Exploring Relevance of Agro Input Dealers in Disseminating and Communicating of Soil Fertility Management Knowledge: The Case of Siaya and Trans Nzoia Counties, Kenya

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Abstract: In most parts of sub Saharan Africa (SSA), a lack of access to necessary agro-inputs contributes to low agricultural productivity and slows the overall economic growth and development. Agro-input dealers make inputs more easily accessible to rural-based smallholder farmers. 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 in Siaya and Trans Nzoia counties in Kenya, and looked at agro-input dealers' awareness of ISFM practices and communication channels used to access agricultural information. The study underscores the important role played by community based channels of communication in the ISFM knowledge dissemination and suggests a need to improve the provision of extension services to agro-input dealers to enable them effectively communicate information about ISFM technologies to farmers

Resumé: Dans la plupart des régions de l'Afrique subsaharienne (ASS), le manque d'accès aux intrants agronomiques nécessaires contribue à une faible productivité agricole et ralentit la croissance et le développement économiques globaux. Les concessionnaires d'intrants agronomiques rendent les intrants plus facilement accessibles aux petits agriculteurs ruraux. Cette étude a évalué le rôle joué par les concessionnaires d'intrants agronomiques dans la diffusion et la communication de l'information sur les pratiques de gestion intégrée de la fertilité des sols (GIFS) aux petits exploitants agricoles pour les comtés de Siaya et Trans Nzoia au Kenya ; et a étudié la sensibilisation des concessionnaires d'intrants agronomiques aux pratiques de la GIFS et les canaux de communication utilisés pour accéder aux informations agricoles. L'étude souligne le rôle important joué par les canaux de communication fondés sur la communauté dans la diffusion des connaissances de la GIFS et suggère la nécessité d'améliorer la fourniture de services de vulgarisation aux concessionnaires d'intrants agronomiques pour leur permettre de communiquer efficacement les informations sur les technologies de la GIFS aux agriculteurs.

Resumen: En gran parte de África Subsahariana, la falta de acceso a los insumos agrícolas necesarios contribuye a una baja productividad agrícola y retarda el desarrollo y crecimiento económicos en general. Los distribuidores de insumos agrícolas hacen que los insumos sean de más fácil acceso para los pequeños agricultores en zonas rurales. Este estudio evaluó el papel desempeñado por los distribuidores de insumos agrícolas en la difusión y comunicación del prácticas de manejo integrado de la fertilidad del suelo (MIFS) e información a los pequeños agricultores en los condados de Siaya y Trans Nzoia en Kenia, y analizó el conocimiento que tenían los distribuidores de insumos agrícolas acerca de prácticas de MIFS y los canales de comunicación utilizados para acceder a la información agrícola. El estudio resalta el papel importante que desempeñan los canales comunitarios de comunicación en la difusión de conocimientos acerca del MIFS y sugiere la necesidad de mejorar la prestación de los servicios de extensión a los distribuidores de insumos agrícolas para que puedan comunicar de manera efectiva la información sobre tecnologías de MIFS a los agricultores.

Limited access to necessary agro-inputs has been the main cause of low agricultural productivity and the overall poor economic growth and development in most parts of Sub-Saharan Africa (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 disseminating and communicating 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 of that year (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 International Tropical Agriculture (CIAT-TSBF). The International Fertilizer Development (IFDC) and the U.S. Agency for International Development (USAID) are among the other donors supporting agro-input dealers' related projects in Sub-Saharan Africa. 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. Such efforts are also being explored by the International Plant Nutrition Institute Africa (IPNI) 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 the agro-input trade with respect to agrochemicals and farming equipment use (Camara and Heinemann, 2006). Much less effort, however, has gone into understanding the role of agro-input dealers in the dissemination and communication of ISFM knowledge.

This study explores the knowledge among the agro input dealers on various soil fertility management practices and the communication channels used to receive such information. The soil fertility management components that will be looked at in this study include the use of improved seeds and fertilizers in maize production. 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 a maize doctor and soil map.

Objectives – The main objective of the study was to assess the role agro-input dealers play in disseminating and communicating the Integrated Soil Fertility Management (ISFM) practices and agricultural information in Siaya and Trans Nzoia Counties in Kenya.

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.

