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# Agricultural Information Sources and their Effect on Farm Productivity in Kenya

**Rosina Wanyama, Mary W.K Mathenge, Zachary S. Mbaka**

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**by**

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Tegemeo Institute of Agricultural Policy and Development is a Policy Research Institute under Egerton University with a mandate to undertake empirical research and analysis on contemporary economic and agricultural policy issues in Kenya. The Institute is widely recognized as a centre of excellence in policy analysis on the topical agricultural issues of the day, and in its wide dissemination of findings to government and other key stakeholders with a view to influencing policy direction and the decision making process. Tegemeo's empirically based analytical work, and its objective stance in reporting and disseminating findings has over the past decade won the acceptance of government, the private sector, civil society, academia, and others interested in the performance of Kenya's agricultural sector.

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**Abstract**

Agriculture information within the reach of farmers plays a vital role towards improved productivity and enhanced economic development. Globally, agriculture extension has been used as a tool for disseminating agriculture information to farmers. Extension services are seen as key investments that if efficiently utilized can enhance sustainable agriculture. In Kenya, Agriculture extension has been highlighted as a critical agent for transforming subsistence farming to modern and commercial agriculture thereby improving household food security, incomes and reducing poverty. Traditionally, delivery of extension services to farmers was predominantly the government's role. However, recent transformation in extension has resulted to adoption of a pluralistic system which comprises multiple sources of information. Despite this, literature on the effect of these sources of information on farm productivity is limited. This study therefore sought to identify the various actors involved in provision of agriculture extension services in Kenya, and their effect on farm productivity. From our results, there are three major sources of agriculture information in Kenya. These are; public, private for-profit and private nonprofit extension service providers. However, farmers' preference for any of the sources is significantly influenced by a number of socio-economic characteristics like age, group membership, household size, land size and ownership of a mobile phone. In addition, despite the existence of many service providers, only 21% of the sampled farmers accessed extension services within the reference period, with public extension services being the most utilized. This is significantly low considering the large number of farmers in need of such information. Moreover, although the public extension system has overly been criticized for its inefficiency, this is largely dependent on the enterprise in question. Therefore, increased investment in extension and strengthening the modalities for coordination between public and private extension service providers will improve the efficiency and quality of extension services.

***Key words***: Agriculture information, Extension, Multinomial Logistic, Information sources

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**Acronyms**

| | |
|---|---|
| AEZs | Agro-ecological Zones |
| AKIS | Agriculture Knowledge & Information Systems |
| CAK | Communications Authority of Kenya |
| CBOs | Community-based Organization |
| ESPs | Extension Service Providers |
| FBOs | Faith-based Organizations |
| ICT | Information Communication Technology |
| IFPRI | International Food Policy Research Institute |
| KALRO | Kenya Agricultural and Livestock Research Organization |
| MoA | Ministry of Agriculture |
| MoALF | Ministry of Agriculture Livestock and Fisheries |
| NAEP | National Agriculture Extension Policy |
| NALEP | National Agriculture & Livestock Extension Programme |
| NASEP | National Agriculture Sector Extension Policy |
| NGOs | Non-governmental Organizations |
| RoK | Republic of Kenya |
| SAPs | Structural Adjustment Programs |
| SRDP | Special Rural Development Project |
| T&V | Training & Visit |
| TAPRA | Tegemeo Agricultural Policy Research and Analysis |

## 1 Introduction

Agricultural information covers all published and unpublished knowledge on general aspects of agriculture and consists of innovations, ideas and technologies of agricultural policies (Aina, 1990). If properly utilized, agriculture information can significantly contribute towards overall economic development. Nevertheless, achieving the desired objective for agricultural information can only be realized if farmers have access to this information. The current constant technological development requires that farmers are made aware of the existing technologies and know how to use these innovations for the exploitation of inherent yield potentials (Davidson *et al*, 2001). For decades, agriculture extension has been used as a tool for disseminating agricultural information in Kenya. The term "extension" is used interchangeably with "advisory services", or "agriculture education", and its purpose is to bridge the gap between farmers and sources of information/knowledge. The importance of agricultural extension has further been underscored in the Agriculture Sector Development Strategy (ASDS) as a critical agent needed to transform subsistence farming into a modern and commercial agriculture to promote household food security, improve income and reduce poverty (RoK, 2010).

Although researchers have developed many technologies, their adoption is low due to inadequate awareness of existing technologies, exacerbated by wide communication gap between researchers and farmers (Odendo, 2006). Moreover, the modalities for technology transfer both in research institutions and extension systems have remained weak and not adequately funded (RoK, 2010). Indeed, information alone cannot be sufficient to improve productivity unless the right type of information is provided at the right time, using the right channels. Research shows that development of agricultural technologies requires among other inputs a timely and systematic transmission of useful and relevant agricultural information (messages) through relatively well educated technology dissemination (extension) from formal technology generation system (research/source) via various communication media (channel) to the intended audience (Oladele, 1999). However, for this communication process to be complete, it is expected that the message from the client is passed back to the source/research (feedback). A strong extension system is therefore essential for moving research from the laboratory to the field to help farmers improve their productivity while ensuring that more research takes place with farmers in the field.

Similar to other developing countries, delivery of extension services in Kenya was predominantly the government's role through the relevant Ministries. However, evidence shows that public extension services have consistently failed to deal with the site-specific needs and problems of the farmers (Mengal *et al*, 2012).

After the implementation of the Structural Adjustment Programmes (SAPs) in 1980s, government scaled down its involvement in the national economies because of its inefficiencies. The staffing and facilitation of public sector extension declined mainly as a result of freeze on public employment. In Kenya for instance, the ratio of public frontline extension worker to farmers is about 1:1000 compared to the desired 1:400 (RoK, 2012). As a result, several other extension service providers (ESPs) have emerged to fill the gap created by the public sector. These include; Non-governmental Organizations (NGOs), Community-based Organizations (CBOs), faith-based organizations and community-based private companies among others. Agriculture extension has therefore developed into a complex system where services are offered by a range of public, private, non-governmental organizations, community based organizations and faith based organization sector entities.

Despite the emergence of different actors in provision of agricultural extension services beyond the traditional public extension agencies, access to extension services is still limited in most parts of the country. Yet, the changing climatic conditions coupled with technological advancement have led to an increased demand for agricultural information among farmers. In addition, there is little knowledge on the extent to which farmers are utilizing the different sources of information available and the factors that influence the use of these sources. According to Mittal and Mehar (2013), farmers prefer using sources of information which offer adequate (useful, when needed, unbiased and relevant to farmers situation) and complete information. This study therefore sought to establish;

- Existing sources of agricultural information available to farmers
- Factors influencing farmers' choice of agricultural information source
- Level of farm productivity under different information sources and
- Provide policy guidelines on delivery of agricultural information by different actors to help farmers make informed decisions.

