Assessment of the role of agro-input dealers in dissemination and communication of integrated soil fertility management: The case of Siaya and Trans Nzoia counties

MSc. Thesis

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DECLARATION AND APPROVAL

I, Tiberious Brian Etyang, declare that this thesis is my original work and has not been presented for a degree in any other university or any other award.

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Dedication

Foremost this work is dedicated to my late grandmother, Phoebe Ikakoro, a pillar and inspiration. Secondly to all the pioneers of the African green revolution in their efforts in addressing the challenges that smallholder farmers are facing in Sub Saharan Africa.

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My gratitude goes to my colleagues Franklin Mairura, Boaz Waswa, Ayuke Fredrick, Kibor Benjamin, Hellen Kamiri, Fredah Maina, Joyce Jefwa, Jeremiah Mosioma, Ivan Adolwa and Savini Isaac for their support during my studies phase. I would also like to thank my classmates, Agricultural Information and Communication Management (AICM) class of 2009, for the support they may have lent me in the course of my studies. lastly, I highly appreciate the work carried out by the enumerators and the cooperation received from the agro-input dealers in Siaya and Trans Nzoia counties.

Abstract

Lack of access to necessary agro-inputs contributes to low agricultural productivity and slows the overall economic growth and development in most parts of sub Saharan Africa (SSA). Agro-input dealers make inputs more easily accessible to rural-based smallholder farmers. Despite their importance, little is known about the strategies agro-input dealers use in the dissemination and communication of information and knowledge on agricultural technologies. This study assessed the role played by agro-input dealers in disseminating and communicating integrated soil fertility management (ISFM) practices and information to smallholder farmers. The study was conducted in Siaya and Trans Nzoia counties in Kenya, and looked at agro-input dealers' awareness of ISFM practices, communication channels used to access agricultural information and the support services offered to farmers by agro-input dealers. The study also assessed the agro-input dealers willingness to pay (WTP) for the communication tools that can help them better communicate soil fertility management practices to their clients was also assessed. The study interviewed 144 agro-input dealers randomly selected across the study area. Two surveys were conducted, with the first survey focusing on awareness of ISFM practices, communication channels and support services provided to farmers while the second survey examined the WTP for two agriculture information communication tools (namely Maize doctor and Soil map).The result from logit regression model estimated showed that gender, age, educational level, experience in agro-input business and visit by extension staff significantly influenced the agro-input dealers' awareness of ISFM technologies. Paired sample T-test on the mean numbers of farmers that benefitted from the support service from agro-input dealers showed a significant difference across gender of the farmers. Factor analysis of the communication channels that agro-input dealers used to access agricultural information indicated that community based

(Cosmopolite interpersonal) channels of communication were the most preferred communication channels among the agro-input dealer network in two study areas. The study also found that male agro-input dealers were willing to pay more for the Maize doctor and Soil map tools compared to female agro-input dealers. Also, agro-input dealers with more education and those who had been visited by extension agents and researchers were willing to pay more for communication tools compared to those with less education and who had not been visited by extension agents and researchers. The study underscores the important role played by community based channels of communication in the ISFM knowledge dissemination. The study findings suggest the need to improve the provision of extension services to agro-input dealers to enable them effectively communicate information about ISFM technologies to farmers. Such initiatives on capacity building should take into consideration gender of the agro-input dealers.

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Chapter 1: Introduction

1.1 Background information

Lack of access to necessary agro-inputs has been blamed for the low agricultural productivity and the overall poor economic growth and development in most parts of sub Saharan Africa (SSA) (Sanchez and Jama, 2002). Agro-input dealers play a significant role of bringing the inputs close to the farmers (Chianu, 2008). The agro-input dealers play a vital role in guaranteeing that farmers have access to some of the essential agricultural inputs that contribute to boosting the agricultural productivity (Ayieko, 2006). Despite this importance, the strategic role and position of the agro-input dealers has not been fully exploited especially in dissemination and communication of the key agricultural development technologies such as Integrated Soil Fertility Management (ISFM).

In 2006, the plight of African farmers was highlighted when the African policymakers met during the Africa fertilizer summit held in Abuja, Nigeria in June 2006 (IFAD[1], 2006; IFDC[2], 2010). The meeting highlighted the gap in agricultural productivity caused by limited use of agricultural inputs. From the meeting and subsequent follow up summits, the role of agro-input dealers and agro-input business started receiving serious attention both in agricultural development discussions and policy-making (COMESA, 2009).

The Alliance for Green Revolution in Africa (AGRA), among other organizations has been in the forefront in supporting agro-input dealers (AGRA, 2009). Such efforts are also being undertaken by Citizens Network for Foreign Affairs (CNFA) that is working closely with research organizations such as Tropical Soil Biology and Fertility Research institute of the Centre for

[1] International Fund for Agricultural Development
[2] International Fertilizer Development Centre

International Tropical Agriculture (CIAT-TSBF[3]). IFDC and USAID[4] are among the other donors supporting agro-input dealers' related projects in SSA. Interventions are also beginning to involve agro-input dealers in the extension of ISFM information to smallholder farmers in various parts of Sub Saharan Africa (SSA). Such efforts are also being explored by the International Plant Nutrition Institute Africa (IPNI[5]) that is working with stakeholders to synthesize information and develop research programs to encourage fertilizer use in ways that are technically efficient, economically viable, and environmentally friendly.

Past research has produced numerous technical know-how and practices, which if adopted by resource poor smallholder farmers could reverse the declining soil fertility and increase crop yields (Scherr, 1999) and thus address the issue of food security in sub Saharan Africa. Most documented studies have focused on the role of agro-input dealers in improving farmers' access to fertilizers and seeds, with little contribution to the understanding of agro-input trade with respect to agrochemicals, and farming equipment use (Camara and Heinemann, 2006). Much less effort has however gone into understanding the role of agro-input dealers in the dissemination and communication of ISFM knowledge.

According to Vanlauwe (2010), ISFM is the application of soil fertility management practices, and the knowledge to adapt management practices to local conditions, which optimize fertilizer and organic resource use efficiency and crop productivity. The study focused on crop varieties, fertilizer type, rate, time and place of application, organic resources and soil fertility variability as the ISFM components that will be investigated. The crop doctor and soil maps will also be investigated as communication tools to be used by agro-input dealers.

[3] Tropical Soil Biology and Fertility Institute of the International Centre for Tropical Agriculture
[4] United Stated Agency for International Development
[5] International Plant Nutrition Institute

1.1.1 Description of study area

This study was conducted in Siaya and Trans Nzoia counties in western Kenya. Western Kenya is among the most densely populated regions in the SSA (Tittonel et al, 2005). The high population is attributed to the earlier settlements that were motivated by the high agro ecological potential of the area making it conducive for crop production and high fertility of the soils in the region (Tittonel et al, 2005). Despite the high potential exhibited by the region, the area has remained highly under-developed. The population faces many challenges including poor infrastructure, high rates of HIV/AIDS epidemics, poor market access, and heavy out-migration of the youth (Ramisch et al, 2006). The region experiences bimodal rainfall and has relatively deep soils, mostly of clay and loam textures which tend to be fertile (Jaetzold and Schmidt, 1993; Jaetzold and Schmidt, 1982).

Siaya county, lies between latitude 0^{0}30' North and longitude 34^{0}30' East. The altitude of the area rises from 1141 m to 1400 m above sea level on the shores of Lake Victoria in the south and southwest, to 1400 m above sea level in the North and East. The average annual rainfall is about 800-2000 mm, with annual mean maximum temperature ranging between 27^{o}C and 30^{o}C and annual mean minimum temperature ranging between 15^{o}C and 17^{o}C (Jaetzold and Schimidt, 1983). The soils are well drained, deep and friable in some places, shallow over petro ferric (with murram) layer. The predominant soil types in the district are mainly the *Nitisols, Orthic ferrralsols* and *Acrisols* (Republic of Kenya, 1997). There are however sections of the county that are drier with poor soils. The administrative map of Siaya County is shown in Figure 1.

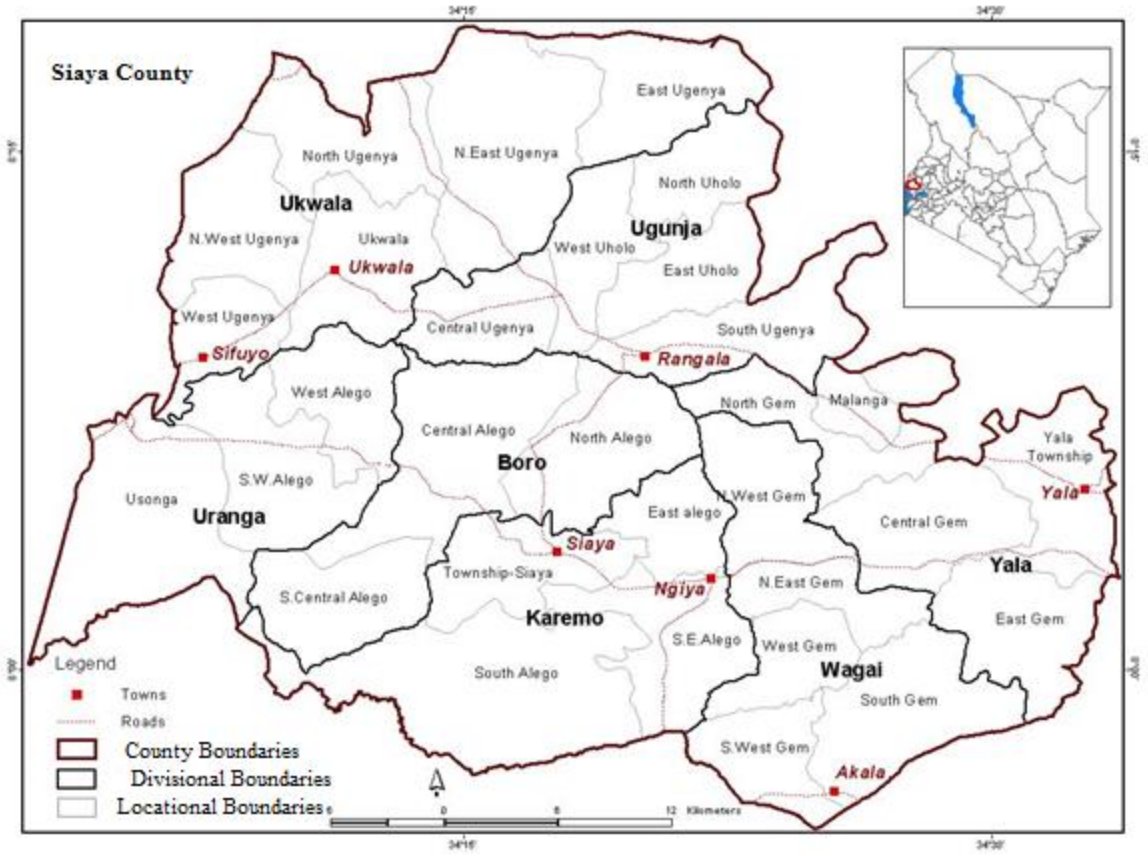

Figure 1: Siaya County Map

Trans Nzoia County is located between the Nzoia River and Mount Elgon. Its centre is the town of Kitale and it is the continuation of the of the fertile Uasin Gishu plateau beyond ("Trans") the Nzoia river. It is the best zone in the country for maize and sunflower production. The altitude varies between 1800 – 1900m above sea level. Major parts of the region consist of a series of uplands of progressively lower altitude towards the west. The eastern boundary is formed from Cherangani hills while on the western boundary the extinct volcanic Mt. Elgon is an outstanding landmark. A scarp in the north marks the watershed between the Lake Turkana drainage basin and the Lake Victoria basin; the latter contributed to by the Nzoia River, which drains most of the county. Apart from the volcanic rocks of the Mt. Elgon area, the majority of the county is

underlain by acid to intermediate rocks of the basement system (Republic of Kenya, 1997). The administrative map of Trans Nzoia County is shown in Figure 2.

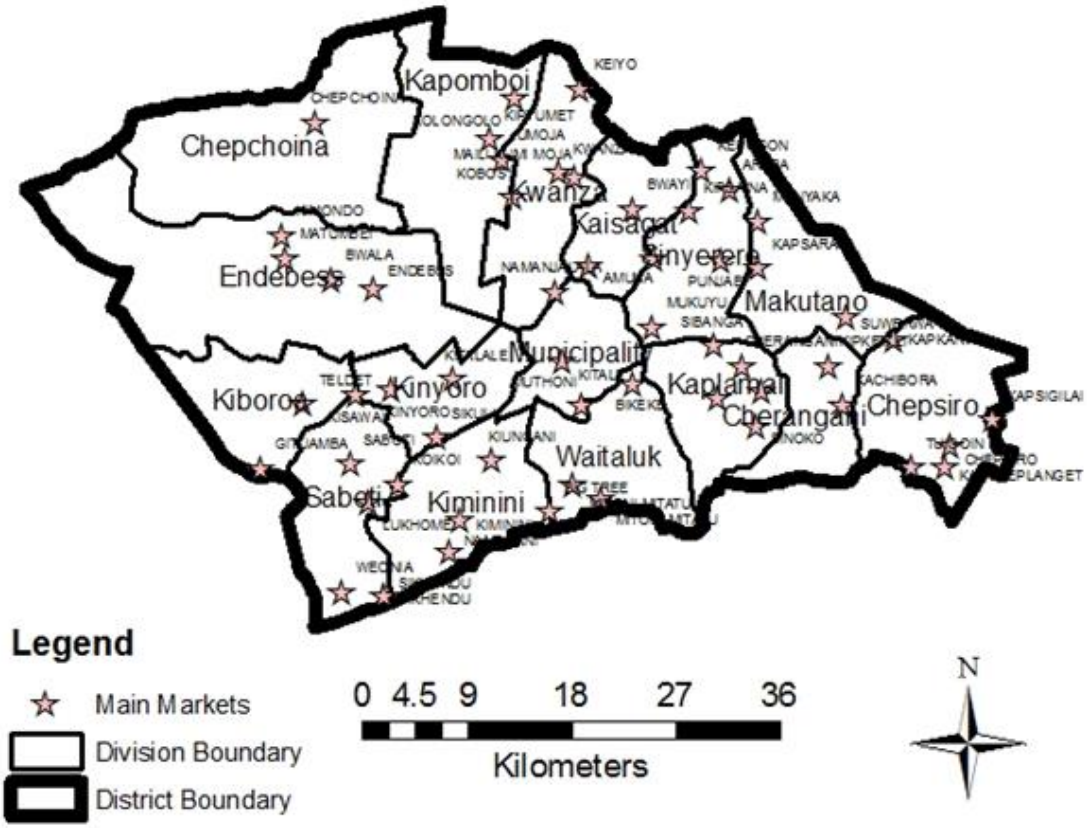

Figure 2: Trans Nzoia County Map

3.2.1 Soil Maps

In this study, the soil map of Siaya and Trans Nzoia Counties were used and the NPK soil attributes were analyzed. Figure 3 and Figure 4 shows the NPK soil map of Trans Nzoia County and Sidindi in Siaya County. The maps were aimed at being used by agro-input dealers in advising farmers on the state of their soils. A farmer from any given region in the county when visiting the agro-input dealer can therefore be advised on which fertilizer combination will ensure optimum yield and is also cost effective based on the health of the soils in his /her farm.