Literature review

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 well-being and economic growth (Bationo, 2007). Most Africans (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 to 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 as well as crop destruction by pests and diseases—all despite the availability of modern chemicals and tools that would have been useful (Bationo, 2007). 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). There are also problems associated with the dissemination and communication of information to farmers (Rege, 2006; Rees, 2000). This has led to a call for strategies to accord farmer education the priority that is needed to spur the use of improved technologies such as fertilizer, improved seed varieties, and pesticides (Oniango, 2001). Additionally, agricultural production needs to grow by 50–70% to cope with a growing world population (Denning and Jeffrey, 2008), and the efficiency of input applications also needs to increase substantially. Climate change is yet another challenge, one that requires farmer education to incorporate strategies for overcoming its effects (Njuguna, 2011).The low adoption of agricultural technologies that would address many of these challenges is attributed to various factors such as the lack of awareness (Ramisch et al, 2006).

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 were introduced, due mainly to a well-funded extension service, an elaborate set of farmer incentives including a ready market, subsidized inputs and credit, and 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—i.e, many players along the agricultural production value chain are involved in extension services and these efforts are not well coordinated; and poor linkages with extension facilitating factors (Wanga, 1999).

The extension services system is also facing the major challenge of a lack of facilities and resources 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 formats 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 be addressed; e.g., structural, organizational, motivational, incentive, resource constraint and communication challenges facing the system (Muyanga et al 2006).

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 Sub Saharan Africa 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 costs, 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).

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 terms. Information is defined as one or more facts received by a human being and that may be useful or of worth to the recipient (Avelock, 1986). It is any news or facts about something, 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 a clear distinction between information sources and channels. Information sources provide the content and the expertise of interest to the information seeker; the key sources of agricultural information include the agricultural research and learning institutions. The channels, on the other hand, are the vehicles through which the information is transferred or received, and 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.

Information channels are therefore ways that messages get from a source to a receiver. Such channels can be further categorized broadly into (i) interpersonal (face-to-face) versus mass media (TV, radio, newspaper, etc.) communication and (ii) localite (local) versus cosmopolite (outside the local social system) channels (Rodgers, 2003).

The mass media include television, radio, newspapers and magazines, and generally allow few individuals to reach out to larger audiences (Rodgers, 2003); it is entirely cosmopolite, whereas interpersonal channels can either be cosmopolite or local. Local interpersonal channels are traditional in nature; for instance poems, exchanges

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 although it involves face-to-face interaction with the participants; they involve community-based channels like workshops, farmer field days, on farm demonstrations, seminars, farm to farm visits, public *barazas,* and agricultural shows.

Besides the mass media and ICT-based channels such as the internet and mobile telephones, there exist many channels through which ISFM information can be shared (Rees et al., 2000). There are print based media, including books, billboards, brochures and posters. There are also development workers and agencies, outreach services, cooperatives, faith-based organizations and other indigenous sources of knowledge (Adolwa et al 2012).

Methodology and Materials

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 Sub Saharan Africa (Tittonel et al, 2005). The high population is attributed to the earlier settlements who were drawn 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°30′ North and longitude 34°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 °C and 30 °C and annual mean minimum temperature ranging between 15 °C and 17 °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