## 2 Data and Methods

### 2.1 Data

The study majorly draws from the larger household survey data collected in 2014 by Tegemeo Institute in collaboration with Michigan State University (MSU) under the Tegemeo Agricultural Policy Research and Analysis (TAPRA II) project. A total of 6,512 households, drawn from 38 out of the 47 counties in Kenya across seven agro-ecological zones (Coastal Lowlands, Lower Highlands, Lower Midland 1-2 and 3-6, Upper Highland, Upper Midland 0-1 and 2-6) were interviewed using semi-structured questionnaires.

### 2.2 Theoretical Framework

This study is guided by the Random Utility Model (RUM) framework. This framework is based on the idea that while consumers may have perfect information in terms of utility functions, the analyst lacks precise knowledge about the consumers' decision processes and as such, uncertainty must be taken into account (McFadden, 1974). The framework assumes a decision maker *i*, which is the farming household, who must choose from a set of mutually exclusive alternatives, in $n = 1, 2, 3\ldots\ldots, n.$, obtains utility $U_{in}$ from each choice made. In general, within a set of alternatives, a rational individual will choose an alternative that provides the highest utility. However, this utility is not directly observed but indirectly through attributes of the alternatives and the attributes of decision maker. Therefore, the random utility function presumes that the perceived utility $U_{in,}$ obtained by individual *i* by product *n*, is composed of a deterministic component $\beta_i$, which is computed based on observable characteristics $X_{in}$, that influence the perceived desirability of the choice and an unobserved stochastic error component $\varepsilon_{in}$ assumed to be independently and identically distributed (iid) (Greene, 2000). The function is expressed as;

$$U_{in} = (\beta_i X_{in} + \varepsilon_{in}) \quad (1)$$

The probability of an individual *i* choosing alternative *k* (which represents the different information sources available) among alternatives is expressed as:

$$\begin{aligned} P_{ik} &= \Pr(U_{ik} > U_{in}) \forall n \neq k \\ &= \Pr(V_{ik} + \varepsilon_{ik} > V_{in} + \varepsilon_{in}) \forall n \neq k \end{aligned} \quad (2)$$

where $P_{ik}$ is the probability function which depends on the probability distribution function of the random term $\varepsilon$, $V$ and $U$ are defined as above.

### 2.3 Estimating factors influencing farmers' preference of information source

In order to establish factors influencing farmers' preference for information sources, a multinomial logit model was used. Multinomial logistic regression can be used to predict a dependent variable, where the unordered response has more than two outcomes (Woodridge, 2002). In this study, small scale farmers are faced with a wide variety of options in relation to sources of agricultural information. However, we group these sources based on the motivation of the service providers to offer their services. As a result we have three categories as are public, private nonprofit and private for-profit sources. Preference for any of these sources is based on the alternative that maximizes their utility, subject to their farm and farmer characteristics. The general form of a multinomial logit model can be expressed as:

$$\Pr(y_i = j) = \frac{exp\ (X_i\beta_j)}{1+\sum_{j=1}^{J} exp\ (X_i\beta_j)} \quad (3)$$

The estimated equation (3) leads to a set of probabilities for $J+1$ choices for a decision maker with the vector $x_i$ describing each observable characteristics and the vector of coefficients $ß_j$ associated with the $j^{th}$ source of information (Greene, 2002).

$$\Pr(y_i = 0) = \frac{1}{1+\Sigma_{j=1}^{J} exp\ (X_i\beta_j)} \quad (4)$$

Where for the $i^{th}$ individual, $y$ is the observed outcome, $X_i$ is the vector of explanatory variables and $\beta$ is a vector of source-specific parameters to be estimated.

The model can then be summarized as follows:

$$P_{ij} = \frac{exp\ (\gamma_j X_i)}{1+\sum_{j=1}^{3} exp\ (\gamma_j X_i)} \text{ for j=1, 2, 3} \quad (5)$$

Where $P_{ij}$ is the probability of being in category 1 or 2,

$$P_{i0} = \frac{1}{1+\sum_{j=1}^{3} exp\left(\gamma_j X_i\right)} \text{ for j=0} \quad (6)$$

$P_{i0}$ is the probability of being in reference group. When estimating the model, the coefficients of the reference group are normalized to zero (Madalla, 1990; Greene, 1993). This is because the probabilities of all the choices must sum up to unity. In this case, for the 3 sources of agricultural information, only 3-1 distinct sets of parameters can be identified and estimated.

The natural logarithms of the odd ratio of equations (3) and (4) give the estimating equation as

$$ln = \frac{(P_{ij})}{P_{i0}} \gamma_j X_i \quad (7)$$

Equation 7 denotes the relative probability of each of the group 1 or 2 to the probability of the reference group. The estimated coefficients for each choice therefore reflect the effects of $X_i$'s on the likelihood of farmers choosing an alternative source of information relative to the base or reference category. The model parameters are estimated by the maximum likelihood estimation. The dependent variable need not be normally distributed under the maximum likelihood estimation since the estimates remain consistent. The explicit functions can therefore be specified as

$$Logit(pi) = ln(Pi/1 - pi) = \beta_0 + \beta_1 Age + \beta_2 Gender + \beta_3 Educ + .. + \beta_n x_n + U_t \quad (9)$$

where: $ln(Pi/1 - pi)$ is the selected information source of the $i^{th}$ farmer, $U_t$ is the error term assumed to have a distribution with mean 0 and variance 1. $X$ is a vector of observable characteristics that influence a farmer's choice of a particular information source.

**2.4 Effects of information sources on productivity**

A comparison of maize and milk productivity under the three major sources of information was done to estimate the effect of information source on agricultural productivity. Analysis of variance (ANOVA) therefore provides a statistical test of whether or not the average productivity under the three sources of information is equal and therefore generalizes the t-test to more than two groups (Gelman, 2005). ANOVA test is used to compare means of three or more groups, in order to verify whether the means vary significantly. In the case where both samples are large, unequal variances is normally assumed.

The definitional equation for the sample variance is expressed as:

$$S^2 = \frac{1}{n-1}\sum(y_i - \bar{y})^2 \quad (10)$$

where $S^2$ represents the mean square (MS), $n-1$ is the degrees of freedom (df), $\sum(y_i - \bar{y})^2$ is the sum of squares (SS) and the squared terms are the deviations from the sample mean. ANOVA estimates 3 variances; the total variance based on the observation deviations from the grand mean, an error variance based on all the observation deviations from their appropriate treatment means and the treatment variance. The treatment variance is based on the deviations of the treatment means from the grand mean, the result being multiplied by the number of observations in each treatment to account for the difference between the variance of observations and the variance of means. Equation 13 can be simplified further as;

$$SS_{Total} = SS_{Error} + SS_{Treatments}$$

For a single factor ANOVA, statistical significance is tested for by comparing the F-test statistic as shown below:

$F = \frac{Variance\ between\ treatments}{Variance\ within\ treatments}$ Therefore;

$$F = \frac{MS_{Treatments}}{MS_{Error}} = \frac{SS_{Treatment/(I-1)}}{SS_{Error}/(n_T-1)} \quad (11)$$

where MS is the means square, *I* is the number of treatments and $n_T$ is the total number of cases to the F-distribution with *I* -1, $n_T - 1$ degrees of freedom. We also compare the results of ANOVA with Ordinary Least Squares (OLS) to control for biases.