Once the farmer has given the agro-input dealer the information on where he/she comes from, the agro-input dealer is able to look up the state of the soils in the famers' field in terms of the level of Nitrogen, Phosphorus and Potassium from the map and advise accordingly.

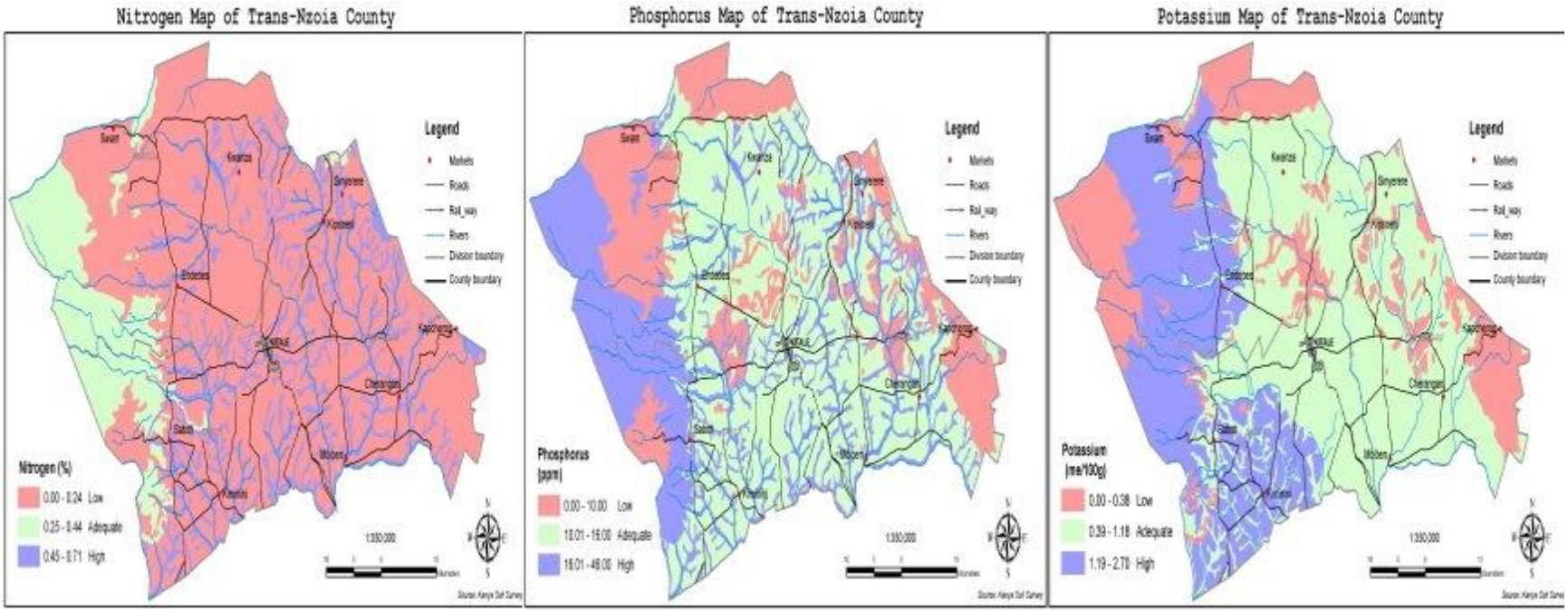

Figure 3: NPK Soil Map of Trans Nzoia County

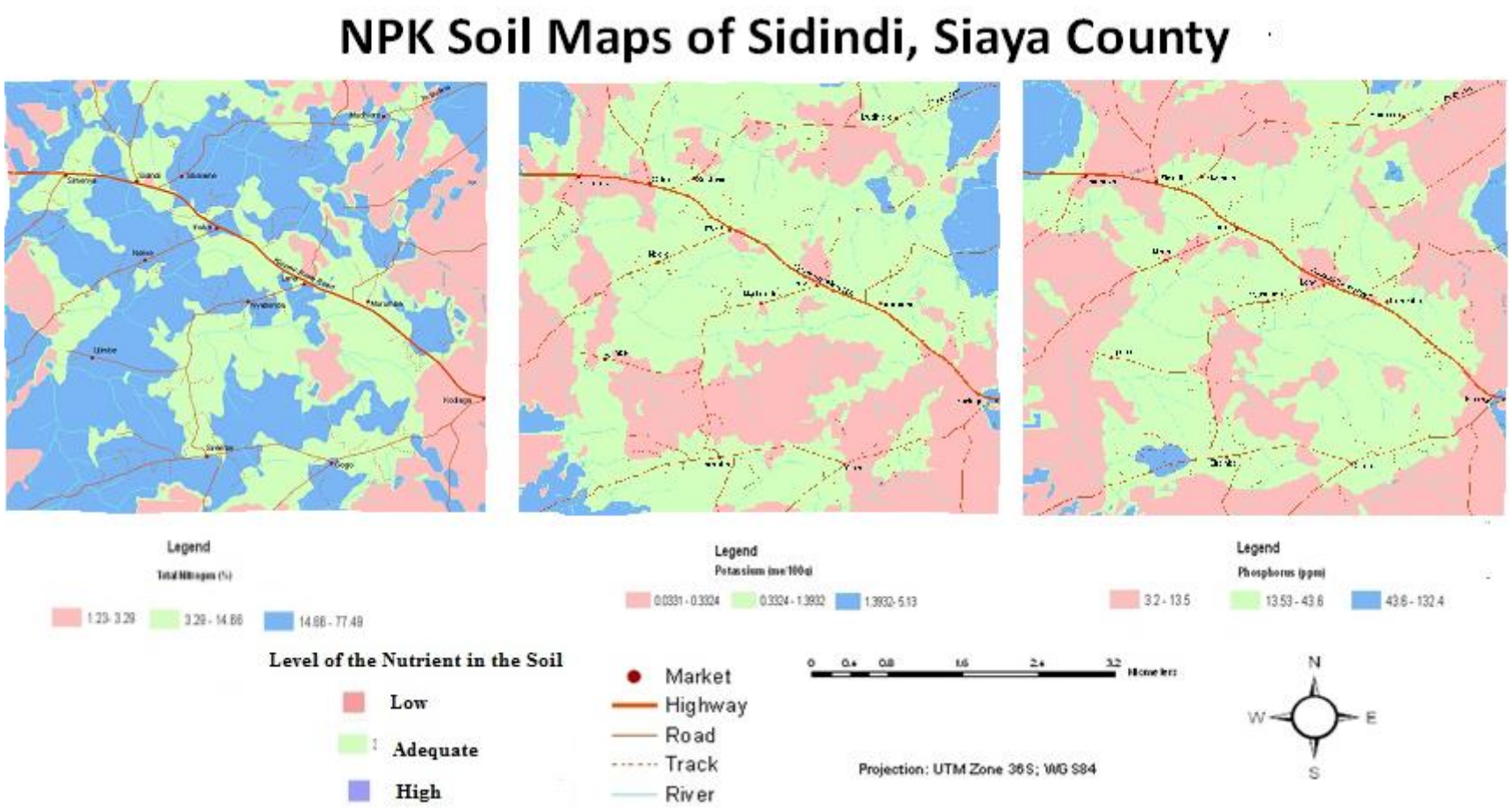

Figure 4: NPK Soil Map of Sidindi, Siaya County

3.2.2. The maize doctor

The Maize Doctor was designed by scientists at International Plant Nutrition Institute (IPNI). It provides a simple, stepwise method for identifying maize production problems, pests and diseases and suggests ways one can overcome production challenges. Maize Doctor contains a checklist of questions about farmer's crops and gives a series of remedial options/ actions. The booklet features colour illustrations showing typical symptoms of nutrient deficiencies, toxicities, diseases, and other disorders in maize production (Figure 5). While it does not substitute for diagnostic tools such as plant tissue analysis and soil testing, this communication tool can help distinguish and identify various field problems. CIMMYT and Kenya Seed Company have also developed crop doctors for other cereals and horticulture crops

Be Your Own Maize Doctor

HAVE YOU had a "maize check-up" this season? Every grower should learn to recognize the symptoms that are pictured here — signs that a maize crop is deficient in one or more of the nutrients that are essential for healthy plant growth and profitable yields. You can be your own maize doctor. It is an important part of crop management to look at fields regularly and identify signs that problems are developing.

Nutrient DeficiencySymptoms

Optimum economic returns on your crop production investment depend upon an adequate nutrient supply throughout the growing season. These nutrient deficiency symptoms indicate that this need is not being met. Check the field several times during the season. Some deficiencies detected early may be corrected by additional fertilizer applications. Even if they cannot be corrected this year, knowing where they occur can be helpful information in planning fertilizer programs for next season.

Healthy maize leaves should have a rich, dark green color. Any stress or nutrient shortage will alter the color.

Additional copies of *Be Your Own Maize Doctor* publication are available for purchase from the International Plant Nutrition Institute (IPNI). Contact Dr. Shamie Zingore, Director, IPNI Africa Program; c/o IFDC
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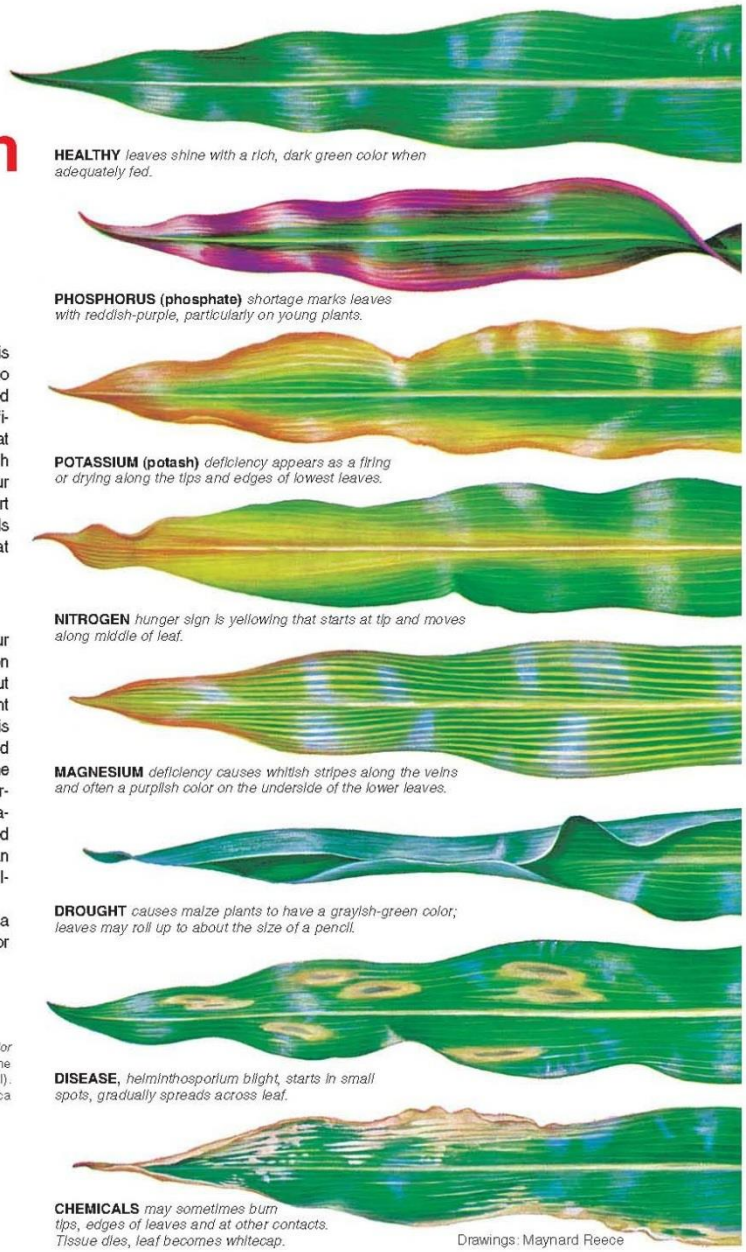
E-mail: szingore@ipni.net
Website: http://africa.ipni.net



HEALTHY *leaves shine with a rich, dark green color when adequately fed.*

PHOSPHORUS (phosphate) *shortage marks leaves with reddish-purple, particularly on young plants.*

POTASSIUM (potash) *deficiency appears as a firing or drying along the tips and edges of lowest leaves.*

NITROGEN *hunger sign is yellowing that starts at tip and moves along middle of leaf.*

MAGNESIUM *deficiency causes whitish stripes along the veins and often a purplish color on the underside of the lower leaves.*

DROUGHT *causes maize plants to have a grayish-green color; leaves may roll up to about the size of a pencil.*

DISEASE, *helminthosporium blight, starts in small spots, gradually spreads across leaf.*

CHEMICALS *may sometimes burn tips, edges of leaves and at other contacts. Tissue dies, leaf becomes whitecap.*

Drawings: Maynard Reece

Nitrogen Deficiency

Nitrogen (N) deficiencies are less likely to be detected early in the season, but when young plants are light yellowish-green in color, shortage of N may be responsible. If deficiency is detected early, topdressed N fertilizer may be applied to help correct the problem.

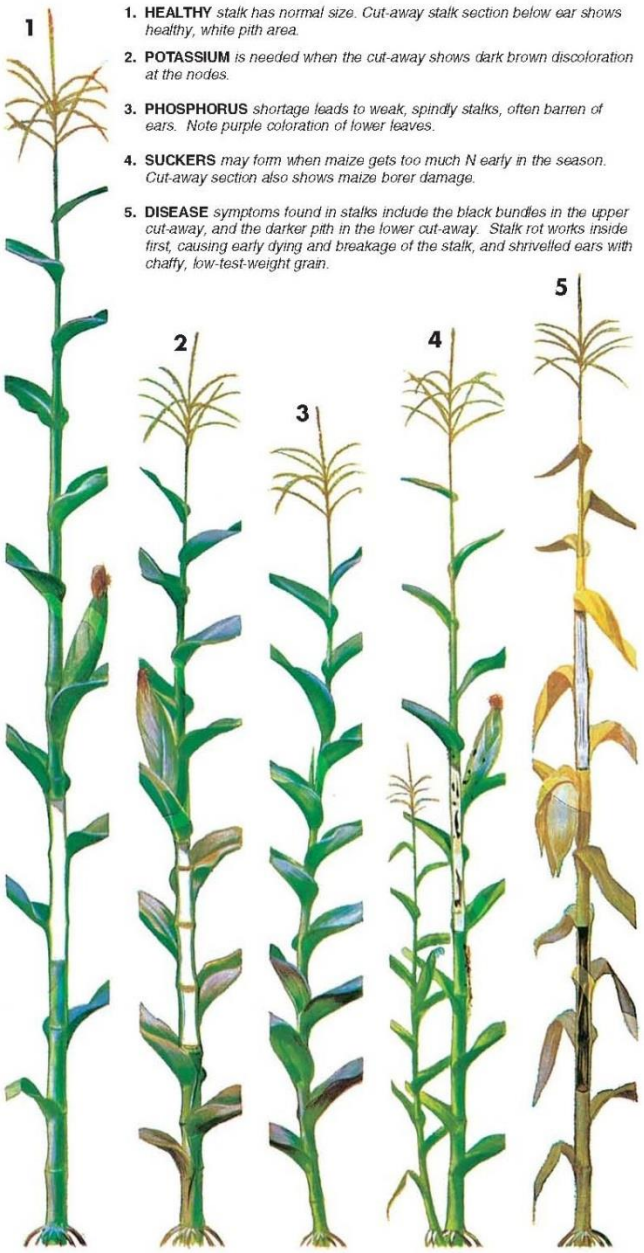
After the maize is about knee-high, growth rate increases, and N demand increases rapidly. If not enough is available, lower leaves begin to turn yellow at the tops, with yellowing progressing along the midrib. Since N is a mobile nutrient in the plant, the symptoms gradually move to leaves higher on the plant. Lower leaves die. Premature death of the plant and small, chaffy ears result from N deficiency.