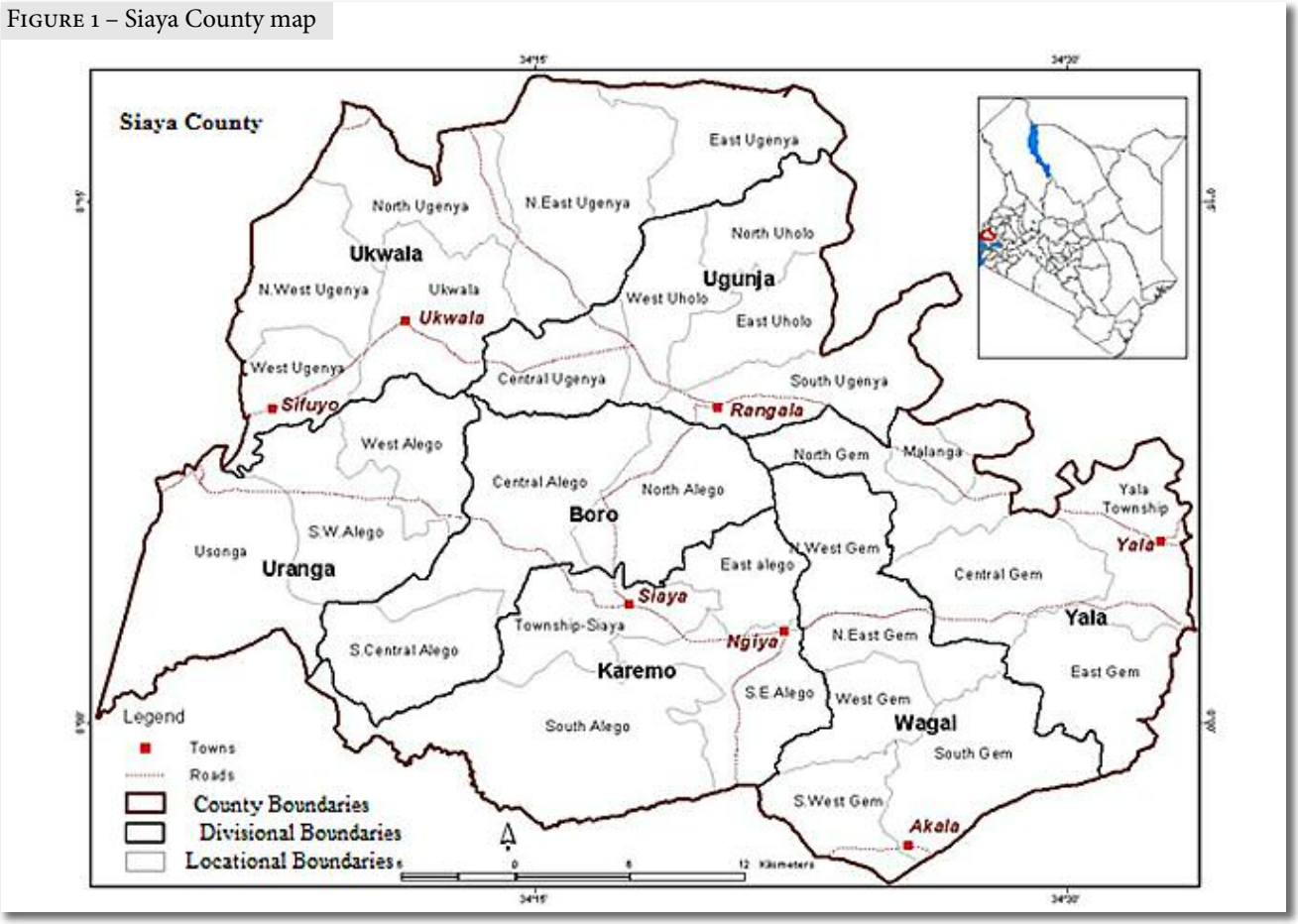
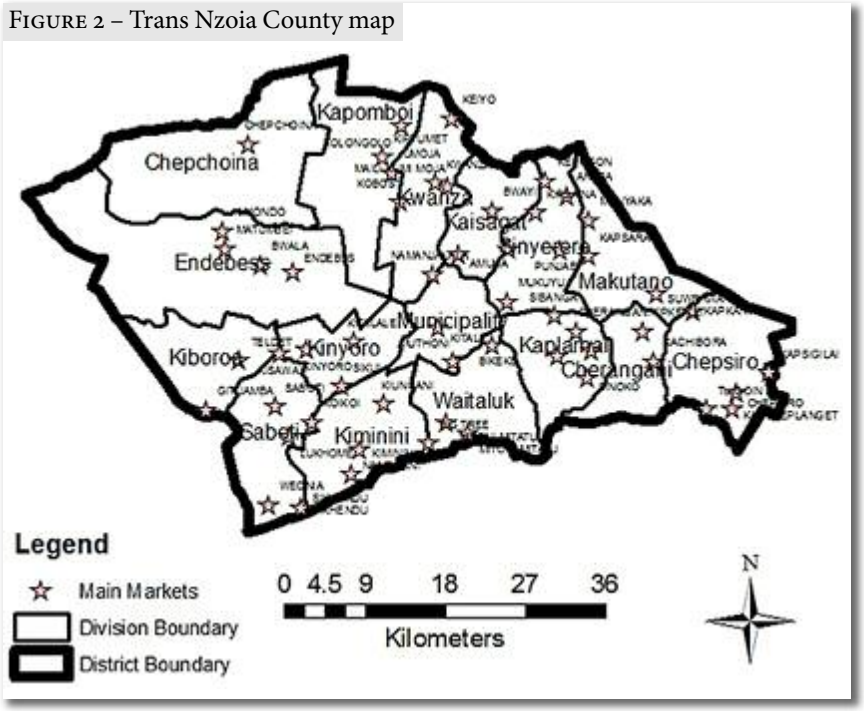


Figure 2 – Trans Nzoia County map



Trans Nzoia County is located between the Nzoia River and Mount Elgon; its center is the town of Kitale and it is the continuation of the fertile Uasin Gishu plateau beyond the Nzoia river. It is the best zone in the country for maize and sunflower production, with an altitude varying between 1800–1900 m 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 by the 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 is 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.