## 3 Results and Discussion

### 3.1 Descriptive statistics

#### *3.1.1 Socio-economic characteristics of farmers*

The results in Table 1 show a comparison between households that received extension advice between July 2013 and June 2014 and those that did not receive advice in terms of the various socioeconomic characteristics. A total of 1,364 households had received extension advice within the reference period, representing only 21% of the sampled households. This is significantly low considering the important role of extension information in enhancing agricultural development, poverty reduction and food security.

**Table 1: Socio-economic characteristics of farmers**

| Variables | | Accessed extension advice | | Chi2 test | Total |
|---|---|---|---|---|---|
| | | *No (%) (n=5148)* | *Yes(%)(n=1364)* | | |
| Gender | Male | 75.4 | 80.9 | 18.32*** | 76.6 |
| | Female | 24.6 | 19.1 | | 23.4 |
| Group membership (*if yes*) | | 52.1 | 71.6 | 166.32*** | 56.2 |
| Credit Access (*if yes*) | | 24.6 | 18.9 | 19.14*** | 23.4 |
| Own mobile phone *(if yes*) | | 84.9 | 93.5 | 68.90*** | 86.7 |
| | | ***Mean*** | ***Mean*** | ***t-test*** | ***Total*** |
| Age (years) | | 50.5 | 50.6 | -0.34 | 50.6 |
| Years of schooling | | 6.5 | 8.0 | -10.6 | 6.8 |
| Land size owned (acres) | | 3.9 | 3.7 | 0.44 | 3.4 |
| Size of land under cropping (acres) | | 1.7 | 1.9 | -4.00*** | 1.7 |
| Household size | | 5.5 | 5.8 | -3.85*** | 5.4 |
| Dependency ratio | | 54.4 | 66.2 | -1.93* | 53.2 |
| Distance to the nearest motorable road (Km) | | 0.4 | 0.3 | 4.81*** | 0.4 |
| Distance to nearest extension service provider (Km) | | 8.3 | 6.5 | 7.35*** | 7.6 |
| Total value of assets(Kshs) | | 178280 | 280324 | -5.05*** | 199717 |
| Net annual household income (Kshs) | | 231570 | 405774 | -2.92** | 266797 |
| *Crop income(Kshs)* | | 51560 | 95488 | -4.34*** | 60443 |
| *Livestock income(Kshs)* | | 19997 | 79879 | -2.07** | 32106 |
| *Off-farm income(Kshs)* | | 146731 | 154380 | -0.68 | 148278 |
| Maize yield (Bags/acre) | | 7.1 | 7.9 | -3.53*** | 7.3 |
| Milk yield (Liters/cow/yr) | | 923.8 | 1174.2 | -6.33*** | 986.7 |

**Significance level:** ***significant at 1%, **significant at 5%, *significant at 10%

**Source:** 2014 TAPRA II household survey data

Disaggregated by gender, a large discrepancy is evident whereby only 19% of those who received extension advice were female headed households as opposed to 81% of male headed households. The results are consistent with other numerous studies (Swanson, *et al*., 1990; Puskur, 2013; Ragasa, 2013) which show that access to extension services is lower for women compared to men; a scenario that is likely to affect agricultural productivity given the vital role of women in the agricultural sector. In terms of schooling, majority (54%) of those who received extension advice had completed primary level of education, while 27% had completed secondary level. Approximately 7% of them had completed tertiary college while only 1% had completed university.

In relation to farmer groups more than half (56%) of the sampled households belonged to a group, while 72% of those who received extension information belonged to a particular group; which were varied based on group activities. This shows that most Extension Service Providers (ESPS) are using the group approach to reach a large number of farmers at once. Although the traditional T&V is viewed as an effective extension approach, the high number of small-holder farmers compared to the number of extension staff available makes it costly and unsustainable. Therefore, group approach has been widely acknowledged as a complimentary approach that is commonly being used to reach large number of dispersed farmers. The benefits of group approach outweigh the face-to-face contact approach for both the extension provider and the farmers. For instance, group approach helps extension services to be more client-driven since farmers can collectively demand for particular services based on their needs, hence reducing the cost of service provision. In marketing, bulking of commodities helps farmers receive fair prices as opposed to individual selling. Moreover, they are able to get better input prices because of joint procurement. These among other benefits have given rise to many farmer groups.

Overall, a small proportion (23%) of households was able to access credit, in cash or in kind. Among those who received extension advice, only (19%) had access to credit within the reference period. This could imply that credit access does not influence household's decisions in terms of extension access. It is also important to note that with the high rate of technological change, penetration of mobile phones in Africa has had a steady increase. For instance, 87% of all the sampled households owned at least one mobile phone, while 94% of all those who received

extension advice owned a mobile phone. This is promising especially with the integration of ICT in agricultural extension, where mobile phones are being used to deliver production and market related information to farmers in a timely manner.

The average age of the household heads was approximately 51 years for both households that received extension and those who did not receive extension advice (Table 1). This implies that majority of the sampled household heads were middle-aged people, with about equal household size of 6 members. In addition, there is a high mean dependency ratio of 66% in households that received extension compared to those that did not receive extension (98%). This is an indication of a slightly higher burden for the working age in maintaining the economically dependent group in households that accessed extension advice. In terms of land ownership, the two categories own approximately the same size of land (4 acres). However, there is a significant difference between the size of land under cropping, with households that accessed extension services having an average of 1.9 acres under cropping and 1.7 acres for households that did not access.

Distance from homestead to the nearest source of extension advice is a critical component that can influence the likelihood of households to access extension advice. From our results, households that received extension advice seem to be located closer to sources of extension advice compared to those who did not, which is evident in the difference in mean distance to the nearest source of extension information(8 km for those who did not receive and 7 km for those who received). Moreover, accessibility in terms of roads is a key factor in enhancing access to information. Most of the sampled households are located close to motorable roads. However, those who received extension advice were located closer to such roads compared to those that did not receive (0.3Km and 0.4Km respectively).

Household income and value of assets are essentially used as proxies to welfare. This implies that households with higher income and value of assets are considered better-off (well endowed) in terms of welfare. From our results, the overall net income is significantly higher (Kshs. 405,774) for households that received extension advice compared to those who did not (Kshs. 231,570). When disaggregated into different income components as crop, livestock and off-farm income, a significant difference is observed in crop and livestock income, whereas there is a minimal margin in off-farm income between the two groups of households. In addition, a significantly higher value of assets owned (Kshs. 280, 324) is evident for households that did receive extension advice

compared to those who did not (Kshs. 178,280). This could imply that extension is more available for farmers who are slightly well-off in terms of welfare compared to poor farmers.

Several studies (Cerdan-Infantes, 2008; Kumar and Quinsumbing, 2011; Hasan *et al*, 2013) have found that access to extension has a positive and significant effect on farm productivity. For instance, according to GFRAS (2012), an extension programme with Cacao farmers in Peru realized an increased productivity from 340 to 600 kg per ha in three years. In this study, we use maize and milk to estimate the mean farm productivity for households with and without access to extension. The results show that the average yield for those who received extension advice was significantly higher, at 7.9 bags per acre compared to those who did not receive advice at 7.1bags per acre. A similar scenario is observed in milk yield where households that received extension advice had a significantly higher yield at 1174.2 liters/cow/year compared to 923.8 liters/cow/year for household that did not receive advice. This could be attributed to the fact that farmers who access extension are more likely to adopt new technologies and effective farming practices to enhance their yield.