Phosphorus Deficiency

Phosphorus (P) deficiency usually appears when plants are very young. An early symptom is reddish-purple coloration of the leaves. Weak, spindly stalks — either barren or with small, twisted ears — are also an indication of P deficiency. Cool temperatures and excessively dry or wet conditions early in the season...or any physical restriction to root development...may lead to deficiency symptoms, even if adequate P supplies are in the soil. Phosphorus deficiency will also result in delayed maturity. High rates of uptake per day during rapid growth emphasize the importance of high soil fertility for adequate P nutrition.

Potassium Deficiency

Potassium (K) deficiency shows up initially as a yellowing or browning along the margins of lower leaves, moving gradually toward the midrib, and to leaves higher on the plant. Another common symptom of K deficiency is a dark-brown discoloration of the nodes inside the stalk which may be revealed by slicing the stalk lengthwise. Ear size may not be affected as much as with N or P deficiencies, but tip kernels do not develop and ears may be chaffy as a result of K deficiency. Potassium is also a major factor in water use efficiency, so drought effects are much more pronounced when K supplies are inadequate.



1. **HEALTHY** *stalk has normal size. Cut-away stalk section below ear shows healthy, white pith area.*
2. **POTASSIUM** *is needed when the cut-away shows dark brown discoloration at the nodes.*
3. **PHOSPHORUS** *shortage leads to weak, spindly stalks, often barren of ears. Note purple coloration of lower leaves.*
4. **SUCKERS** *may form when maize gets too much N early in the season. Cut-away section also shows maize borer damage.*
5. **DISEASE** *symptoms found in stalks include the black bundles in the upper cut-away, and the darker pith in the lower cut-away. Stalk rot works inside first, causing early dying and breakage of the stalk, and shriveled ears with chaffy, low-test-weight grain.*

Figure 5: Maize doctor

1.2 Problem statement

Lack of agricultural information is a major constraint to agricultural production in Sub Saharan Africa (Odendo et al., 2006). Inadequate knowledge on how to apply improved technologies has led to low agricultural production (Chianu et al, 2008). Sanchez and Jama (2002), further noted that absence of necessary agro-inputs has been blamed for the low agricultural productivity and the overall poor economic growth and development in most parts of sub Saharan Africa (SSA). Agro-input dealers play a significant role of bringing the inputs close to the farmers (Chianu, 2008). The agro-input dealers play a vital role in guaranteeing that farmers have access to some of the essential agricultural inputs that contribute to boosting the agricultural productivity (Ayieko, 2006). Despite this importance, the strategic role and position of the agro-input dealers has not been fully exploited especially in dissemination and communication of the key agricultural development technologies such as Integrated Soil Fertility Management (ISFM).

Recent efforts to improve farmer access to information have targeted the agro-input dealer. These efforts aim at making agro-input dealership hubs for agricultural information that can help farmers in their production decisions. However, agro-input dealer still face many challenges. These include not getting the inputs at the right time, lack of database of soil conditions in the areas they cover, absence of soil management recommendations that work for different soil types, weak partnership between agro-inputs dealers and researchers that has caused low transfer of knowledge from researchers to farmers and to support the work of agro-input dealers in diverse socio-economic and bio-physical conditions. Agro-input dealers can therefore supplement shortages and inadequacies of the national extension systems that is a major hindrance in agricultural knowledge diffusion in Kenya and elsewhere in the region.

In response to lack of tools that can aid the communication of ISFM practices to farmers, research organizations (IPNI and TSBF-CIAT) have partnered to develop and/or test some new and existing tools that can be used by agro-input dealers to communicate to farmers practices which the latter need to adopt to remedy soil fertility management problems in their farms. These tools or communication aids include Maize Doctor and Soil Maps.

1.3 Objectives

The main objective of the study was to assess the role agro-input dealer's play in dissemination and communication of the Integrated Soil Fertility Management (ISFM) practices and agricultural information in Siaya and Trans Nzoia Counties in Kenya and their willingness to pay for the tools that can help them better communicate soil fertility management practices to their clients.

1.3.1 Specific objectives

The specific objectives were

1. To assess the awareness of soil fertility management practices by agro-input dealers.
2. To investigate the communication channels that agro-input dealers use to receive agricultural information.
3. To investigate the support services that agro-input dealer's offer to farmers.
4. To assess agro-input dealers willingness to pay for the communication tools (Maize doctor and Soil map).

1.4 Research hypothesis

This study tested the following hypotheses:

1. The level of education of agro-input dealer has no effect on the awareness of the soil fertility management practices.

2. The period of engagement in agro-input business has no effect on the awareness of the soil fertility management practices.
3. Gender of the agro-input dealer has no effect on the kind of support services offered to farmers.
4. The level of education of agro-input dealer has no influence on the willingness to pay for the maize doctor and soil map by the agro-input dealers.
5. Gender of agro-input dealer has no influence on the willingness to pay for the maize doctor and soil map by the agro-input dealers.

This study focused on various components of soil fertility management practices including the use of improved seeds and fertilizers in maize. These inputs are by far the most widely used ISFM practices by farmers for tackling maize productivity problems in Kenya. Maize was chosen because it is the most widely grown and the most important staple crop in Kenya. The other components of integrated soil fertility management practices that were studied include use of inorganic fertilizers, micro dosing or precise fertilization, nitrogen fixations by legumes, biomass transfer, agro-forestry, improved fallow, composting, crop rotation , animal manure, agrochemicals, farm machinery, seed treatment chemicals, pesticides and storage chemicals. The tools that were tested include maize doctor and soil map.

1.5 Justification of the study

The study was carried out in Siaya and Trans Nzoia counties. The focus was on agro-input dealers who had been enlisted by the CNFA project in Kenya and the Ministry of agriculture in Kenya. Siaya County is generally a region that is densely populated with high levels of hunger, extreme poverty and disease. The region is also characterized by low crop yields and low

household cash incomes (Kelly et al., 2003). Most of the residences in this region are subsistence farmers. The farm sizes are very small and farm inputs (such as fertilizer, improved seeds or water pumps) are also very scarce. Rainfall is unpredictable often resulting in low crop and livestock productivity. Many families have difficulty producing enough food to meet their needs. Those who manage to produce a surplus have difficulty finding buyers or getting good prices (Chianu et al, 2008). Trans Nzoia is a highly populated region and it is considered a high yield potential region in the country.

Information generated from this study will help improve the communication of ISFM knowledge to farmers. The study will aid in providing information on appropriate dissemination channels that can be utilized by agro-input dealers and researchers to disseminate and communicate agricultural information and knowledge. The study will also generate data that will be used by various stakeholders such as policy-makers, development agencies, donors and researchers, to enhance soil fertility management technologies knowledge dissemination to farmers through agro-input dealers. Additionally, smallholder farmers in Sub Saharan Africa and specifically Siaya and Trans Nzoia counties in Kenya will benefit when communication by agro-input dealers is enhanced consequently enabling them to utilize ISFM knowledge in solving various soil fertility problems. The study will generate useful information that will guide researchers and other stakeholders in the agriculture sector in decision making especially when it comes to tools and information resources that can be used in the dissemination and communication of given agricultural technologies. This will be central in improving agricultural productivity and production that will be able to bridge the food security gap being experienced in the sub Saharan Africa region.

1.6 Scope and limitations of the study

The study was conducted in two counties in Kenya. The regions were of medium and high agricultural productivity potential and included Siaya and Trans Nzoia counties respectively. The work focused on various components of soil fertility management practices and agricultural information among the agro-input dealers; and the agricultural information resources and communication tools that have been developed by researchers; the Maize Doctor and Soil Maps. The study tested the awareness of the soil fertility management practices and agricultural information, communication channels that agro-input dealers use to access and share soil fertility management knowledge, the support services agro-input dealers provide to farmers, and how much the agro-input dealers were willing to pay for the given communication tools developed by researchers. The study was limited to two counties due to financial and time constraints.

Chapter 2: Literature Review

2.1. Agriculture in sub Saharan Africa (SSA)

Africa remains the only continent that did not fully benefit from the effects of the green revolution experienced in the 1960s in Asia (Adesina, 2009). Food accessibility, affordability and availability are the major concerns for Africa and a primary challenge for human wellbeing and economic growth (Bationo, 2007). Majority of African population (70%) live in rural areas with agriculture as the main source of their livelihood (Asaba et al, 2006). SSA agricultural growth is lagging behind compared to the population growth in the region (FAO, 2008; Vanlauwe et al, 2004). The low and declining productivity can be attributed to Africa's impoverished agricultural resource base, unfavorable socioeconomic and policy environments for investment in agricultural sector development as well as emerging challenges associated with unfavorable weather and climate change (Beets, 1990). Reversing this trend will require improved access of inorganic fertilizers, seeds, pesticides and profitable soil, water and nutrient management technologies by the smallholder farmers in Africa (Bationo, 1998; Nkonya et al, 1997). The slow growth in the use of modern agricultural inputs in the farming systems of SSA has resulted in missed opportunities to increase Africa's agricultural production, productivity, and household incomes and welfare (Chianu et al, 2008).

Even though the majority of the population is fed by smallholder famers, these farmers are faced with many challenges. These include soil fertility, crop destruction by pests and diseases despite the availability of modern chemicals and tools that would have been useful (Bationo, 2007). There are also problems associated with the dissemination and communication of information to farmers (Rege, 2006; Rees, 2000). At the same time, farming practices have remained the same

for a long time despite the advances in technologies and ways of handling the farming practices in other parts of the world (Sanchez, 2002). This has led to call for strategies that can accord farmer education the priority that is needed to spur the use of improved technologies such as fertilizer, the improved seed variety, and pesticides (Oniango, 2001). To cope up with the world population, agricultural production needs to grow by 50-70% (Denning and Jeffrey, 2008). The efficiency of input application also needs to increase substantially. At the same time, the ongoing effects of climate change requires that farmer education incorporate strategies for overcoming these effects (Njuguna, 2011).The low adoption of agricultural technologies is attributed to various factors such as the lack of awareness (Ramisch et al, 2006).

2.2 Extension Services in Kenya

Extension services play a key role in sharing agricultural knowledge, technologies, information and also linking the farmer to other sectors of the economy (NASEP, 2007). The extension service is one of the critical change agents required for the transformation of subsistence farming to modern and commercial agriculture (NASEP, 2007). This is important in promoting household food security and employment creation and poverty reduction (Agbamu, 2000).

For a long time, in Kenya, the extension service was dominated by the public sector. During this period many new technologies being introduced mainly due to a well-funded extension service, an elaborate set of farmer incentives including ready market, subsidized inputs and credit; as well as relatively good infrastructure (Bouare and Bowen, 1990). However, in the last two decades, several constraints have hindered proper functioning of agricultural extension systems and services. The most critical challenges have been: declining human, capital and financial

resources for public extension; uncoordinated pluralistic extension service delivery; and poor linkages with extension facilitating factors (Wanga, 1999).

The extension services system is also facing major challenge of lack of facilities and resources to be able to provide the essential services to smallholder farmers (Wanga, 1999). The extension services and work traditionally benefited the large scale farmers dealing in cash crops (Agbamu, 1998). The major hindrance to targeting smallholder farmers with the extension services has been the lack of resources to effectively reach the many geographically dispersed farmers, yet the need for extension service is great (Kanyanjua et al, 2000). FAO (1996) argues that most of the research findings exist in complex format that might not be readily consumable by farmers. At the same time such information cannot reach the famers on time and in the absence of an effective agricultural extension system.

There have been efforts by donors and NGO's to support the extension system in Kenya. However, the impact of such support has been dismal (Wanga, 1999). IFAD (2006) maintains that greater impact of agricultural extension services can be realized when various stakeholders such as the national agricultural research, extension organization, farmers and farm organizations work together. In addition, making agricultural extension system work for smallholder farmers requires that the various problems e.g. structural, organizational, motivational, incentive, resource constraint and communication challenges facing the system should be addressed (Muyanga et al 2006).

2.3 Agro-input dealers role in agricultural production

Agro-input dealers are sellers of agricultural inputs that include seeds, fertilizer, crop protection chemicals, farm equipment and machines, veterinary products and animal feeds. Agro-input dealers play a major role in ensuring that farmers access some of the important agricultural inputs required to improve agricultural productivity in their respective farms (Poulisse, 2007). Nevertheless the contributions of agro-input dealers in agricultural development in SSA have been largely neglected (IFDC, 2003).

Since 2006, the role of agro-input dealers and agro-input dealer business started receiving some attention as the likely channels for disseminating agricultural information (IFAD, 2006). In Kenya the efforts to tap the potential provided by agro-input dealers has been spearheaded by AGRA and the government through the Kenya Agro dealers strengthening program (KASP). These initiatives have provided training in business management and improved farming methods (AGRA, 2009). Agricultural Market Development Trust (AGMARK), an affiliate of CNFA has certified over 1,900 agro-input dealers in business management, safe product usage and handling, product knowledge and crop husbandry practices. The training has enabled agro-input dealers to provide inputs and share knowledge on improved production practices with smallholder farmers (CNFA, 2009).

Most of the agro-input dealers however still lack business support and hence still encounter various business constraints relating to high transportation cost, low effective demand, lack of appropriate market information, lack of storage facilities and limited skills and knowledge (Isherwood, 2004). The high transportation costs can be attributed to the long distances covered to source the inputs (Chianu et al, 2008).

2.4 Paradigm shift in soil fertility management in Africa

The development focus of the 1960s and 1970s was on improved germplasm. Asia through the green revolution recorded significant positive impacts. However, such impacts were not witnessed in Africa.

The failure of Africa to capture the benefits of green revolution resulted in a paradigm shift with renewed interest in the organic fertilizers in the 1980s. The shift was generally from the mineral inputs to low inputs sustainable agriculture (LISA) where organic resources were considered to be able to facilitate a sustainable agricultural production (Vanlauwe, 2004). Taking up LISA faced technical and socio-economic challenges leading to the second paradigm that incorporated the integrated nutrient management (INM). The INM put more emphasis on better use of both organic and mineral inputs essential for sustainable production (Sanchez, 1994). This new strategy recognized that farmers production decisions were influenced by climatic and soil conditions and also by changes in the social and political environments. This realization led to the formulation of another strategy namely, the integrated natural resource management (INRM) approach (Izac, 2000).

The earlier paradigms of soil fertility management focused on low input methods or fertilizers but rarely explored the options of both. As a result these strategies failed to take into account the fact that fertilizers are most effective and efficient in the presence of soil organic matter and well conserved soil structure. It is this shortcoming that the integrated soil fertility management (ISFM) was designed to address. ISFM is the application of locally adapted soil fertility management practices to optimize the agronomic efficiency of fertilizer and organic resources (Sanginga and Woomer, 2009).

