internet							
Other (please specify)							

c) Knowledge sharing and dissemination

12. Do you have a forum where you meet as farmers on your own to share agricultural knowledge?

       1=Yes   2=No

13. If yes for 12 above, how often do you meet?

       1=Daily   2=Weekly   3=Monthly   4=other (please ~~specify~~) ─────────

14. Which methods do you use to share agricultural knowledge with others?

       1=Face to face interaction
       2=Use of mobile phones
       3=Use of internet
       4=other (please specify) ─────────────────────────

15. How do you meet with the extension agents?

       1=they come to our farms
       2=I go to their offices
       3=Sometimes we go to their offices; sometimes they come to our farms
       4=I use a telephone to call them
       5=I send them emails
       6=other (please specify) ─────────────────────────

16. Do you share agricultural information with other farmers from outside the district?

       1=Yes   2=No

17. If yes for 16 which channels do you use to communicate?

       1=Face to face interaction
       2=Internet
       3=Mobile phones
       4=other (please specify) ─────────────────────────

18. Please indicate whether you attend the events listed below (indicate with a tick).

Event	1=yes	2= no
Workshops		
Field days		
Agricultural shows		
Chief's barazas		

19. Please tick the channels you use to get information about the events listed in 19 above

       1=Radio
       2=TVs
       3=Internet
       4=Extension agents
       5=Fellow farmers
       6=Family relations

7=other (please specify) ——————————————————

20. If you ticked no for any event in question 19 above, please indicate why you do not attend such events.
  1=Lack of information about it
  2=Distance
  3=Lack of funds/resources to attend
  4=Lack of interest
  5=other (please specify) ————————————

D) Knowledge Storage and Retrieval

21. Do you find it necessary to keep the knowledge acquired in a physical form?
  1=yes   2=No

22. The knowledge you acquired is stored in which form?
  1=a paper file
  2=a computer
  3=a compact disc
  4=other (please specify) ————————————

23. How often do you refer to the knowledge acquired previously?
1= Weekly   2=Monthly   3=Never   4=When needed   5= other

24. Please indicate how easy it is to retrieve knowledge stored in the following forms, according to scale given in the table below (1= very easy, 2= moderately easy, 3= not easy, 4= impossible)

Form of Storage	Ease of retrieval			
	1	2	3	4
Paper file				
Computer				
Compact disc				
Other (specify)				

Thank you for taking your time to fill this questionnaire. Your contribution/answers will be treated with utmost confidentiality. You will remain anonymous and your responses will be used for academic purposes only.

Appendix 2: Interviews checklist

COMPARATIVE STUDY OF PERI-URBAN AND RURAL AGRICULTURAL KNOWLEDGE MANAGEMENT: THE CASE STUDY OF DAGORETTI AND MBOONI HORTICULTURE SMALLHOLDERS

Interview checklist

This case study is being undertaken by Dorine Odongo, as part of an Msc course in Agricultural Information and Communication Management from the University of Nairobi.

The study seeks to establish the status of agricultural knowledge management among smallholder horticulture farmers, and to compare the situation between rural and peri-urban settings, with respect to knowledge acquisition, knowledge sharing and dissemination, knowledge storage and retrieval, and the application of this knowledge.

The interview targets the extension agents in the district, both government and non government.

Government's extension service

- What is the ratio of public extension officers to farmers?
- What tools and approaches do you use to disseminate knowledge to farmers?
- How often do you meet the farmers?
- Are you able to reach all the farmers in the district?
- What criteria do you use to reach the farmers?
- What ICT tools do you use to disseminate knowledge to the farmers?
- How do you reach the farmers?
- What collaborative arrangements do you have with other extension agents and players in the district?

Non government extension service
- For how long have you been operating in the district?
- What working relationship do you have with the ministry of agriculture?
- How do you meet with the farmers?
- What tools and approaches do you use to disseminate knowledge to the farmers?
- What criteria do you use to select the farmers you reach?
- How often do you interact with the farmers?