After controlling for regional differences, the above results are supported by the probit estimates shown in the Appendix Table 1. From the results, age, gender, education level, group membership, land under cropping, value of assets and household income positively and significantly influence access to agricultural information. On the other hand, distance to the nearest extension and motorable road have a negative and significant influence on access to agriculture information.

### *3.1.2 Access to extension service by AEZs*

The results in Table 2 show the relationship between access to extension information and the mean distance to the nearest source of Extension Service Provider (ESP) in different Agro-ecological Zones (AEZs). The overall mean distance to the nearest ESP is 8km, with Lower Midland 1-2 zone having the lowest mean distance of 5km and Coastal Lowlands and Lower Midland 3-6 zones recording the highest mean distance of approximately 12km in both zones. It is important to note that the Coastal Lowland zone had the lowest proportion (7%) of households that received extension advice, which could be attributed to the long distance to the nearest source of ESP. On the other hand, the Lower Highland zone had the highest number of households that accessed extension information (22%), with a mean distance of 7km to the nearest ESP, slightly lower than the overall mean distance.

**Table 2: Access to extension advice, mean distance to nearest ESP by AEZs**

| AEZs | % who accessed extension | Mean distance to nearest extension source (Km) |
|---|---|---|
| Coastal Lowland Zone CL | 7.2 | 12.0 |
| Lower Highland Zone LH | 22.4 | 6.9 |
| Lower Midland Zone LM 1-2 | 15.0 | 5.4 |
| Lower Midland Zone LM 3-6 | 13.2 | 11.6 |
| Upper Highland Zone UH | 11.0 | 7.4 |
| Upper Midland Zone UM 0-1 | 14.4 | 5.5 |
| Upper Midland Zone UM 2-6 | 16.9 | 7.4 |

**Source**: 2014 TAPRA II household survey data

Table 3 shows the relationship between access to extension services and different income groups (Quintiles). The mean income was divided in 5 quintiles, with quintile 1 representing the lowest income group and quintile 5 representing the highest income group. From the results, it is apparent that majority of those who received extension were relatively wealthier, with 27.6% being in the highest income quintile, while only 13% were in the lower quintile. Contrary to this, 22%of those who did not receive extension advice were concentrated in the lowest income quintiles, with about 18% in the highest income group.

**Table 3: Access to extension by income groups**

| Income Quintiles | Access to extension | | | | | |
|---|---|---|---|---|---|---|
| | No | | | Yes | | |
| | Percent households | Mean | Std. Deviation | Percent households | Mean | Std. Deviation |
| 1(Lowest) | 21.8 | 12445 | 69655.9 | 13.0 | 12077 | 79275.2 |
| 2 | 21.2 | 69704 | 13929.8 | 15.4 | 71412 | 14544.4 |
| 3 | 20.1 | 129361 | 21171.4 | 19.7 | 130980 | 21004.3 |
| 4 | 18.9 | 235468 | 44673.9 | 24.2 | 239512 | 45778.5 |
| 5 (Highest) | 18.1 | 795071 | 872249.2 | 27.6 | 1120113 | 4017356.3 |

**Source**: 2014 TAPRA II household survey data

### *3.1.3 Sources of Agricultural Information*

Agricultural information services can essentially be provided by public or private ESPs. The results from our study indicate that farmers have a wide variety of information sources from which they can obtain agricultural information. The public sources include government agents from the Ministry of Agriculture Livestock and Fisheries (MoALF), research organizations like the Kenya Agricultural and Livestock Research Organization (KALRO) and education institutions like

Universities. The private sources were further classified as private nonprofit and private for-profit. In this case private nonprofit sources included; local and international NGOs, CBOs, FBOs, local leaders and other farmers, while private for-profit include; input dealers, processing and marketing enterprises and private individuals/firms who are both users and providers of extension information. Figure 1 below shows the use of information from the three main sources of information by farmers.

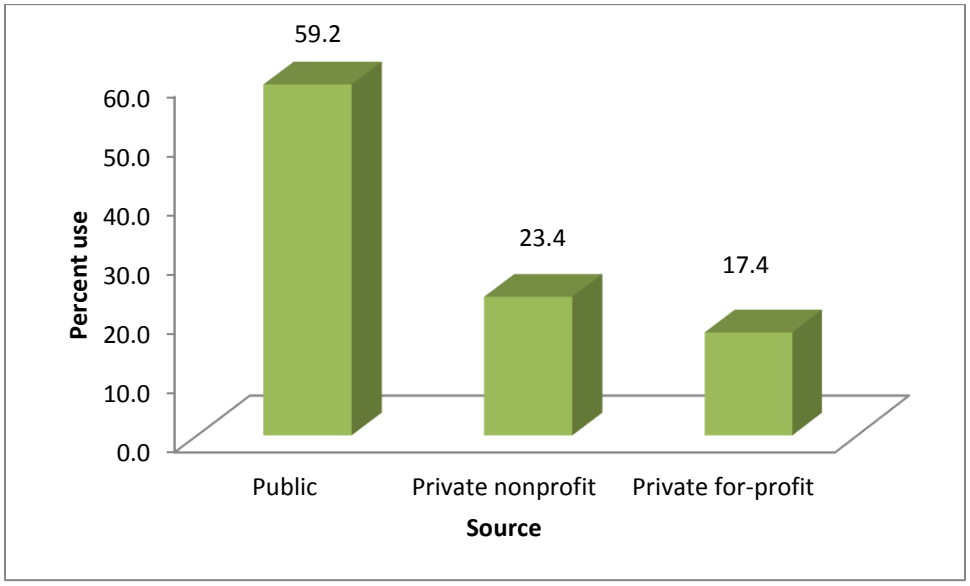


**Figure 1: Sources of Agricultural Information**

**Source**: 2014 TAPRA II household survey data

Despite the low number of government extension staff in the country the results indicate that public extension sector is the most utilized source of agricultural information by approximately 59% of those who received extension advice. On the other hand, private for-profit is the least utilized source by only 17% of households while 23% received information from private nonprofit sources. The cause of low utilization of private for-profit extension service providers could be two fold. First, these service providers' main objective is to maximize profits from their services, and as a result, many poor small-holder farmers may opt to use public extension which is offered at no cost. Second, the low utilization could be because of the perception of farmers towards privatized extension services. A study by Jiyawan *et al.* (2009) reveals that farmers perceive a lot of constraints in private extension services mainly because of fear of exploitation and a lack of regulatory mechanism from the government. However, it is important to note that farmers do not

exclusively use one source of information, with some of them combining information from different sources based on their information needs and availability.