Other authors have defined ISFM as 'the development of adoptable and sustainable soil management practices that integrate the biological, chemical, physical, social, cultural, economic and political processes that regulate soil fertility' (Vanlauwe and Giller, 2006). The physical and chemical processes include carbon sequestration, organic/inorganic inputs, and inherent traits such as soil organic matter and cation exchange capacity. Biological factors include germplasm, integrated pest management, livestock and below ground biodiversity. Socio-economic and cultural factors entail local knowledge, land, labour and finances. Policy factors revolve around prices, markets, information and infrastructure.

ISFM attempts to make the best use of inherent soil nutrient stocks, locally available soil amendments and mineral fertilizers to increase land productivity while maintaining or enhancing soil fertility. ISFM is a shift from traditional fertilizer response trials designed to come up with recommendations for simple production increases (Sanginga and Woomer, 2009). ISFM is therefore designed to provide comprehensive solutions that consider such diverse factors as weather, the presence of weeds, pests and diseases, inherent soil characteristics, history of land use and spatial differences in soil fertility. It involves a range of soil fertility enhancing methods, such as improved crop management practices, integration of livestock, measures to control erosion and leaching, and measures to improve soil organic matter maintenance. ISFM strategies also include the combined use of soil amendments, organic materials, and mineral fertilizers to replenish soil nutrient pools and improve the efficiency of external inputs (Sanginga and Woomer, 2009).

From a technical point of view ISFM promotes the utilization of locally available resources, the combined application of organic resources and fertilizer, and enhancement of the use efficiency

of both organic and inorganic inputs (Vanlauwe, 2004). Central to the ISFM paradigm is the realization that no single component of soil fertility management can on its own lead to sustainable soil fertility management (Marenya and Barrett, 2007). ISFM generally looks at giving the farmers more options to make choices by creating the awareness of the possibilities available to the farmer and how best they can complement or even substitute for one another (Place et al, 2003). In western Kenya, TSBF with its partners have developed, evaluated, disseminated and outlined various ISFM practices as shown in Figure 6(Vanlauwe et al, 2004).

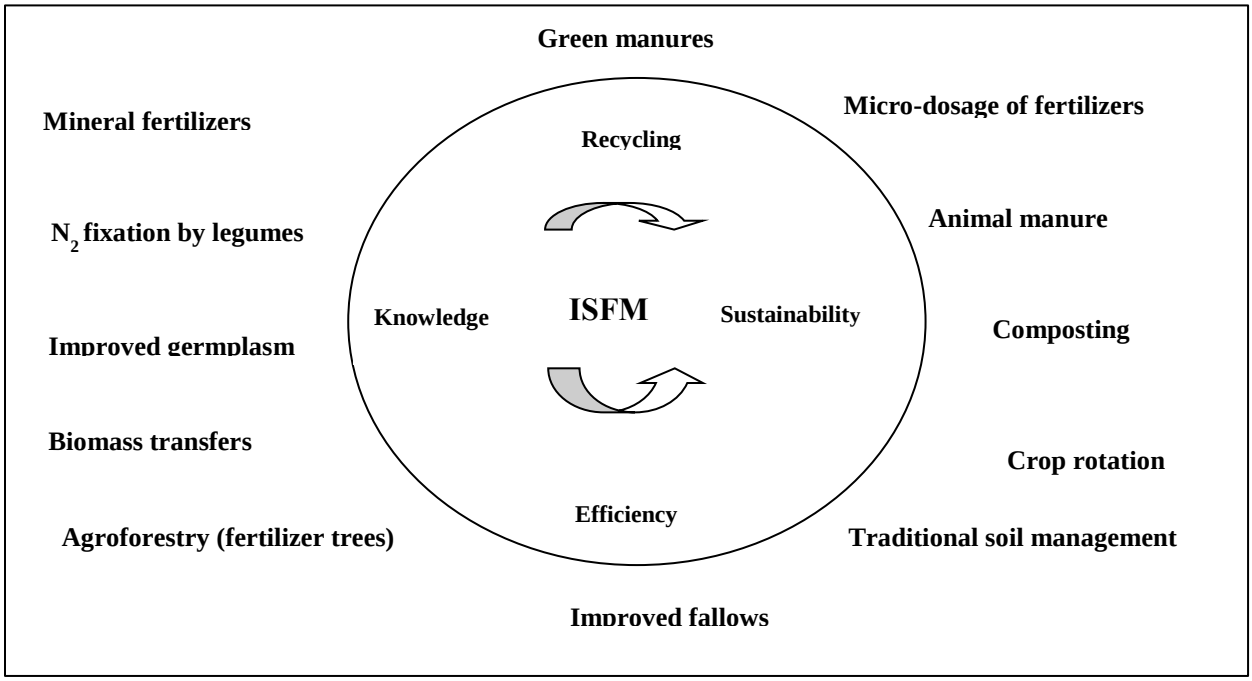


Figure 6: Illustration of the ISFM technologies promoted in western Kenya

Source: Vanlauwe et al, 2004.

2.5 Information sources and channels in relation to ISFM knowledge

Information and knowledge have been used synonymously even though there is a distinction between the two terminologies. Information is defined as one or more facts that is received by a human being and that may be useful or of worth to the recipient (Avelock, 1986). Information is any news or facts about something. It is the flow of messages that play a vital role of reducing uncertainty (Rodgers, 2003). Knowledge, on the other hand, is created and organized by the very flow of information based on the commitment and beliefs of the information holder. Knowledge is the information that has been put together in a given form into a pool of facts and concepts that can be applied. Knowledge can further be defined as processed information (Rasmussen, 2001).

There is also clear distinction between information and knowledge sources and channels. Information sources provide the content and the expertise of interest to the information seeker. The channels are the vehicles through which the information is transferred or received. Channels can either be disseminative (i.e. uni- directional) or communicative (i.e. multi-directional) (Momodu, 2002). Disseminative channels do not allow for feedback whereas communicative channels allow for feedback from the source and recipient of the information.

Communication channels are therefore ways that messages get from a source to a receiver. Such channels are categorized broadly into (i) interpersonal (face-to-face) versus mass media (TV, radio, newspaper, etc.) communication and (ii) localite versus cosmopolite channels (Rodgers, 2003).

The mass medium includes television, radio, newspaper and magazines. Mass media generally allow few individuals to reach out to larger audiences (Rodgers, 2003). It is entirely cosmopolite

whereas interpersonal channels could either be cosmopolite or local. Rogers (2003) indicated that cosmopolite channels usually link individuals with sources outside the given social system set up. Local interpersonal channels are traditional in nature, for instance poems, exchange with neighbors', relatives, friends or peers and songs (Dutta, 2009). In these channels the message conveyed is usually over a short distance and within the boundary of the target group or the participating individuals. In a cosmopolite interpersonal channel, the source of information is from outside the system though it involves face to face interaction with the participants; they involve community based channels for instance workshops, farmer field days, on farm demonstrations, seminars, farm to farm visits, public *baraza's*, and agricultural shows. Print based media include books, billboards, brochures and posters.

The ICT based channels include the Internet, mobile phones, DVD/CD players, and faxes. The key sources of agricultural information include the agricultural research and learning institutions. There exist many channels through which ISFM information can be shared (Rees et al., 2000). Other classification include indigenous source of knowledge, Information Communication Technologies (e.g. internet, mobile telephones), mass media (television, newspapers and magazines), development workers and agencies, outreach services, cooperatives, and faith-based organizations through which the ISFM information can be shared (Adolwa et al 2012).

2.6 Willingness to pay for goods and services

Willingness to pay (WTP) is one method that can be used to determine the price of a good. The method is applicable where the price is not known. The method tries to determine the price that people are willing to pay for a given good. The main concepts in WTP include identification of the cost benefits versus the social costs and benefits. The cost benefit analysis, the social costs

and benefits are often spread across the society, rather than being paid or accrued directly to the company or organization that is undertaking the project. The social costs are usually considered externalities, they must be key concept is that in decision making process to ensure greatest efficiency.

WTP measures are considered useful for various reasons. Foremost, they can directly inform the policy makers by providing information about how much people value some goods or services and can thus inform the pricing of the goods or services (Hanley et al., 2003). WTP measures can be the important inputs economic evaluation such as cost benefit analysis (Balcombe et al, 2008). WTP further measures can be looked as the convenient tool to make relative comparisons and rankings of the desirability of goods and services.

There are many ways to estimate WTP measures in many ways. In this case, the respondents were asked directly how much they were willing to pay for the maize doctor and soil map. Though the direct questions about willingness to pay are cognitively difficult to answer directly and respondents may have incentives to answer strategically (Ryan, 2004). The other alternative method is derived from discrete choice models estimated using either revealed preference data or data from discrete choice experiments. In this case the WTP of an alternative attribute can be calculated as the ratio of the attribute coefficient to the price coefficient (Balcombe et al, 2008).

Chapter 3: Study Methods

3.1 The conceptual framework

The focus of this study is to examine the role of agro-input dealers in the dissemination and communication of ISFM knowledge among farmers in Siaya and Trans Nzoia Counties in Kenya. Agro-input dealers can play an important role in the agricultural production sector adopting the diagnostic-to-prescription/treatment model applied in health sector. As in the case of diagnosable illness in the medical sector, the farmers (patients) are distressed about the status of their land's declining food production and land degradation; and are eager to get solutions to these problems. The farmers can then come to the agro-input dealers (doctor) and describe the nature of the problem. The agro-input dealers having been well equipped with agricultural production knowledge should then be able to isolate the causes of the problem and recommend solutions to the problem in form of products (inputs) or information on ISFM through the information resources and communication tools developed by researchers and development agencies. Such a working system would then build trust among the farmers and the agro-input dealers and provide a platform where continuous learning and exchange of ISFM knowledge would be achieved. A similar approaches of diagnosis has been demonstrated by Rapport et al (1985) and Rapport and Whitford (1999) in addressing problems of ecosystem degradation.

Agro-input dealers that are well equipped with agricultural production knowledge can be very resourceful in addressing the poverty issues in SSA and help in the achievement of the African green revolution. Researchers have developed tools and equipment that can be used in testing soil quality and other important parameters in the soil health assessment. Such tools include the digital soil map (Atlas) that is being developed by researchers in Africa Soil information system

(AfSIS) with financial support from AGRA and Bill and Melinda Gates foundation (BMGF). Others include Hand-held spectrometer that researchers at World Agroforestry Centre are piloting, Crop doctor being pioneered by IPNI, CIMMYT and other CGIAR centers. Cornell University has also developed soil testing kits. These tools can generate knowledge that agro-input dealers need to resolve the challenges that farmers are facing.

The maize doctor is likely to improve the use of fertilizer and improved seed variety. Fertilizer and seed are the key factors that have the potential of enormously improving the farmer's yield. The agro-input dealer knowledge of various aspects of fertilizer usage (ISFM knowledge) will be very essential in providing the farmer with useful information that can be used in improving the farmer's yield. The approach presented in this research will provide an opportunity for the role of farmers and farmer organizations to be able to provide essential feedback on the dissemination and communication of the ISFM technologies and this will be useful especially in helping setting the priorities and improving the relevance of the program.

Figure 7 presents a schematic presentation of how key stakeholders in agricultural production and productivity can interact effectively. The agro-input dealer dealers play a pivotal role in linking the various players ranging from information sources and end users using the varied communication channels that can be utilized. The maize doctor and soil map can be useful in strengthening the link between the agro-input dealer and farmer by making the farmer be the source of information hitherto obtained only through agricultural extension services.

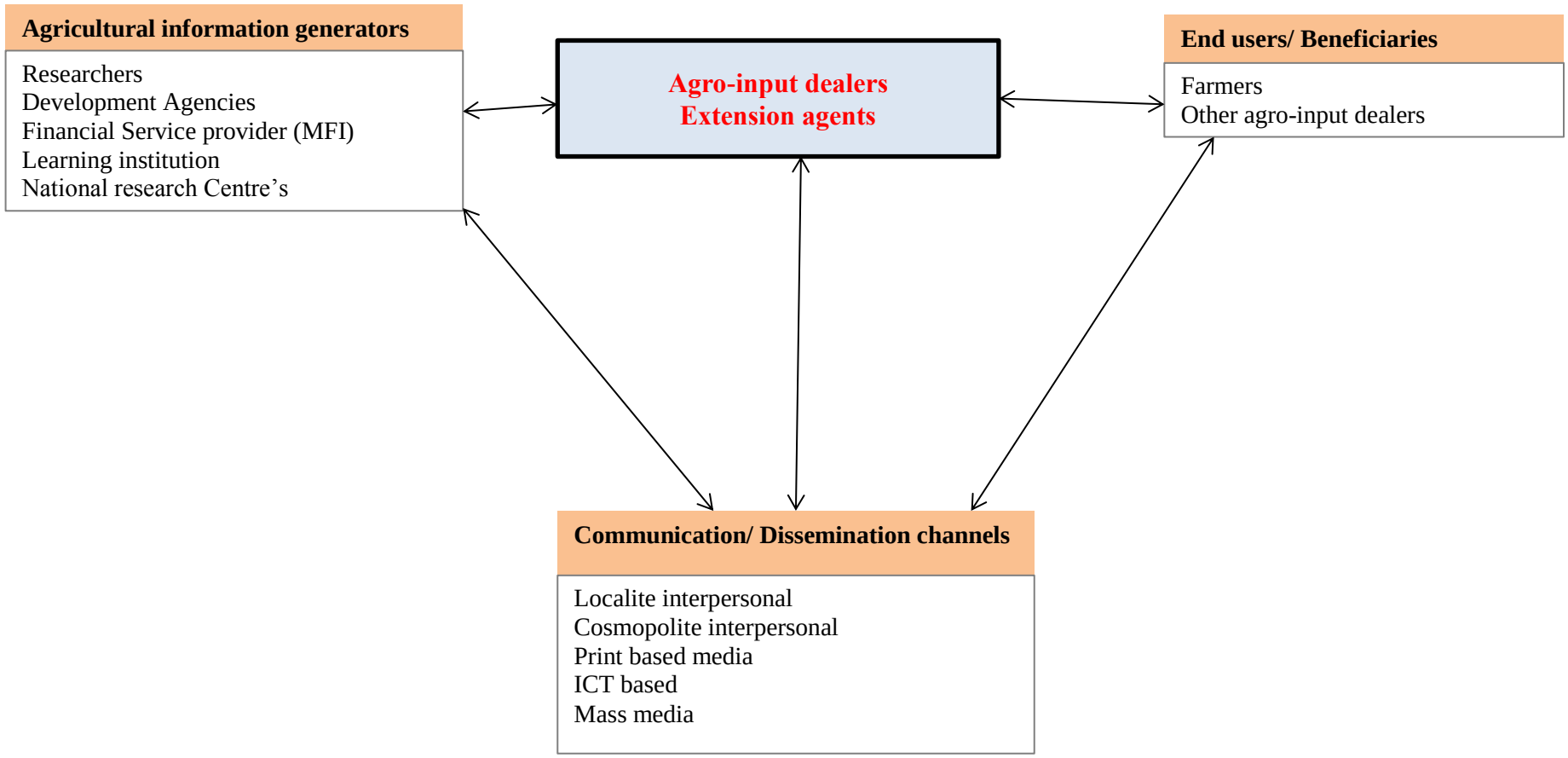


Figure 7: ISFM information and communication tools dissemination and communication path

Source: Author; 2012

3. 2 Sampling and data collection

The study involved agro-input dealers as the main respondents. The agro-input dealers were drawn from the prior participants in the Kenya Agro dealers Strengthening Program (KASP) projects. The sampling frame consisted of 288 agro-input dealers that had participated in the KASP project. They comprised of 140 agro-input dealers in Trans Nzoia and 148 agro-input dealers in Siaya County.