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 much like the diagnostic-to-prescription/treatment model applied in the 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 (doctors) 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 in the 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 for achieving continuous learning and exchange of ISFM knowledge. A similar approach to diagnosis has been demonstrated by Rapport et al (1985) and Rapport and Whitford (1999) in addressing problems of ecosystem degradation.

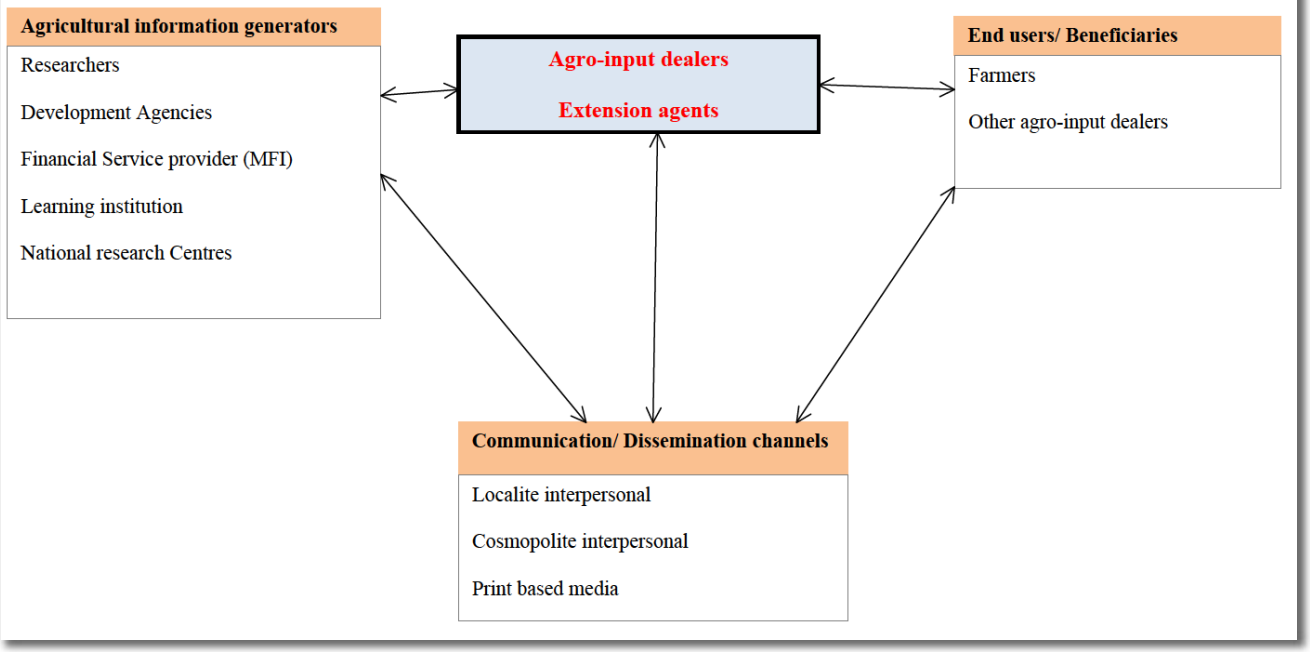
Agro-input dealers who are well equipped with agricultural production knowledge can be very resourceful in addressing the poverty issues in Sub Saharan Africa and can help in the achievement of the African green revolution. Researchers have developed tools and equipment that can be used in testing soil 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 the Bill and Melinda Gates Foundation (BMGF). Others include hand-held spectrometers that researchers at the World Agroforestry Centre are piloting, a "Crop Doctor" system being pioneered by IPNI, CIMMYT and other CGIAR centers, and Cornell University's soil testing kits. These tools can generate knowledge that agro-input dealers need to resolve the challenges that farmers are facing.

The agro-input dealer's 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 will be especially useful in helping set the priorities and improving the relevance of the program.

Figure 3 presents a schematic presentation of how key stakeholders in agricultural production and productivity can interact effectively. The agro-input dealer plays 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 the source of information hitherto obtained only through agricultural extension services.

Sampling and Data Collection – The study involved agro-input dealers as the main respondents. The agro-

FIGURE 3 – ISFM information and communication tools dissemination and communication path (Source: Author; 2012)



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 who had participated in the KASP project: 140 agro-input dealers in Trans Nzoia and 148 agro-input dealers in Siaya County.