### *3.1.4 Distribution of ESPs across income groups*

Figure 2 shows the distribution of the three ESPs across households with different income profiles. On average, all the service providers are concentrated in regions with households in the highest income group (Quintile 5). However, their spread varies across the income groups. For instance, the private for-profit curve is steeper compared to public and private nonprofit curves. This indicates that private for-profit service providers are generally concentrated in areas with households that are better off in terms of welfare. On the other hand the proportion of private nonprofit ESPs in the lowest quintile is higher compared to public and private for-profit ESPs. These results are similar to the findings by Muyanga and Jayne (2006) who found out that private extension is generally skewed towards well-endowed regions with high value crops while remote areas and poor producers growing low-value crops with limited marketable surplus are poorly served and targeted by nonprofit private providers.

Jiyawan *et al.* (2009) observed that despite the various benefits of private extension services, their concentration in big and progressive farmers may lead to promotion of own benefit with less attention to improve the farmer's condition. The results further indicate that private nonprofit service providers are slightly well distributed across all households which is evident by the lesser steep curve. It is important to note that while public extension service providers are the most utilized, they also tend to be skewed towards the better off households. This is worrying since majority of the country's farmers are small-holders within the lower income quintiles, and their inadequate access to extension exposes them to risks of poor agricultural productivity and as a result will affect the county's overall food security and agricultural development.

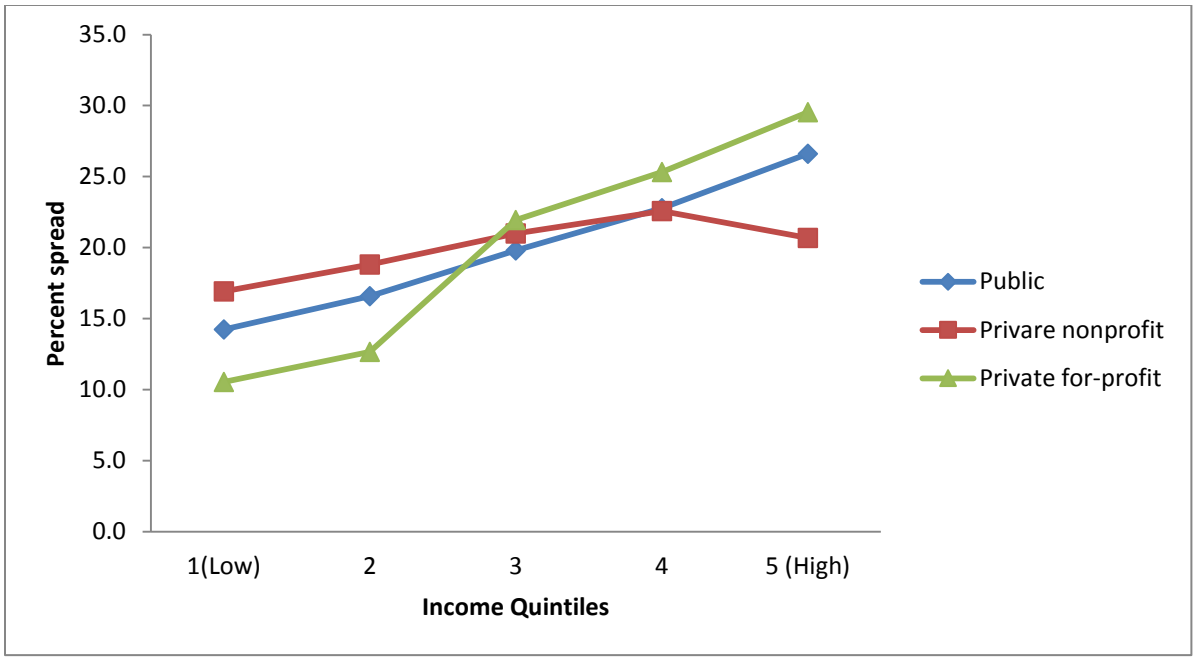


**Figure 2: Distribution of ESPs across income groups**

**Source:** 2014 TAPRA II household survey data

### *3.1.5 Demand Driven Extension*

Over time, agriculture extension system was purely supply-driven, where information from researchers was brought to farmers regardless of their needs. The T&V system is a perfect example of the supply driven extension which has also been termed as top-down model. A review of extension system models gave rise to the demand/farmer-driven extension, which focusses on addressing the goal of making services meet the demands and priorities of farmers. In this particular model, farmers seek for particular information from research based on their needs. In principle, the model captures the idea that the information, advice and other services offered by ESPs is tailored to the expressed demands of the clients or recipients and not just the needs as identified by different stakeholders. To identify the concept of demand driven extension in our data, all the 1,364 respondents who received extension advice were asked whether they actively sought for advice or not. Approximately 22% of those who received extension advice (Table 4), confirmed to have actively sought for extension advice. From the results, it is also evident that majority of those who actively sought for the advice were those who are relatively well endowed given 34% of them lie in the highest income quintile. The results further indicate that majority of

the households sought advice from private nonprofit ESPs while private for-profit were the least sought.

**Table 4: Active seeking of extension advice by income groups**

| Income quintiles | Actively sought advice | | Total |
|---|---|---|---|
| | No | Yes | |
| 1(Lowest) | 13.6 | 11.9 | 13.3 |
| 2 | 16.2 | 15.3 | 16.0 |
| 3 | 21.6 | 17.7 | 20.7 |
| 4 | 23.7 | 19.7 | 22.9 |
| 5(Highest) | 24.9 | 35.4 | 27.1 |
| **Total** | **78.4** | **21.6** | **100.0** |
| **Information Source** | | | |
| Public | 78.8 | 21.2 | 59.2 |
| Private nonprofit | 75.5 | 24.5 | 23.4 |
| Private for-profit | 81.0 | 19.0 | 17.4 |
| **Total** | **78.4** | **21.6** | **100.0** |

**Source:** 2014 TAPRA II household survey data

### *3.1.6 Extension Communication pathways*

Table 5 below shows the range of information communication pathways used by extension service providers. Depending on the source of information, the choice of the communication channel used by extension service providers varies greatly based on the type of information, target group, efficiency of the channel among others. Moreover, most extension service providers do not necessarily use one pathway but may choose a combination of two or more communication pathways. The results indicate that farm visits/face-to-face contact was the most utilized by 42% of those who sought extension advice. Farm visits are the most common form of personal contact between extension agents and farmers, used especially by public extension agents. However, it is the most time consuming pathway compared to group approach because it requires an extension staff to physically visit individual farmers and address their concerns on a one-to-one basis. Nevertheless, according to FAO, (1985) farm visits can be important in several ways; a) they familiarize the agents with individual farmers and offers them an opportunity to give farm specific advice, b) build up the agent's knowledge of the area and the nature of problems experienced in the locality, c) permit the agent to advice on recommended practices and make follow up, and d) they also arouse general interest among farmers and stimulates their involvement in extension activities.