The respondents of the first phase of the study were drawn from the 288 agro-input dealers through simple random sampling. A total of 144 agro-input dealers were selected for this phase. In the second phase involving determining WTP for the maize doctor and soil map a simple random sample of 93 agro-input dealers were drawn from those who had participated in phase 1 interviews. The distribution of the respondents in the two counties is presented in Table 1.

Table 1: Sampling scheme for agro-input dealers in Siaya and Trans Nzoia Counties

County	Sampling frame	Proportion (%)	Sample agro-input dealers	
			Phase 1	Phase 2
Siaya	148	50	74	45
Trans-Nzoia	140	50	70	48
Total	288	100	144	93

Source : Author ; 2012

3.3 Empirical methods

This study used a detailed 12-page questionnaire to collect data from 144 agro-input dealers from 2 counties (*Siaya* and *Trans Nzoia*) covering 33 market centers. The questions covered in the questionnaire were organized into 5 sections. These included general characteristics of agro-input dealers (gender, age, years in school, main and secondary occupation, year started agro-

input business, etc.), assessment of ISFM awareness, assessment of the channels of communication used by agro-input dealers to receive agricultural information, support services that agro-input dealers provide to farmers and willingness to pay by agro-input dealers for the information resource tools. The questionnaire was administered in two phases.

Following training of enumerators, actual data collection was carried out between November and December 2011. There was a follow up phase on the willingness to pay (WTP) for the Soil map and Maize doctor. During the second phase, a total of 93 agro-input dealers were interviewed in February 2012. Data entry was done in CSPro. Data cleaning and analysis was carried out using the Statistical Package for Social Sciences (SPSS) and MS Excel.

For the purpose of this research, the following broad category of the communication channels was adopted from Sanginga and Woomer (2009); (i) Mass media includes television, radio, Newspapers and magazines; (ii) Local Interpersonal includes other agro-input dealers, Songs/Poems/skits; (iii) Cosmopolite Interpersonal includes workshops/ seminars, Farmer field days, *Barazas*/public gatherings, on farm demonstrations, (iv) Print based includes Books, Billboards/posters, Brochures and (v) ICT based media include Internet, mobile phones, DVD/CD players.

3.3.1 Data analysis

Data was analysed using the SPSS version 20. Frequencies, descriptives, correlations and cross-tabulations were generated to derive summary statistics. Regressions (Logistic regressions) and ANOVA's were undertaken to determine causal relationships between variables. Logistic regression was selected due to the fact that the responses are binary i.e aware or not aware. The

methods also allows for combination of numeric and non-numeric data to compute binary response (Smith et al, 1999).

To address objective 1, on the factors that influenced agro-input dealer awareness of various ISFM technologies a logistic regression was used (Smith et al. 1999).

Following Gujarati (1999), Hardin and Hilbe (2001), the logistic regression model characterizing awareness by the sample agro-input dealer can be specified as:

$$Pi = F(\alpha + \beta Xi) = \frac{e^{(\alpha+\beta Xi)}}{1+ e^{(\alpha+\beta Xi)}} \quad (2)$$

Where:

Pi is the probability that an individual agro-input dealer is aware of the ISFM technology given Xi, and *i* denote i-th observation in the sample

X*i* is the random variable

F (.) is the accumulative distribution function of the Logit model

e is the base of natural logarithm

α and β are the coefficients associated with each explanatory variable

Awareness is defined as whether the agro input dealer is aware or heard of the various ISFM components such as inorganic fertilizers, precise fertilization(micro-dosing), nitrogen fixation by legumes, improved germplasm (seeds), biomass transfer, agro-forestry, improved fallow, compositing, crop rotation, animal manure, farm machinery, seed treatment chemicals, pesticides or storage chemicals.

The variables used in the logistic model are gender, age, level of education, experience in agro business, visit by extensions and researchers, participation in famer field days and education days.

For objective 2, regression analysis was used to help in identifying factors influencing use of communication tools used by agro-input dealers to communicate with farmers (Long, 1997). Correlation among the communication channels was also generated. Factor analysis is a data

reduction method that allows for discovery of the underlying patterns in the data. Varimax rotation allows for maximum loadings per component. The correlation between factors is set to zero thus no correlation between factors (Long, 1997).

Factor analysis was used to study the relationship among the communication channels, by statistical grouping of the 15 communication channels into various factors (Bredja et al, 2000) through Varimax rotation. Varimax rotation with Kaiser Normalization was used because it results in factor pattern that loads highly significant variables into one factor, which was considered to offer a theoretically plausible and acceptable interpretation of the resulting factors.

For objective 3, descriptive statistics of the support services agro-input dealers provided to farmers was generated. The number of farmers who benefitted from various support services was examined across gender and the mean number reached in an annual basis determined.

For objective 4, Analysis of Variance (ANOVA) was used to compare the mean prices agro-input dealers were willing to pay (WTP) for the maize doctor and soil map. A linear regression model was used to model WTP (Y variable) using several agro-dealer characteristics, e.g. age, level of education, gender, main occupation and county as the X variables.

Chapter 4: Results and Discussions

4.1. Socio-demographic characteristics of agro-input dealers

The summary statistics of the variables used in this study are presented in Table 2.

Most of the agro-input dealers (65.3%) were men. The age of agro-input dealers ranged from 19 to 68 years, with a mean and standard deviation of 37.3 and 9.68 years, respectively. The number of years that agro-input dealers have been in agro business ranged from 1 to 16 years (with a mean of 5.5 years and a standard deviation of 3.14 years). Sixty five percent of the surveyed agro-input dealers had post-secondary education, 32.6% had secondary education while 2.8% had primary education as the highest level of education attained.

Over 82.6% of the agro-input dealers regarded agro-input business as their main occupation. The rest indicated that they spent 20 to 45% of their time on agro-input business with their main occupation being farming (13.2%), veterinarian (2.8%) and teaching (1.4%). About 122 of the 144 i. e 84.7% agro-input shops interviewed were specialized agro-input shops. The remaining combined agro-input dealer business with other business lines. The most important of the non-agro-input items that sold alongside agro-input dealers were building materials (nails, iron sheets, cement, paint and brush paint), human medicines, bicycle and machinery spare parts, food items (maize products, common bean, flour, sugar, and bread).

Table 2: Socio- demographic characteristics of surveyed agro-input dealers in Trans-Nzioa and Siaya Counties in Kenya

		Frequency	Percentage
Gender			
Male		94	65.3
Female		50	34.7
County			
Siaya		73	50.7
Trans Nzoia		71	49.3
Main occupation			
Agro-input dealer		119	82.6
Farmer		19	13.2
Veterinary officer		4	2.8
Teacher		2	1.4
Agro-dealer experience		**Gender**	
		Male	Female
Age (years)	Minimum	19.0	20.0
	Maximum	68.0	50.0
	Mean	39.2	33.7
	Std. Deviation	10.34	7.09
Duration in business (years)	Minimum	1.0	2.0
	Maximum	16.0	15.0
	Mean	5.6	5.2
	Std. Deviation	3.18	3.07
Agro-dealer-interaction		**Year**	
		2010	2011
Number of times agro-input dealers interacted with extension staff	Minimum	1.0	1.0
	Maximum	20.0	12.0
	Mean	2.0	1.9
	Std. Deviation	3.71	1.61
Number of times agro-input dealers interacted with researchers	Minimum	1.0	1.0
	Maximum	5.0	9.0
	Mean	1.5	1.5
	Std. Deviation	1.08	1.06
Number of field days /shows/fairs attended	Minimum	1.0	1.0
	Maximum	15.0	11.0
	Mean	3.0	2.1
	Std. Deviation	1.92	1.73

Source: Author 2012

Over 92% of agro-input dealers admitted having been visited by an extension staff. The visits ranged from once to twenty times a year with a mean and standard deviation of 1.98 and 3.712 times respectively in 2010. In 2011, 134 agro-input dealers were visited by extension staff in various occasions which ranged from once to 12 visits a year with a mean and standard deviation of 1.84 and 1.612 times. Some agro-input dealers indicated that they were visited by researchers. Of the 144 surveyed agro-input dealers, 91% were visited by researchers in 2010, while 132 agro-input dealers were visited by researchers in 2011. The interviewed agro-input dealers also indicated that they attended farmer field days and agricultural shows and fares. In 2010, 139 agro-input dealers attended farmer field days while 134 agro-input dealers attended the farmer field days, agricultural shows and fairs in 2011, respectively.

4.2. Agro-input dealers awareness of ISFM technologies

This study assessed whether the agro-input dealers were aware of ISFM technologies. Awareness was defined as whether the agro-input dealer ever heard of ISFM technologies such as use of inorganic fertilizers, precise fertilization or micro dosing, nitrogen fixations by legumes, use of improved seeds or germplasm, biomass transfer, agro-forestry, use of improved fallows, composting, crop rotation, use of animal manure, use of farm machinery, seed treatment chemicals, pesticides and storage chemicals. Results indicate 57.6% were aware of various ISFM technologies.

4.2.1. Logit regression of factors influencing awareness of ISFM by agro-input dealers in Siaya and Trans Nzoia Counties in Kenya

A logistic regression was fitted to assess the effects of gender, age, county, level of education of agro-input dealers, number of years of engagement in agro-input dealer business, visit by extension and researchers, attending farmer field days, primary and secondary occupation on ISFM awareness by 144 agro-input dealers (Table 3). Five variables positively influenced agro-input dealer's awareness of ISFM technologies significant. These were the gender, age, educational level, experience in agro business and visit by extension of agro-input dealers.

The agro-input dealers' level of education affected awareness of ISFM technologies. Results from the logistic regression imply that agro-input dealers with basic education were less likely to be aware of some of the ISFM technologies compared to those with secondary or post-secondary education. From the logit regression model, holding other variables constant, an increase in the level of education by one unit such as from primary level to secondary level increases the chances of ISFM awareness by 0.91 ($p=0.000$).This findings highlights the importance of education in the dissemination and communication of ISFM technologies.

Holding other factors constant, increasing the number of years of engagement in agro businesses increases the chances of agro-input dealer awareness of ISFM technologies by 0.08 ($p=0.000$). This implies agro-input dealers who have been in business for a longer period are more likely to be aware of ISFM technology that those who have been in agro business for a shorter period. This further means that agro-input dealers who have been in

business for a longer period would have had higher chances of learning or interacting with other agro-input dealers and agents who are likely to share about the ISFM technologies.

Age of agro-input dealer is also statistically significant. Holding other factors constant, the model indicates that with increase in the age of agro-input dealer by one year increases the chances of agro-input dealer awareness of ISFM by 0.036 (p=0.000). This means that agro-input dealer awareness of the various ISFM components is determined by the age, thus knowledge intensive technologies will require more time as shared in the previous sections and Table 3.

Table 3: Logit regression of factors influencing awareness of ISFM by agro-dealers in Siaya and Trans Nzoia Counties in Kenya

Variables	Co-efficient	S.E.	P value	Marginal effects
Gender of agro-input dealer	-0.395	0.117	0.001	1.335
Age of agro-input dealer (Years)	0.036	0.007	0.000	37.213
Education level	0.906	0.109	0.000	3.696
Experience in agro business	0.076	0.021	0.000	5.587
Visit by extension	0.569	0.264	0.031	0.931
Visit by researcher	0.038	0.23	0.869	0.916
Farmer field days/shows	-0.442	0.415	0.287	0.991
Engagement in farmer education	0.127	0.287	0.657	0.958
Constant	-4.042	0.669		

Overall percentage predicted correct (86.7%), Model Summary (-2 Log likelihood =1927.42, Cox & Snell R Square (0.11), Nagelkerke R Square (0.16), N=142.
Source: Author 2012

Gender was also statistically significant, holding other variables constant female agro-input dealers were significantly less likely to be aware of ISFM technology compared to

male agro-input dealers. This indicates that farmers who will have to rely on male agro-input dealers are more likely to benefit on the awareness advantage they may have of ISFM technologies as compared to farmers who rely on female agro-input dealers as their source of the ISFM technologies.

Visits by extension staff were another variable that affects the agro-input dealer's awareness of ISFM technologies. Holding other things constant, an additional visit by extension staff, increases the probability of agro-input dealer being aware of ISFM technology by 0.57% ($p=0.031$). This indicates that extension service has a role to play in the knowledge of ISFM.

Several variables had no significant influence on the awareness of ISFM technologies by agro-input dealers; visitation by researchers, attending farmer field days and involvement in farmer education were found to have no significant influence on the ISFM awareness.

Based on the above findings, the level of education of the agro-input dealer affects the likelihood of the agro-input dealer's awareness of the ISFM technologies and the results further show that the years of engagement in agro-input business also affects the awareness of the ISFM technologies by agro-input dealers. Therefore the null hypothesis that the level of education of the agro-input dealer has no effect on the awareness of ISFM technologies was rejected. Subsequently, the null hypothesis that the period of engagement in agro-input business has no effect on the awareness of ISFM technologies was rejected.

4.3. Assessment of the channels used by Agro-input dealers to receive ISFM Information

4.3.1. Analysis of the accessibility of the channels of communication used by agro-input dealers to get ISFM and agricultural information

Most of agro-input dealers considered farmer field days, on-farm demonstrations, and public gatherings as the most accessible, with 82%, 60% and 49% respectively of them ranking these channels very highly in terms of accessibility (Table 4). Songs/poems and skits were ranked inaccessible with 98% of agro-input dealers ranking the accessibility of this channel low. DVD /CD player and internet were least accessed with 91% and 63% respectively ranking them low in terms of accessibility.