The respondents of the study were drawn from the 288 agro-input dealers through simple random sampling. A total of 144 agro-input dealers were selected. The distribution of the respondents in the two counties is presented in Table 1.

Empirical Methods – This study used a detailed twelve page questionnaire to collect data from 144 agro-input dealers from the two counties covering 33 market centers. The questions covered in the questionnaire were organized into three sections. These included: 1. General characteristics of agro-input dealers (gender, age, years in school, main and secondary occupation, year started agro-input business, etc.); 2. Assessment of ISFM awareness; and 3. Assessment of the channels of communication used by agro-input dealers to receive agricultural information. Following training of enumerators, actual data collection was carried out between November and December 2011. Data entry was done in CSPro, while 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 categories of communication channels were adopted from Sanginga and Woomer (2009): (i) Mass media, including television, radio, newspapers and magazines; (ii) Local Interpersonal, including other agro-input dealers and songs/poems/skits; (iii) Cosmopolite Interpersonal, including workshops/ seminars, Farmer field days, *Barazas*/public gatherings, and on-farm demonstrations; (iv) Print-based, including books, billboards/ posters, brochures; and (v) ICT based media, including internet, mobile phones, and DVD/CD players.

Data Analysis – Data was analyzed using SPSS version 20. Frequencies, descriptives, correlations and cross-tabulations were generated to derive summary statistics. Regressions (Logistic regressions) and ANOVAs 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. These methods also allow for a 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:

TABLE 1 – Sampling scheme for agro-input dealers in Siaya and Trans Nzoia Counties

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

Source: Author; 2013

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

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

Xi 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 has 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, visits by extension agents and researchers, participation in famer field days and education days.

For objective 2 — investigating the communication channels that agro-input dealers use to receive agricultural information — regression analysis was used to help identify factors influencing the 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 there is no correlation between factors (Long, 1997).

Factor analysis was used to study the relationship among the communication channels, by statistical grouping of the fifteen communication channels into various factors (Bredja et al, 2000) through Varimax rotation. Varimax rotation with Kaiser Normalization was used because it results in a 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.

Results and Discussion

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 the agro business ranged from 1 to 16 years (with a mean of 5.5 years and a standard deviation of 3.14 years). 65% 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 farmer (13.2%), veterinarian (2.8%) and teacher (1.4%). About 122 of the 144, or 84.7%, of 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 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).

Over 92% of agro-input dealers admitted having been visited by an extension staff member. 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 twelve 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.

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 had ever heard of ISFM technologies such as the 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 that 57.6% were aware of various ISFM technologies.

Logit Regression of Factors Influencing Awareness of ISFM by Agro-Input Dealers in Siaya and Trans Nzoia Counties – A logistic regression was fitted to assess the effects of variables on ISFM awareness by 144 agro-input dealers; these variables included gender, age, county, level of education, number of years of engagement in agro-input dealer business, visits by extension and researchers, attendance at farmer field days, and primary and secondary occupation (Table 3). Five variables positively influenced agro-input dealer's awareness of ISFM

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
		Gender	
Agro-dealer experience		**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
		Year	
Agro-dealer-interaction		**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; 2013

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; 2013

technologies significantly: gender, age, educational level, experience in agro business and visits by extension staff.

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 finding 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.

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

Assessment of the Channels Used by Agro-Input Dealers to Receive ISFM Information / 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, ranking them 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 players and the internet were also considered inaccessible, with 91% and 63% respectively ranking them low.

Cosmopolite interpersonal channels-workshops/seminars, farmer field days, public gatherings/*baraza's* and on farm demonstrations — were considered by agro-input dealers to be more accessible compared to other channels of communication (Figure 4).

Communication Channels Factor Analysis and Agro-Input Dealer Perspectives of Accessibility of Communication Channels – The fifteen communication channels initially analyzed were reduced by factor analysis to seven main components when assessing the accessibility of the communication channels for the ISFM information; these seven 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 ($> \pm 0.5$) 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 correlations 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*