**Table 5: Modes of extension delivery by income groups**

| Mode of delivery | Income Quintiles | | | | | |
|---|---|---|---|---|---|---|
| | 1(Highest) | 2 | 3 | 4 | 5(Lowest) | Total |
| Field days/Demonstrations | 27.8 | 16.7 | 27.8 | 17.5 | 18.2 | **20.7** |
| Group meetings/Discussions | 36.1 | 33.3 | 42.6 | 35.1 | 25.3 | **33.0** |
| Farm visits/ Face to face contacts | 33.3 | 47.9 | 27.8 | 43.9 | 48.5 | **41.8** |
| ASK shows | 0.0 | 0.0 | 1.9 | 0.0 | 5.1 | **2.0** |
| Mobile phones | 2.8 | 2.1 | 0.0 | 0.0 | 2.0 | **1.4** |
| Radio | 0.0 | 0.0 | 0.0 | 3.5 | 1.0 | **1.0** |
| Total | **12.2** | **16.3** | **18.4** | **19.4** | **33.7** | **100.0** |

**Source:** 2014 TAPRA II household survey data

The results further indicate that group meetings/discussions were the second most utilized pathway through which 33% of respondents received information. In Kenya, most public and private extension service providers are currently using farmer groups to advance their services to farmers. Such meetings are useful educational forums where the agent and a group of farmers come together and share ideas, and information is able to reach a larger population compared to other pathways. According to Muyanga and Jayne (2006), farmer groups make extension services more accessible to small-scale farmers by providing the economies of scale in service delivery and it is also a mechanism for producers to express their demands for services.

An additional 21% of farmers received extension advice through field days/demonstrations. Field days/demonstrations are day-long events where farmers are invited to a particular field or plot and specific information about a technology is demonstrated and discussed. Depending on the content of the technology, this may take 4 to 6 hours. In such events, farmers can walk through the fields/demonstration plots to view the demonstrations while asking questions, or it might involve hands-on training and physical participation. While this is seen as a good opportunity for farmers to learn by doing, the low number of farmers who used this pathway could be due to the fact such events are not organized frequently. In addition, a major limitation for field days is that there is limited time for farmers to effectively interact with their facilitators (Murage *et al*., 2011).

The use of ICT; which includes mobile phones, radio, television internet, video conferencing, information kiosks among others, has been underscored as one promising area in agricultural extension that is meant to facilitate extension information to reach many farmers (Asenso-Okyere and Mekonnen, 2012). This is feasible especially with the proliferation of mobile phones in many

developing countries. According to the Communications Authority of Kenya quarter four report for the 2013/2014 financial year, the total number of mobile subscriptions grew by 5.6% to 32.2 million as at the end of June (CAK, 2014). This translates to 79.2% penetration in the country. Moreover, the use of data/internet subscriptions reached 13.9 million from 13.3 million in March of the same year. Despite this progress, the results show that only a small proportion (1.4%) of those who sought extension advice received information through mobile phones, yet, approximately 94% (Table 1) of those who received extension advice owned at least one mobile phone. The low intensity in the use of mobile phones for receiving agricultural information could be due to the fact that farmers have not yet adopted the technology or that the extension service providers have not fully utilized mobile phone technology as a communication channel. Even though there are a number of ICT platforms in Kenya, the extent to which farmers are utilizing such platforms has not been established.

#### *3.1.7 Extension service by Enterprise*

Table 6 shows the results of two main enterprises; livestock and crop, upon which extension services were offered for both demand driven and supply driven services. For both categories, majority (60% and 44% respectively) of the households received crop related services. Overall, more than half (57%) of those who received extension services, received information on crop related issues, 19% received information on livestock while 25% received information on both crop and livestock. This implies that crops are being given more emphasis than livestock by both extension service providers and the recipients (farmers), which could be driven by the important role of crop income to the total household income.

**Table 6: Access to extension advice by enterprise**

| Enterprise | Accessed Extension Advice | | |
|---|---|---|---|
| | Supply driven | Demand driven | Total who received |
| Livestock | 16.2 | 28.2 | 18.8 |
| Both | 23.6 | 27.6 | 24.5 |
| Crop | 60.2 | 44.2 | 56.7 |

**Source:** 2014 TAPRA II household survey data

### 3.2 Econometric Results

#### *3.2.1 Preference of agricultural information sources*

The parameter estimates for the Multinomial Logit model are presented in Table 7. The results indicate factors influencing famers' preference for private ESPs (private nonprofit and private for-

profit) with reference to public service providers as the base / reference category. From our results, factors that influence farmers' preference to use a particular source of agriculture information include age, group membership, household size, land size owned, ownership of a mobile phone and asset value.

**Table 7: Factors influencing farmers' preference of agricultural information source**

| Characteristics | Private nonprofit | | | Private for-profit | | |
|---|---|---|---|---|---|---|
| | **Coefficient** | **Std. Err** | **P>\|z\|** | **Coefficient** | **Std. Err** | **P>\|z\|** |
| Age (Years) | -0.0205*** | 0.0057 | 0.000 | -0.0127** | 0.0062 | 0.041 |
| Gender of the household head | -0.2552 | 0.1781 | 0.152 | 0.0172 | 0.2049 | 0.933 |
| Education level | -0.0834 | 0.0786 | 0.289 | -0.1322 | 0.0887 | 0.136 |
| Group membership | -0.0248 | 0.1535 | 0.871 | -0.2950* | 0.1675 | 0.078 |
| Distance to the nearest extension service provider | -0.0010 | 0.0042 | 0.813 | -0.0060 | 0.0042 | 0.155 |
| Distance to the nearest motorable road | -0.1367 | 0.1016 | 0.178 | -0.1810 | 0.1359 | 0.183 |
| Household size | 0.0389 | 0.0275 | 0.158 | -0.1214*** | 0.0348 | 0.000 |
| Land size (acres) | -0.0124 | 0.0121 | 0.306 | -0.0551*** | 0.0211 | 0.009 |
| Ownership of a mobile phone | 0.7807** | 0.3389 | 0.021 | 0.2133 | 0.3398 | 0.530 |
| Dependency ratio | 0.0001 | 0.0005 | 0.763 | 0.0005 | 0.0004 | 0.298 |
| Log value of assets | -0.1695 | 0.1258 | 0.178 | 0.4764** | 0.1426 | 0.001 |
| _constant | 0.4536 | 0.6635 | 0.494 | -1.8098 | 0.7364 | 0.014 |
| Number of observations | 1359 | | | | | |
| LR chi2(22) | 85.57 | | | | | |
| Prob > chi2 | 0.0000 | | | | | |
| Pseudo R2 | 0.0330 | | | | | |
| Log likelihood | -1253.7994 | | | | | |

**Significance level:** ***significant at 1%, **significant at 5%, *significant at 10%

**Source:** 2014 TAPRA II household survey data

Age has a negative significant influence on preference for both private nonprofit and private for-profit service providers. This implies that older farmers are less likely to use private service providers compared to public service providers. In addition, group membership has a significant negative effect on preference for private for-profit service providers, an indication that members in a group prefer to use public service providers than private. This could be due to that fact that majority of members in a group are small-scale farmers who are mostly served by public service providers than private. In addition, since private for-profit service providers seek to maximize profit, they are likely to be skewed towards households that are well endowed. This is more evident from the results where the coefficient of assets is positive and significant, an indication that farmers

with higher asset value are more likely to use private for-profit service providers as opposed to public.