Table 4: Agro-input dealers' assessment of the accessibility of ISFM communication channels (N=142)

Communication Channels	Accessibility					
	Low		Medium		High	
	Count	%	Count	%	Count	%
Workshops/Seminars	5	4	125	88	12	8
Other agro-input dealers	1	1	98	69	43	30
Billboards/Posters	15	11	121	85	6	4
Internet	90	63	40	28	12	8
Brochures	8	6	111	78	23	16
Newspapers/Magazines	87	61	50	35	5	4
DVD/CD players	129	91	12	8	1	1
Radio	26	18	109	77	7	5
Books	30	21	77	54	35	25
Television	17	12	120	85	5	4
Songs/Poems/Skits	139	98	3	2	0	0
Public gatherings/*baraza*'s	6	4	67	47	69	49
Farmer Field Days	1	1	25	18	116	82
On-farm demonstrations	4	3	53	37	85	60
Mobile phones	9	6	105	74	28	20

Source: Author 2012

Cosmopolite interpersonal channels, that is, the workshops /seminars, farmer field days, public gatherings/*baraza's* and on farm demonstration were considered by agro-input dealers to be more accessible compared to other channels of communication (Figure 8)

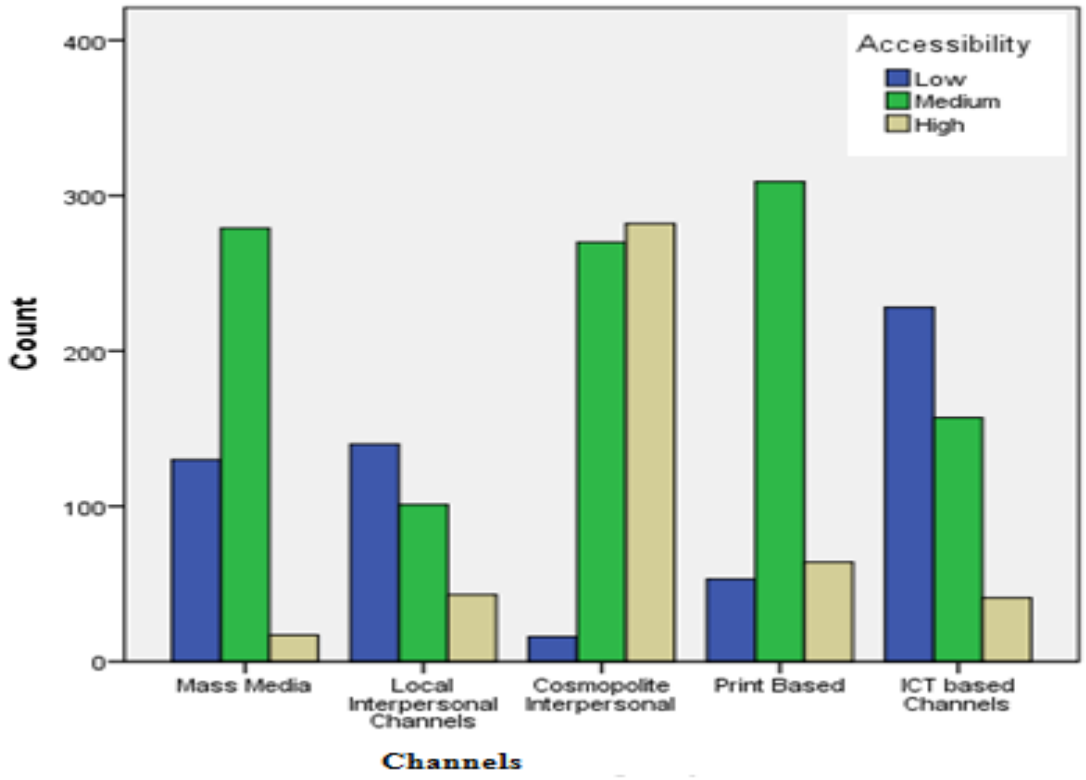


Figure 8: Agro-input dealers' assessment of the accessibility of Communication channel

Source: Author 2012

4.3.2 Communication channels factor analysis and agro-input dealer perspectives of accessibility of communication channels

The 15 communication channels initially analyzed were reduced by factor analysis to 7 main components when assessing the accessibility of the communication channels for the ISFM information. The 7 main components were consequently retained for identification and interpretation (Brejda et al, 2000). Table 5 shows factor loadings and communalities for the reduced components. Large amounts of correlations (loadings) between the parameters and factors (>±0.5) were used to group and identify the communication channels (Brejda et al 2000). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.503 which was

satisfactory for the factor analysis process and Bartlett's Test for sphericity were significant (p=.000) as shown in Table 6.

The first factor which accounted for 15.019% of the variance had high positive loadings of on farm demonstrations (0.736), workshops and seminars (0.6.3) brochures 0.568 and public gatherings (0.555). There was positive and significant correlation between the brochures and Cosmopolite channels of communication as shown in Table 6 and thus the factor was identified as the '*Cosmopolite interpersonal and print based communication channels factor'.* The second factor accounted for 12.993% of the variance and had higher loadings on television (0.795), radio (0.673) and books (0.52), with a significant correlation between the books and Mass media (radio and television) as shown in Table 6 and this factor was identified as '*mass media and print based communication channels factor'.* The third factor accounted for 8.737% of the variance and entailed loadings on internet (0.753) and books (0.542) with a significant correlation between internet and books of 0.303 and the factor was identified as '*Print and ICT based communication channels factor*'. The fourth factor had loadings on mobile phones (0.905) and it was identified as '*ICT based communication channel factor'.* The fifth factor was made up of loadings on billboards and posters (0.744) and a negative loading for farmer field days (-0.525) which also indicated negative correlation between billboards/posters and farmer field days of -0.123 and hence the elimination of the farmer field days from the group and the factor was thus identified as '*Print based communication channels factor'.*

Table 5: Factor loadings, eigen values and communalities for a seven factor model of the communication channels agro-input dealers use to access ISFM information

Accessibility	Component							Communalities
	1	2	3	4	5	6	7	
On farm demonstrations	0.736							0.721
Workshops /Seminars	0.603							0.53
Brochures	0.568							0.642
Public gatherings /*baraza's*	0.555							0.692
Television		0.795						0.666
Radio		0.673						0.693
Internet			0.753					0.613
Books		0.52	0.542					0.763
DVD/ CD players								0.57
Mobile phones				0.905				0.831
Billboards/ Posters					0.744			0.585
Farmer Field Days					-0.525			0.617
Other Agro-input dealers						0.843		0.756
Newspapers/ Magazines						0.503		0.625
Songs/ Poems/ Skits							0.792	
Eigen values	2.3	2.0	1.3	1.3	1.1	1.1	1.0	
% of Variance	15.019	12.993	8.737	8.377	7.496	7.176	6.699	
Cumulative %	15.019	28.013	36.750	45.127	52.622	59.798	66.497	

KMO and Bartlett's Test: KMO Measure of Sampling Adequacy=0.503; Bartlett's Test of Sphericity: X^2=280.491, df=105, Sig. =0, Cut point for loadings =0.5.
Source: Author 2012

The sixth factor was composed of other agro-input dealers (0.843) and newspapers/magazines (0.503) which had a positive significant correlation of 0.220 and thus was identified as '*Mass media and local interpersonal communication channels factor'.* The seventh factor was highly composed of positive loadings of Songs/poems/skits (0.792) and thus this was identified as '*local interpersonal channels of communication factor'.*

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Table 6: Correlations among the communication channels in the context of accessibility of the ISFM Information

Parameters	Workshops/ Seminars	Other agro-input dealers	Billboards/ Posters	Internet	Brochures	Newspapers/ Magazines	DVD/ CD players	Radio	Books	Television	Songs/ Poems/ Skits	Public gatherings/ *baraza*'s	Farmer Field Days	On farm demon	Mobile phones
Workshops/ Seminars	1														
Other agro-input dealers	-0.047	1													
Billboards/ Posters	0.024	0.065	1												
Internet	0.027	0.071	0.117	1											
Brochures	.192*	-.178*	0.039	0.006	1										
Newspapers/ Magazines	0.038	.220**	.159*	.155*	.156*	1									
DVD/ CD players	-0.044	-0.1	-0.064	-0.113	.170*	0.121	1								
Radio	-0.136	0.084	.152*	-0.105	.167*	.272**	0.041	1							
Books	-0.099	.166*	0.064	.303**	-0.104	0.128	-0.016	.195**	1						
Television	-0.022	0.021	0.108	0.097	.172*	.264**	.182*	.332**	.364**	1					
Songs /Poems/Skits	0.122	-0.092	0.025	0.049	0.073	-0.023	0.107	0.042	0.065	0.032	1				
Public gatherings/ *baraza*'s	.139*	-0.042	-0.065	-0.083	.305**	-0.057	0.03	0.064	-0.076	.169*	-0.028	1			
Farmer Field Days	.167*	-0.001	-0.123	-0.075	.145*	-0.079	-0.018	-0.097	-0.078	0.032	0.068	0.059	1		
On farm demon.	.225**	-0.053	-0.063	-0.03	.210**	-.142*	.160*	-0.06	-.415**	-.139*	0.026	.336**	.294**	1	
Mobile phones	-0.039	-0.049	0.008	0.098	-.220**	-0.026	-.173*	.140*	-0.035	-0.052	-0.04	-0.06	-0.048	.160*	1

* Correlation is significant at the 0.05 level (1-tailed), **Correlation is significant at the 0.01 level (1-tailed).List wise N=142

Source: Author; 2012

Based on the above results, cosmopolite channels of communication (community based) channels emerged as the most accessible. Farmer fields days ranked highest among the agro-input dealers in all aspects tested. This medium therefore provides agro-input dealers with a chance to interact with each other and also other stakeholders. The Community based channels provide a two-way communication where feedback or clarity can be sought on site and thus allows for feedback between the sender and receiver of the information. Such channels are considered to be effective especially when dealing with knowledge intensive information such as the ISFM technologies (Norrish et al, 2001). The ability to provide feedback reduces the uncertainty and thus the reason why the cosmopolite channels were considered more appropriate by majority of the agro-input dealers.

Mass media was among the least used channels of communication by agro-input dealers to receive information on ISFM technologies. This can be due to the fact that mass media is not as interactive as the community based channels which allow for feedback. Mass media can thus be considered as a channel that allows for dissemination of information which does not allow for feedback since the information reaches out to many audiences. Radio has the potential to reach out to many audiences in rural areas. The timing, wrong language and its unsuitability for imparting technical skills to the target audience may be its major limitation (Norris 2001). Television and newspapers/magazines are considered relatively expensive for an average agrodealer (Makinen, 2007). Makinen (2007) further noted that very few Kenyans are able to buy newspaper and there is an impediment of illiteracy and language barrier that deter communication through these channels.

Print based channels were far much better than the mass media especially the brochures, books and posters in terms of accessibility by agro-input dealers. Despite the fact that these channels are disseminative by nature and mostly provided by the agro-input dealer companies, most agro-input dealers acknowledged that they can still provide feedback to the providers of the information. Print based media were also considered more accessible compared to mass media, ICT based and local interpersonal channels of communication. This finding may be due to the fact that print based channels are provided for free by the companies that supply the various agro-inputs and the companies deal with different products and due to competition they try to do as much as possible in terms of campaigns and promotion of the products and thus the technologies become familiar with agro-input dealers. Socio-economic factors play a vital role in limiting the full utilization of print based channels; such factors include low income and low level of education (Bationo et al, 2004, Sanginga and Woomer, 2009). There is also an impediment of difficulty in distribution, minimal impact where the target group is illiterate, susceptibility to wear and tear due to fragile nature, and most of them are impersonal and thus can easily be ignored by those with no interest (Norris, et al,. 2001). This explains the low utilization of print based channels by agro-input dealers for seeking agricultural information.

ICT based communication channels (DVD/CD players, mobile phones and internet) showed minimal advantage to agro-input dealers which can be due to the complex nature of use and comparatively high cost of accessing them. Internet was poorly used by agro-input dealers in the two regions and this can be attributed to the disparity in access to ICTs between rural and urban populations (Munyua, 2007, Oguya, 2006). The high cost and insufficient infrastructure contributed to the low uptake of the ICT based technologies especially the use of internet by agro-input dealers.

Mobile phones are in common use by most agro-input dealers since approximately a member of a household in Kenya owns a mobile phone handset (Kinyua, 2004). Mobile phones are mostly used by agro-input dealers to communicate with other agro-input dealers, the farmers and suppliers. The use of mobile phones for information seeking has been under-utilized mostly due to high cost of airtime. Inadequate ICT infrastructure, high cost of ICTs and telecommunications, presence of monopolies, low bandwidth thus low internet speeds and weak policies on ICT use in Africa are some of the major hindrances to the utilization of ICT channels of communication (Munyua, 2007). There are efforts to address some of these challenges especially the laying of the submarine and terrestrial cables being laid out in Africa which is aimed at enhancing improved speeds and connectivity and thus improve the international communication service since the continent is being connected with other parts of the world (Echezona and Ugwuanyi, 2010).

4.4. Services provided by agro-input dealers

Apart from selling inputs, the agro-input dealers also provided additional services to farmers. The three most important services provided to farmers were information on agronomic practices for seeds, information on agronomic practices for pesticides, and information on agronomic practices for fertilizers (Table 7).

Table 7: Services provided by agro-input dealers

Other Services	Number of farmers extended to in a year				
	Male Famers		Female Farmers		Total
	N	%N	N	%N	N
Information on agronomic practices for fertilizers	270	66.3	137	33.7	407
Provide them with farm credit	206	71.0	84	29.0	290
Information on agronomic practices for improved seeds	302	66.5	152	33.5	454
Information on agronomic practices for pesticides/herbicides	297	66.3	151	33.7	448
Allow them to buy on credit	180	64.5	99	35.5	279
Information on soil suitability	144	64.0	81	36.0	225
Information on soil fertility	140	64.5	77	35.5	217

Source: Author 2012

The number of farmers that benefited from other services extended to them by the survey agro-input dealers ranged from 140 (information on soil fertility) to 302 (Information on agronomic practices for improved seeds) for male farmers and from 77 (information on soil fertility) to 152 (Information on agronomic practices for improved seeds). Generally there were more male farmers benefitted from the services provided by agro-input dealers than their female counterparts

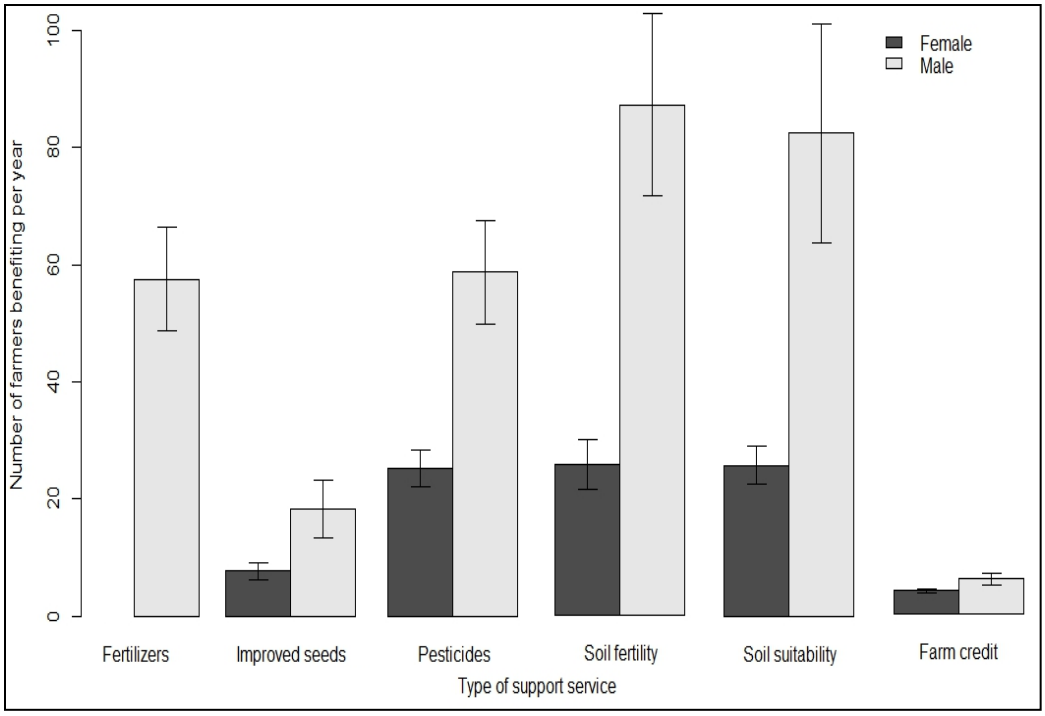

Figure 9: Support services the agro-input dealers offer farmers by gender
Source: Author 2012

Table 8: Number of farmer's agro-input dealers extend other services to, by gender

Services agro-input dealers offer	Gender				T-statistics	P-Value
	Male		Female			
	N	Mean	N	Mean		
Information on soil fertility	90	5.9	90	3.8	4.349	0.007
Provide farm credit	51	18.3	51	7.7	2.768	0.008
Information on improved seeds	105	58.7	105	25.2	4.223	0.000
Information on pesticides/herbicides	104	57.5	103	21.4	4.584	0.000
Information on fertilizers	47	82. 5	47	25.7	3.354	0.000
Information on soil suitability	29	87.1	29	25.7	4.389	0.002
Buy on credit	28	87.3	28	24.6	2.764	0.000
Total	456	49.4	455	18.1		

Source: Author 2012

The results from paired sample t-test on mean number of male and female farmers that benefitted from different services from agro-input dealers indicate that there was significant difference

between the number of male and female farmers reached with regard to the seven other services evaluated (Table 8 and Figure 9). This implies that the gender of the farmer plays a significant role in determining the kind of support services agro-input dealer dealers extend. The null hypothesis that gender has no effect on the kind of support services offered by agro-input dealers to their clients was therefore rejected.