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

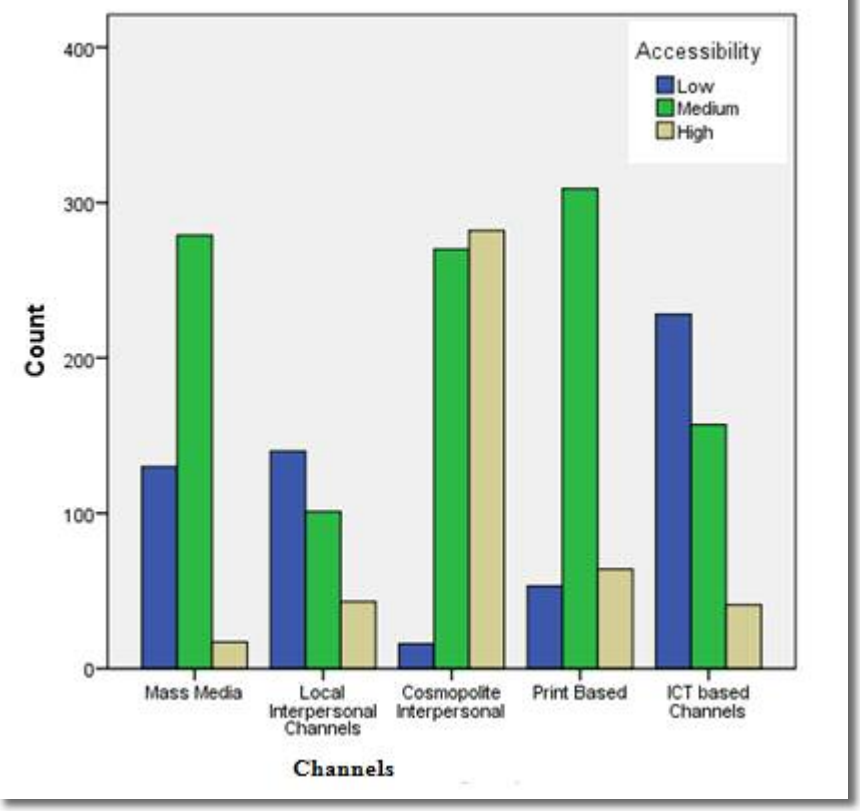
	Accessibility					
	Low		Medium		High	
Communication Channels	Count	%	Count	%	Count	%
Workshops/Seminars	5	4	125	88	12	8
Other agro-input dealers	1	1	98	69	43	30
Billboards/Posters	15	11	121	85	6	4
Internet	90	63	40	28	12	8
Brochures	8	6	111	78	23	16
Newspapers/Magazines	87	61	50	35	5	4
DVD/CD players	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; 2013

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 a negative correlation between billboards/posters and farmer field days of –0.123 and hence the elimination of the farmer field days from the group; the factor was thus identified as '*Print based communication channels factor'*.

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'*.

Figure 4 – Agro-input dealers' assessment of the accessibility of communication channel (Source: Author; 2013)



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

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

	Component							
Accessibility	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Communalities**
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

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 explains why the cosmopolite channels were considered more appropriate a 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 but 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, but may be limited by issues of timing, wrong language and its unsuitability for imparting technical skills to the target audience (Norris 2001). Television and newspapers/magazines are considered relatively expensive for an average agrodealer (Makinen, 2007). Makinen further noted that very few Kenyans are able to buy a newspaper and there is also an impediment of illiteracy and language barriers that deter communication through these channels.

Print based channels — especially the brochures, books and posters — were much better than the mass media, ICTs and local interpersonal channels of communication in terms of accessibility for 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. And print based channels are provided for free by the companies that supply the various agro-inputs, and due to competition these companies 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 levels 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 its fragile nature, and the fact that most 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 the internet) showed minimal advantage to agro-input dealers, which may be due to the complex nature of their use and the comparatively high cost of accessing them. The 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 commonly used by most agro-input dealers since almost every household in Kenya owns at least one 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 and 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 in Africa which is aimed at enhancing speeds and connectivity and thus improving the international communication service since the continent is being connected with other parts of the world (Echezona and Ugwuanyi, 2010).

Conclusions

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 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 also a need to address the existing

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 demonstration	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; 2013

knowledge gap among agro-input dealers to enable them to effectively communicate ISFM technologies to farmers. There is a 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. And finally there is a 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 very much.

The government agencies' engagement in training of agro-input dealers has been minimal, and there is a 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.

Community based channels of communication were found to be the most accessible by agro-input dealers, but 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 one mobile phone. This means that if exploited as mode of communication, these devices can effectively reach out to many people. Using such a platform for communication has been hindered by the costs of making phone calls or sending SMS (short message service) messages. 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 to develop a cost effective querying system where agro-input dealers' specific needs will be addressed and thus making the initiative worth investing in.

Notes

1. International Fund for Agricultural Development
2. International Fertilizer Development Centre

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