In terms of land size, the results show that size of land is negatively and significantly associated with private for-profit service providers. This implies that farmers with large land sizes are less likely to use private extension. These results are contrary to other studies which show that private for-profit extension service providers are mainly focused in regions with medium and large scale farmers (Sulaiman *et al.*, 2005). Moreover, according to Kahan (2007), private for-profit extension organizations appear to be well suited to serve the private interests of clients operating particularly in areas with good infrastructure and high potential in agricultural production. However, this results could be attributed to the fact that majority of the sampled population comprise of smallholder farmers with an average land size of 3.4 acres and a small proportion of 1.7 acres under cropping (Table 1). Despite the low use of mobile phones in receiving agricultural information, the use of mobile phones has as significant effect on the use of private nonprofit ESPs relative to public. This shows that households with mobile phones are more likely to contact nonprofit ESPs compared to pubic ESPs. Mobile phones are essential for co-ordination of group meetings which majority of ESPs use in reaching their target farmers.

### *3.2.2 Agriculture information sources and farm productivity*

In Figure 3, we use maize and milk productivity to compare the efficiency under the three extension service providers. A total of 1,280 farmers who cultivated maize received extension services. More than half (59.5 per cent) received their services from the public ESPs, 23 per cent received from private nonprofit ESPs while 16.7 per cent received from private for-profit ESPs. From the results, it is apparent that households that received extension services from private for-profit ESPs recorded higher yields at 8.5bags per acre, followed by public ESPs at 7.9bags per acre while private nonprofit recorded the lowest yields at 7.4bags per acre. In addition, households that did not receive extension services had the lowest yields at 7.1bags per acre compared to all households that received extension services from either of the three service providers.

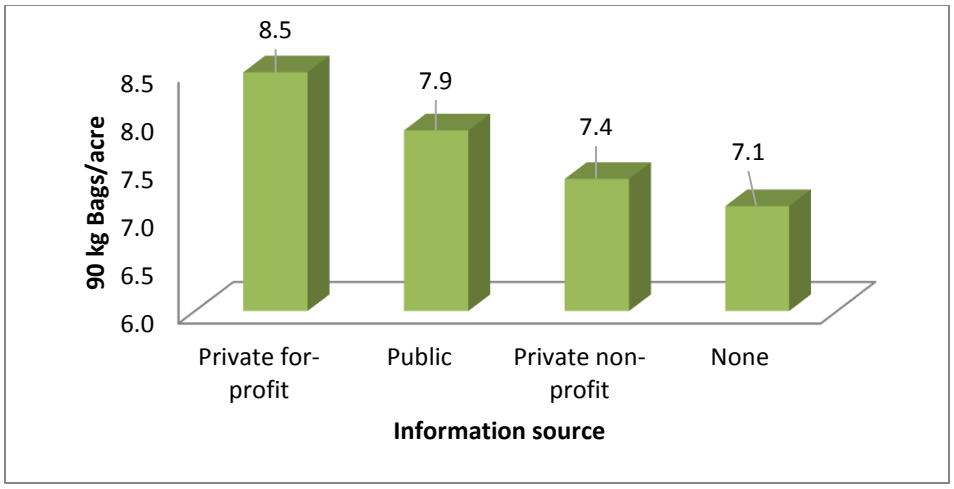


**Figure 3: Maize productivity and fertilizer use by extension service providers**

**Source:** 2014 TAPRA II household survey data

Figure 4 below shows milk productivity under the three service providers. Similar to maize productivity, households that used private for-profit service providers had the highest milk productivity per cow per year (1626 liters/cow/year) while private nonprofit had the lowest (940 liters/cow/year). Households that did not receive any form of extension services had the lowest milk productivity at 924 liters/cow/year compared to all households that received extension services from either of the three service providers.

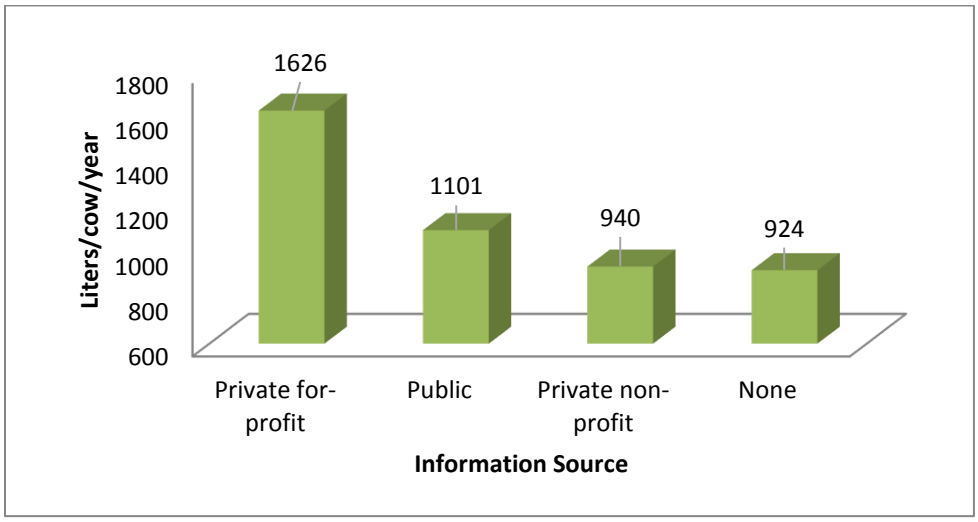


**Figure 4: Milk productivity by extension service providers**

**Source:** 2014 TAPRA II household survey data

### *3.2.3 Analysis of Variance (ANOVA)*

To further explain the results in Figure 3 and 4 above, a one-way ANOVA was conducted to determine if there was a significant difference in maize and milk productivity under the different sources of agricultural information. The results in Table 8 indicate that there is a significant difference between groups for both maize and milk productivity as determined by the one-way ANOVA (F=5.25, *p*=0.001 for maize and F=29.06, *p*=0.000 for milk. It is however important to note that the results in Table 8 do not indicate which of the three groups differ from one another. A Tukey's HSD (Honest Statistical Difference) post-hoc test was therefore further conducted to determine whether the productivity and input for the different pairs was significantly different.

The results in Table 9 show no significant difference in maize productivity between groups. However, there is a significant difference in yield between those who received advice from private for-profit service providers and those who did not receive extension services. In relation to milk, there is a significant difference in milk productivity between public and private for-profit (1100.51litres/cow/year and 1626.17litres/cow/year respectively), and also between private for-profit and private nonprofit (939.99litres/cow/year and 1626.17litres/cow/year respectively). This shows that households that received advice from private for-profit service providers had significantly higher milk productivity compared to those who received from public and private nonprofit sources and those who did not receive extension services at all.