Table 9: Agro-input dealers' rating of their ability to extend different 'other services to farmers

Other Services	N								
	Male			Female			Across gender		
	Little	Medium	High	Little	Medium	High	Little	Medium	High
Buy on credit	56	1	0	29	0	0	85	1	0
Provide farm credit	31	6	0	8	3	0	39	9	0
Information on improved seeds	8	57	2	2	31	1	10	88	3
Information on pesticides/herbicides	7	56	2	1	32	1	8	88	3
Information on fertilizers	7	20	2	2	14	1	9	34	3
Information on soil suitability	7	10	0	2	8	1	9	18	1
Information on soil fertility	7	8	1	1	6	1	8	14	2

Source: Author 2012

The results of the analysis of the ability of agro-input dealers to provide other services to farmers are presented in Table 9. The table shows that none of the surveyed agro-input dealers had a high ability to allow farmers to buy on credit or to provide farmers with farm credit. Only one agro-input dealer out of the 144 surveyed had a high ability to provide farmers information on soil suitability. At the same time, the results shows that only two agro-input dealers had a high ability to provide information on soil fertility, while three had a high ability to provide information on improved seeds, information on pesticides herbicides and information on fertilizers.

Table 10 : Sources of advice that encourage agro-input dealers to sell to smallholder farmers

Who gave you the encouragement		
	Frequency	**Percentage**
Institutions	48	33.3
Distributors	17	11.8
Farmers	55	38.2
Government Agencies	24	16.7
Total	144	100

Source: Author 2012

Further investigation showed that 66.7% of the agro-input dealer dealers acknowledged having been encouraged to sell fertilizers to smallholder farmers. This encouragement mostly came from farmers (38.2%), agricultural marketing institutions and NGOs (33.3%), Government agencies (16.7%) and fertilizer companies and seed manufacturers (11.8%) as shown in Table 10.

The years that the agro-input dealer dealers were encouraged to sell agro-input dealers to small holder farmers varied with high cases reported in 2010 (29.2%), 2009 (13.9%), 2011(9%) while low cases were reported in 1997,2000 and 2005 whereby 0.7% cases were reported. This is an indication that it is only recently that agro-dealers received encouragement to serve smallholder farmers. Overall, this encouragement has resulted in 47.9 % increase in sale of inputs by agro-input dealers that resulted in higher crop yields at the farm-level.

4.5 Willingness to pay by agro-input dealers for Maize doctor and Soil maps

The agro-input dealers' willingness to pay for the maize doctor and soil map piloted during the survey was investigated. Analysis of Variance (ANOVA) was used to compare the mean prices agro-input dealers were willing to pay for the maize doctor and soil map as shown in Table 12 and Figure 11.

Table 11: Mean price (Kshs) agro-input dealers are WTP for maize doctor and soil map

Variables	Parameters	Communication tools							
		Maize doctor				Soil map			
		Mean	N	Std. Deviation	P-Value	Mean	N	Std. Deviation	p-Value
Gender	Male	192.3	57	187.26	P>0.05	191.6	57	252.49	P>0.05
	Female	135.8	36	134.07		114.7	36	179.71	
Education level	Primary	100.0	2	70.71	P>0.05	50.0	2	0.00	P>0.05
	Secondary	166.9	32	139.66		115.6	32	170.29	
	Post-Secondary	174.8	59	187.64		190.7	58	255.61	
County	Siaya	220.4	45	193.27	0.005	111.8	45	151.03	0.041
	Trans Nzoia	123.5	48	130.59		208.8	48	277.10	
Main occupation	Agrodealer	167.4	82	170.34	p>0.05	136.7	82	174.38	0.006
	Farmer	174.4	9	153.71		310.0	9	418.84	
	Veterinarian	275.0	2	318.20		525.0	2	671.75	
Visit by extension	No	135. 6	9	167.71	p>0.05	166.67	9	314.245	0.011
	Yes	174.2	84	170.97		161.31	84	220.639	
Visit by research	No	71.8	11	87.50	0.040	150.0	11	283.73	p>0.05
	Yes	183.7	82	174.46		163.4	82	222.89	

Source: Author 2012

Male agro-input dealers were willing to pay more for maize doctor and soil map compared to their female counterparts. There was no significant difference between the mean prices that both the males and females agro-input dealers were willing to pay for the maize doctor and soil maps. Female agro-input dealer dealers were less educated, had lower income and expenditure capacity. These characteristics probably explain the difference in WTP between male and female

agro-input dealers. In absolute terms, men were willing to pay more than women agro-input dealers whereas female agro-input dealers were willing to pay a greater proportion of their income for the Maize doctor and Soil map.

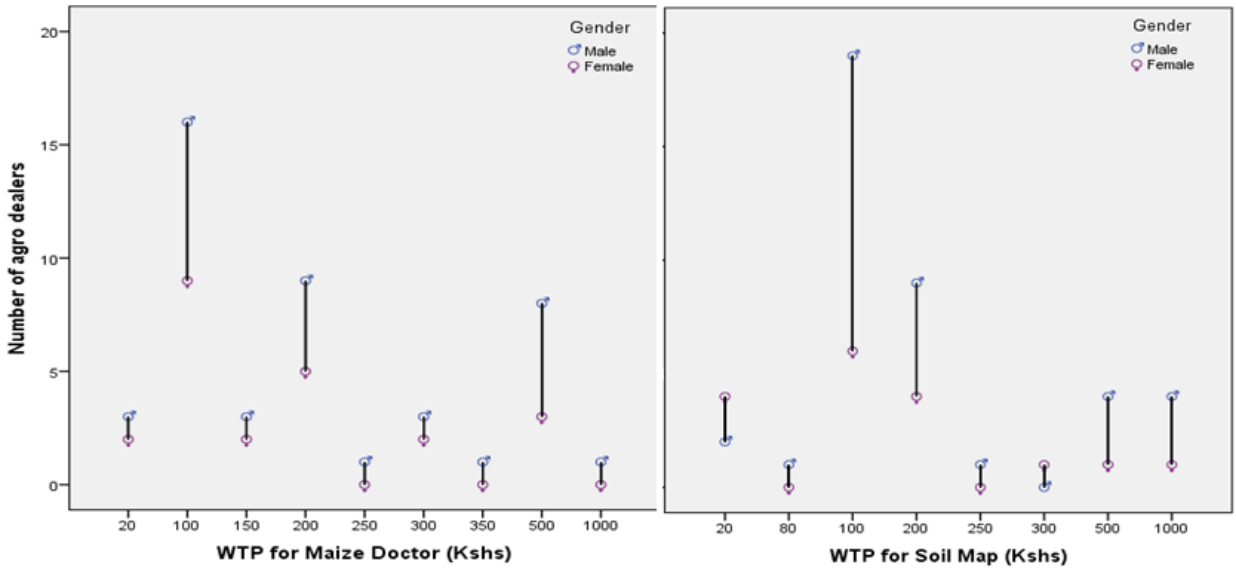

Figure 10: Drop line plot for WTP for Maize doctor and Soil Map by gender

Source: Author 2012

Agro-input dealers with higher level of education were willing to pay more for the maize doctor and soil map. This suggests that agro-input dealers with higher education were willing to pay more since they understood the value of investing in it.

Results also indicate that there is a significance difference in the amount that agro-input dealers were willing to pay for the maize doctor and soil map (Table 11). Agro-input dealers in Trans Nzoia County were willing to pay more for the Soil map as compared to their counterparts from Siaya County. This case can be attributed to the fact that the soil map for Siaya County covered a smaller geographical region (Sidindi division) as compared to the Trans Nzoia county soil map which covered a larger area (Trans Nzoia County).

Agro-input dealers from Siaya County were willing to pay more for the maize doctor as compared to agro-input dealers from Trans Nzoia County. This is likely to be due to the fact that agro-input dealers in Trans Nzoia County reported that they had earlier received the same device (i.e., maize doctor) either at a subsidized rate or for free from the Kenya Seed Company and other agro-input dealer companies unlike their counterparts in Siaya County (Figure 12).

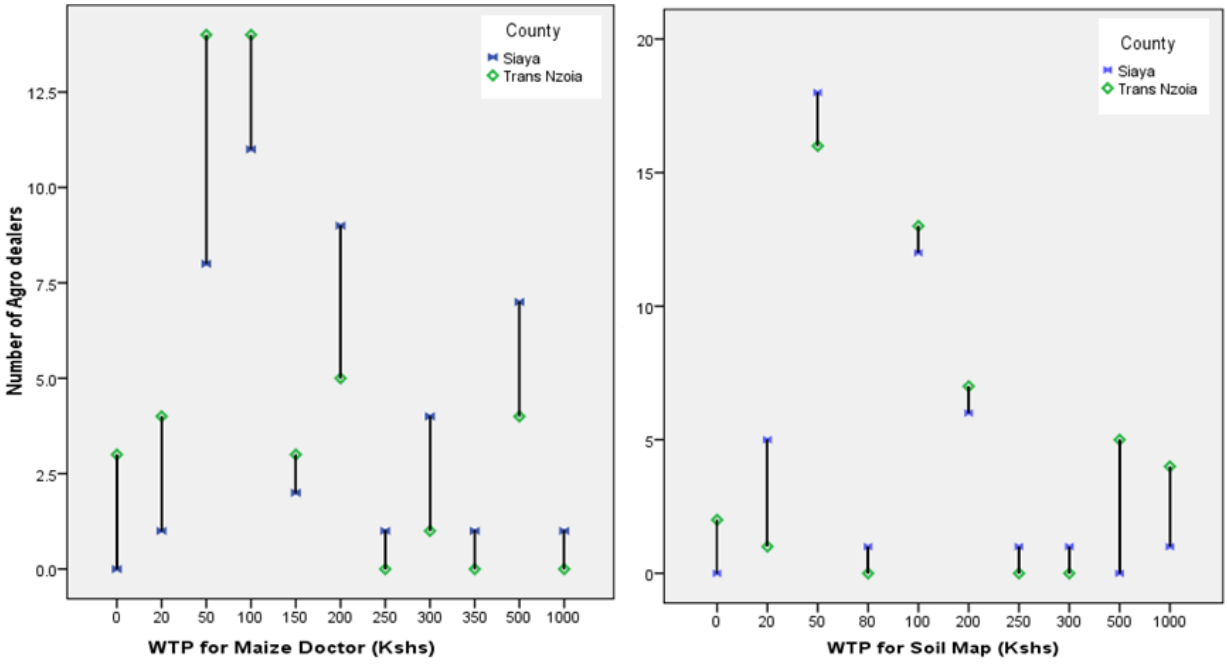

Figure 11: Drop line plot for WTP for Maize doctor and Soil Map by County
Source: Author 2012

The study assessed the difference in WTP for Maize doctor and Soil map by the type of occupation, veterinarian were willing to pay more for both the Maize doctor and Soil map compared to farmers and agro-input dealers. The main occupation had no effect on the mean prices that agro-input dealers were willing to pay for the maize doctor. However main occupation affects the mean prices that agro-input dealers were willing to pay for the soil map (Table 11). Veterinary officers and farmers were willing to pay more for the Maize doctor as

compared to agro-input dealers (Figure 13). This indicates that agro-input dealers that are better in terms of income are willing to pay more for the communication tools.

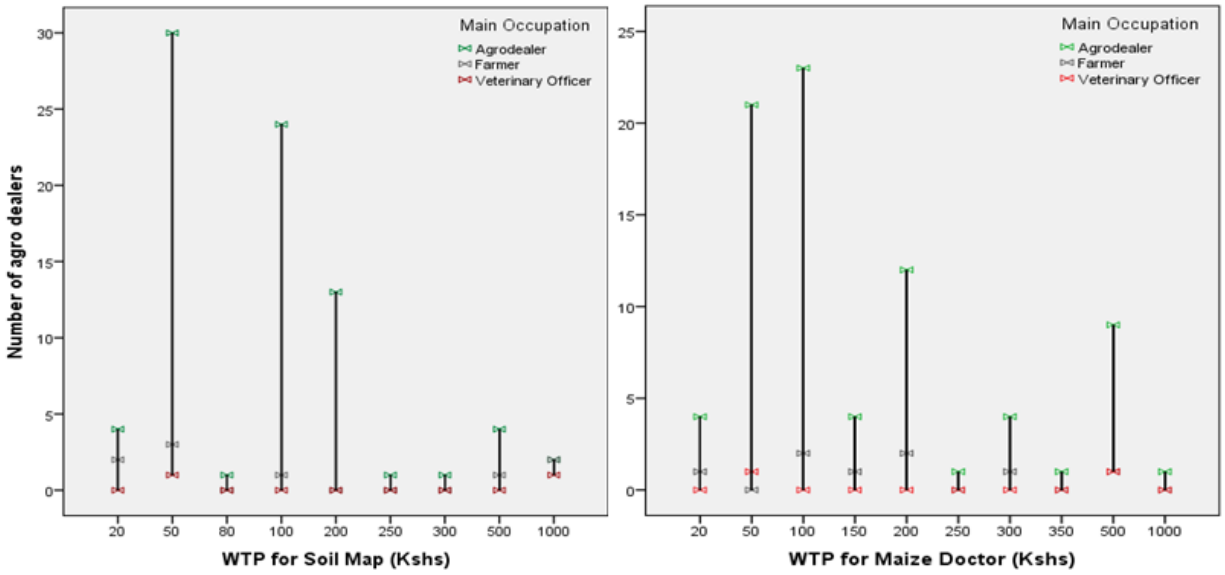

Figure 12: Drop line plot for WTP for Maize doctor and Soil Map by main occupation

Source: Author 2012

The study evaluated the differences in WTP by whether agro-input dealer were visited by extension staff or researchers. There was a significant difference in the amount that agro-input dealer dealers were WTP for the Soil map with respect to extension visits and in the WTP for the Maize doctor with respect to visits by researchers (Table 11 and Figure 14). The agro-input dealers that were visited by extension staff were willing to pay less for the maize doctor and soil map. This is probably because they felt that they could not rely on agricultural extension advice.

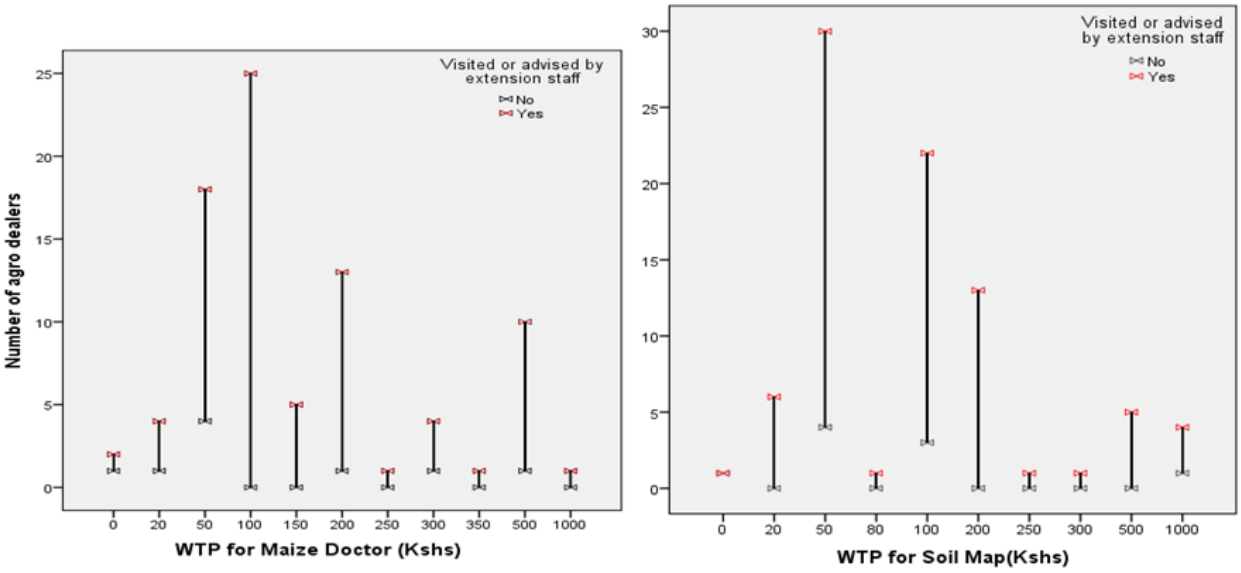

Figure 13: Drop line plot for WTP for Maize doctor and Soil Map by visit by extension staff

Source: Author 2012

Analysis of variance for the mean prices that agro-input dealers were WTP for the Maize Doctor and soil map was insignificant across gender, level of education, whether the agro-input dealer attended farmer field days or not, and whether the agro-input dealer was engaged in farmer education. There were however significant differences in mean prices that agro-input dealers were WTP for the Maize Doctor among the agro-input dealers that had been visited or advised by researchers.

From the analysis, the null hypothesis that level of education of agro-input dealer has no influence on the WTP for the maize doctor and soil map was rejected. Subsequently, the null hypothesis that gender of agro input dealers has no influence on the WTP for the Maize doctor and Soil map was rejected.

Chapter 5: Summary, Conclusion and Recommendation

5.1 Summary

The results from this study indicate that majority of the agro-input dealers interviewed were male and over 57% were aware of ISFM technologies. The awareness of ISFM technology was found to be influenced by agro-input dealers' age, gender, level of education, experience in agro business and visit by extension staff. Interaction with researchers, attending farmer field days and involvement in farmer education were found to have no influence on the ISFM awareness.

Community based (cosmopolite interpersonal) channels of communication such as on farm demonstration, farmer field days, workshops/seminars and public gatherings were found to be more accessible by agro-input dealers and thus used by agro-input dealers to receive and disseminate agricultural information. Other agro-input dealers, newspapers/ magazines, songs and poems were the least used channels by agro-input dealers to access and share agricultural information. ICT based communication channels (DVD/CD players, mobile phones and internet) showed minimal advantage to agro-input dealers which can be due to the complex nature of use and comparatively high cost of accessing them.

Apart from selling inputs, the interviewed agro-input dealers also provided additional support services to farmers. The services ranged from information on agronomic and soil management practices to credit facilities for farmers. The three key services provided to farmers were information on agronomic practices for seeds, pesticides, and fertilizers. There was general limitation in capacity among the agro-input dealers especially when it came to providing credit facilities to farmers. Agro-input dealers were also engaged in breaking the bulk of the agro inputs

they sold aimed at reaching out to smallholder farmers. There are reported efforts by agro-input dealer companies, government agencies, NGO's and private sector to train agro-input dealers in various ISFM technologies and sharing agricultural information. Farmers are also reported to be benefitting from the advice from agro-input dealers on how to apply fertilizer. Agro-input dealers were willing to pay for the communication tools as long as they are informed about its value. The WTP for the communication tools was found to be influenced by agro-input dealers' county, main occupation, interaction with extension and researchers

5.2 Conclusion and Recommendations

From the research findings, the following conclusions can be derived from the study. Foremost, the level of education of the agro-input dealer plays a vital role in the agro-input dealer's awareness of the ISFM technologies. The period of engagement in agro-input business has an influence on the agro-input dealer's awareness of the ISFM technologies. The communicative channels of communication are more effective in accessing and sharing ISFM technologies compared to disseminative channels of communication. The gender of the agro input dealer has an influence on the kind of support service that agro-input dealer offers to farmers. The level of education of agro-input dealer influences the WTP for the communication tools (Maize doctor and Soil map) by agro-input dealers. Finally, the gender of agro-input dealers has an influence on WTP for Maize doctor and Soil map by agro-input dealer.

The findings of this study suggest the need to improve the provision of extension services to agro-input dealers to enable them effectively communicate information about ISFM technologies to farmers. There is need to address the existing knowledge gap among agro-input dealers to enable them effectively communicate ISFM technologies to farmers. There is need for all

stakeholders to be encouraged to engage in awareness creation and capacity building of the agro-input dealers to effectively equip them with skills and knowledge essential in dissemination and communication of ISFM technology. There is need for the empowerment of female agro-input dealers to be able to participate in awareness creation of the agricultural technologies being developed; the results indicate the existing systems do not favor them much.

The government agencies engagement in training of agro-input dealers has been minimal, there is need for more resources in terms of human capital and infrastructure to be invested in national research centers so that agro-input dealers and farmers are able to benefit from basic services like soil analysis and thus be able to effectively know which agronomic practices to adopt for optimum returns. Strategies should be implemented to enhance the agro-input dealer's capacity in providing other agronomic services such as soil and crop management, post- harvest practices and livestock management.

Though the results give a simple picture, further investigation may be needed to examine the relationship between activities of agro-input dealers and crop yield improvement on farms and as proxy farmer benefits and use of inputs. It may also be useful to explore the determinants of the number of farmers reached out by agro-input dealers with different 'other services'.

Community based channels of communication were found to be the most accessible by agro-input dealers. There was minimal interest especially among the rural agro-input dealers on the use of ICT channels of communication. In Kenya, it is approximated that each household has at least a mobile phone. This means that if exploited as mode of communication it can effectively reach out to many people. Using such platform for communication has been hindered by the costs of making phone calls or sending sms (short message service).There is need to develop a

platform that is cheaper to use. This will call for all stakeholders engaged in agricultural information generation, packaging and dissemination to work together is developing a querying system that may be cost effective where agro-input dealers specific needs will be addressed and thus making the initiative worthy investing in.

The agro-input dealers reported their limitation in offering credit services to farmers. The major challenge was reported to be the cases where farmers are not able to repay the credit advanced to them in the terms of agro-inputs and thus expose the agro-input dealers to weather and market risks. This suggests the need to design insurance schemes for smallholder farmers.

The agro-input dealers expressed their desire to pay for the maize doctor and soil map. The price variation in what agro-input dealers were willing to pay for the soil map varied from one region to another depending on the level of education and the period of engagement in agro business. The agro-input dealers reported that some of the communication tools were complex and thus the need for development of simplified versions of the agricultural communication tools that will enhance the agro-input dealers' potential in communicating with other agro-input dealers and farmers. The soil maps were found to be general and thus the information may not be very precise to the farm level. There is therefore need for more precise soil maps enhanced with fertilizer use recommendation for the agro-input dealers to be able to advice farmers with accurate information and recommendations.

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Appendix 1: Questionnaire

Characteristics of agro-input dealers questionnaire

A: General information

1.1. Date of interview: _____

1.2. Name of the enumerator: _____

1.3. Name of agro-dealer: _____

1.4. Gender of agro-dealer: _____

1.5. Age of agro-dealer (years): _____

1.6. No. of years in school: _____

1.7 What is the highest level of education you have attained?

1) No education---------

2) Primary education------

3) Secondary education------

4) Post-Secondary education-----

1.8. Main occupation (major proportion of income): _____

1.9. Secondary occupation (secondary source of income): _____

1.10. Year started agro-dealer business: _____

1. 11. Name of market or point where interviewed: _____

1. 12. County: _____ [Siaya = 1; Trans Nzoia=2]

1. 13. Apart from you, how many other agro-input dealers are in this county? _____

1. 14. What proportion (%) of the shop is occupied by: agro-input items? _____%,

non- agro-input items. _____%__

1. 15. Name the three key non-agro-input items you sell: (a) _____ (b) _____ (c) _____

1. 16. Have you ever been visited or advised by extension staff? _____ (Yes = 1; No = 0)

1.17. A. If YES, how many times were you visited by extension staff in 2010 (Jan – December)?

1.17. B. If YES, how many times were you visited by extension staff in 2011 (Jan – November)?

1.18. Have you ever been visited or advised by researcher? _____ (Yes = 1; No = 0)

1.19. A. If YES, how many times were you visited by researcher in 2010 (Jan – December)?

1.19. B. If YES, how many times were you visited by researcher in 2011 (Jan – November)?

1.20. Do you attend field days/agricultural shows/fairs? _____ (Yes = 1: No=0)

1.21. A. If YES, how many did you attend in 2010 (Jan – Dec)? …….

1.21. B. If YES, how many did you attend in 2010 (Jan – Dec)? …….

1. 22. Have you ever been involved in any form of farmer education or agricultural extension work? _____ (Yes=1/No=0)

1. 23. If yes, indicate for how long …….. (yrs) and year last involved _____

1. 24. As a dealer on farm inputs, have you ever been encouraged to sell fertilizer to smallholder farmers? _____ (Yes=1, No=0)

1. 25. If yes (a) who gave you the encouragement? _____; (b) which year? _____; (c) What was the result? _____

1. 26. What proportion of your client farmers can classify as: (a) Small-scale farmers? _____%; (b) Medium-scale farmers? _____%; (c) Large-scale farmers? _____%

1. 27. About how many customers do you have? (a) Regular _____; (b) Irregular _____?

1. 28. Approximately how many (average) customers visit your shop in a day? _____

B. 1. ASSESSMENT OF ISFM AWARENESS

2.1. Do you usually advise farmers on methods of fertilizer application? _____ (Yes=1; No=0)

2.2 If yes, kindly indicate the different methods you often advise them to use:

(Branding=1) _____; (Side dressing=2) _____; (Top dressing=3) _____; (Broadcasting=4) _____;(Foliage spraying=5)_____; (Injecting gaseous Fertilizer=6) _____; (Others=7) _____;

2.3. Do you know what is meant by 'Soil Fertility Management practices' (ISFM)? ___ (Yes=1, No=0)

2.4. If YES, indicate aspects of ISFM your know in the table below

ISFM	**Are you aware of the following technologies**	**Have you been trained (Yes=1/No=0)**	**Who trained you (list)**
Inorganic Fertilizers			
Precise fertilization(Micro dosing)			
Nitrogen Fixations by Legumes			
Improved Seeds (Germplasm)			
Biomass Transfer			
Agro-Forestry			
Improved Fallow			
Composting			
Crop Rotation			
Animal Manure			
Farm Machinery			
Seed Treatment Chemicals			
Pesticides			
Storage Chemicals			
Other (specify)……..			

2.5. Have you EVER used any of the following agricultural information resource tools?

Tools:	**Response** ***(Yes = 1/ No = 0)***	**If yes, have you been providing such services to smallholder farmers in your catchment?** ***(Yes = 1/ No =0)***
Maize Crop Doctor (Be your own maize doctor)		
Soil maps		
Soil testing kit		
Nutrient Expert		
Any other (specify)		

2.6. Do you know how to test the soil for any of the following characteristic? [**Please use table below**]

How to test the soil for:	**Response** ***[Yes = 1, No = 0]***	**If yes, have you been providing such services to smallholder farmers in your area?** ***[Yes = 1, No =0]***
pH (acidity)		
Carbon: Nitrogen ratio		
Other (please specify…..)		

2.7. Apart from selling inputs, which of these other services do you provide to farmers? ***[NB this question will be used before and after the crop doctor has been administered to agro-dealers]***

Other services provided to farmers	**Do you provide this service? (Yes =1/No=0)**	**How many male farmers benefit per year?**	**How many female farmers benefit per year?**	**How do you rate your current ability to extend this service to farmers (none =0; little=1; medium=2; high=3)**
Spray their crops for free				
Spray their crops at cost				
Allow them to buy on credit				
Provide them with farm credit				
Information on agronomic practices for improved seeds				
Information on agronomic practices for pesticides/herbicides/etc.				
Information on agronomic practices for fertilizers				
Information on soil suitability				
Information on soil fertility				

C: ASSESSMENT OF CHANNELS USED BY AGRO-INPUT DEALERS TO RECEIVE ISFM INFORMATION

3.1. Which of the following channels of communication do you use to receive ISFM information?

ISFM Information Channels	***Rank the different information sources on the basis of the following context*** *[*1-low; 2=medium; 3=high*]*					**What needs influence the preference for this information source** [*Use codes below*]
	Accessibility	**Reliability**	**Informative-ness**	**Comprehension**	**Preference**	
Workshops/Seminars						
Other agro-input dealers						
Billboards/Posters						
Internet						
Brochures						
Newspapers/Magazines						
DVD/CD players						
Radio						
Books						
Television						
Songs/Poems/Skits						
Public gatherings/ *barazas*						
Farmer Field Days						
On-farm demonstrations						
Mobile phones						
Other specify (_____)						

NEEDS: 1= Information/Knowledge needs 2= Social integrative needs 3= Entertainment needs 4= Personal integrative (credibility, status) needs 5= other (please specify)

D: **WILLINGNESS TO PAY:**

4.0: Maize doctor
4.1 Have you ever used the **Maize doctor** before? (Yes=1, No=0)

4.2 How much are you willing to pay for the Maize doctor (Kshs.)……

5.0 Soil Map
5.1 Have you ever used the **Soil Map** before? (Yes=1, No=0)

5.2 How much are you willing to pay for the Crop doctor (Kshs.)……