**Table 8: One-way ANOVA**

| Outcome | Source | SS | df | MS | F | Prob > F |
|---|---|---|---|---|---|---|
| **Maize** | Between groups | 741.8214 | 3 | 247.2738 | 5.25 | 0.0013 |
| | Within groups | 275257.4 | 5845 | 47.09281 | | |
| | Total | 275999.3 | 5848 | 47.1955 | | |
| | *Bartlett's test for equal variances: chi2(3) = 18.1532 Prob>chi2 = 0.000* | | | | | |
| **Milk** | Between groups | 72754554 | 3 | 24251518 | 29.06 | 0.0000 |
| | Within groups | 2.41E+09 | 2883 | 834573.7 | | |
| | Total | 2.48E+09 | 2886 | 858915.7 | | |
| | *Bartlett's test for equal variances: chi2(3) = 46.1613 Prob>chi2 = 0.000* | | | | | |

**Source**: 2014 TAPRA II household survey data

**Table 9: Tukey HSD Pairwise comparison**

| Outcome | Group Vs Group | Group means | | Difference | HSD-test |
|---|---|---|---|---|---|
| **Maize** | None vs Public | 7.09 | 7.88 | 0.79 | 2.35 |
| | None vs Private nonprofit | 7.09 | 7.37 | 0.28 | 0.8455 |
| | None vs Private for-profit | 7.09 | 8.48 | 1.39 | 4.1496* |
| | Public vs Private nonprofit | 7.88 | 7.37 | 0.50 | 1.5046 |
| | Public vs Private for-profit | 7.88 | 8.48 | 0.60 | 1.7996 |
| | Private nonprofit vs Private for-profit | 7.37 | 8.48 | 1.10 | 3.3042 |
| | *Critical value(.05, 4, 5845) = 3.6343929* | | | | |
| **Milk** | None vs Public | 923.79 | 1100.51 | 176.72 | 2.9416 |
| | None vs Private nonprofit | 923.79 | 939.88 | 16.09 | 0.2678 |
| | None vs Private for-profit | 923.79 | 1626.17 | 702.38 | 11.6916* |
| | Public vs Private nonprofit | 1100.51 | 939.88 | 160.63 | 2.6738 |
| | Public vs Private for-profit | 1100.51 | 1626.17 | 525.66 | 8.7500* |
| | Private nonprofit vs Private for-profit | 939.88 | 1626.17 | 686.29 | 11.4238* |
| | *Critical value(.05, 4, 2883) = 3.6354679* | | | | |

**Source:** 2014 TAPRA II household survey data

Table 10 shows the OLS estimates of factors influencing maize and milk productivity. While controlling for other factors, it is evident that the source of extension information had an effect on productivity. There is a positive and significant effect in both milk and maize enterprise for households that received information from private for-profit ESPs. However, information from public ESP is only significant under milk productivity.

**Table 10: OLS Estimates of factors influencing Maize and milk productivity**

| Variables | Milk | | | Maize | | |
|---|---|---|---|---|---|---|
| | Coefficient. | Std. Err. | P>\|t\| | Coefficient | Std. Err. | P>\|t\| |
| Age (Years) | 2.780 | 2.964 | 0.349 | -0.023 | 0.015 | 0.127 |
| Gender of the household head | 209.956** | 99.298 | 0.035 | 0.366 | 0.519 | 0.481 |
| Education level | 37.113*** | 8.965 | 0.000 | 0.069 | 0.051 | 0.175 |
| Distance to the nearest motorable road | -134.341*** | 43.221 | 0.002 | -0.116 | 0.243 | 0.632 |
| Ownership of a mobile phone | 103.284 | 187.939 | 0.583 | 1.846** | 0.842 | 0.029 |
| Total value of assets | 0.000*** | 0.000 | 0.003 | 0.000** | 0.000 | 0.011 |
| Size of land under cropping | 8.588 | 8.790 | 0.329 | -0.147** | 0.061 | 0.015 |
| Private for-profit | 688.344*** | 116.722 | 0.000 | 1.183* | 0.630 | 0.061 |
| Public | 164.277* | 96.304 | 0.088 | 0.699 | 0.483 | 0.148 |
| Constant | 182.234 | 279.025 | 0.514 | 5.962 | 1.333 | 0.000 |
| Observations | 709 | | | 1264 | | |
| Prob > F | 0.0000 | | | 0.0002 | | |
| R-squared | 0.1364 | | | 0.0251 | | |
| Adj R-squared | 0.1253 | | | 0.0181 | | |
| Root MSE | 954.06 | | | 7.0005 | | |

**Source:** 2014 TAPRA II household survey data

## 4 Conclusions and Policy Recommendations

This paper presents findings of the available sources of agricultural information in Kenya and their effect on farm productivity. We compare maize and milk productivity under different extension service providers and also analyze the factors influencing farmers' preference for particular sources of agricultural information. We find that there are three major sources of agricultural information available for farmers in Kenya. These are public, private for-profit and private nonprofit. However, farmers' preference for any source is significantly influenced by a number of socio-economic characteristics like age, group membership, household size, land size and ownership of a mobile phone. Moreover, although the public extension system has overly been criticized for its inefficiency, our findings indicate that this is dependent on the enterprise in question. It is therefore necessary to strengthen the coordination between public and private ESPs to enhance efficiency in delivery of extension services.

Despite the existence of various sources of agricultural information, only a small proportion of smallholder farmers are accessing such information in Kenya. Inadequate access to extension is a key constraint to agricultural production, food security and improved livelihoods. A major limitation in accessing extension is inadequate qualified personnel in the sector. For instance, the national extension staff to farmer ration is 1:1000 compared to the recommended 1:400. This is quite low considering the large number of smallholder farmers that require extension services. Increased investment in extension is therefore necessary in order to achieve the desired impact of transforming subsistence farming into a modern commercial agriculture that will promote household food security, improve income and reduce poverty.

Moreover gender differential in access to agricultural extension is evident from our results, yet the role of women in agriculture cannot be undermined. In order to increase productivity, it is necessary to close the gender gap in accessing agricultural services. This could be achieved through implementation of extension programs that will reach both men and women with quality services. In addition, there is need to adopt appropriate dissemination channels suitable for all groups. Since no one channel is fit-for-all, a combination of different dissemination channels should be adopted.

Public extension is the most utilized source of information by majority of smallholder farmers. However, their increasing trend of operation in well-endowed households; a trend that is common

with private for-profit service providers, is a great risk to agricultural development since majority of smallholder farmers are poor. While private nonprofit extension is slightly well distributed across households in all income groups, their scope is limited and hence they are not able to reach all farmers. These calls for a proper coordination and regulation mechanism of ESPs to ensure all farmers are reached without bias**.**

While there exists a large pool of technologies developed by scientists, there is need to develop effective ways of disseminating such technologies to the target group. Integration of ICT, especially the use of mobile phones in extension is a potential disseminating channel which when effectively used, many farmers will be reached. Other ICT platforms like internet can also be used to improve delivery of agricultural information. However, to achieve the desired result, this will require adequate capacity building for both extension staff and the end users (majors).

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## Appendices

**Appendix Table 1: Probit estimates of factors influencing access to agricultural information**

| **Characteristics** | Coefficient. | Std. Err. | P>\|z\| |
|---|---|---|---|
| Age (Years) | 0.003** | 0.001 | 0.018 |
| Gender of the household head (Male=1) | 0.093* | 0.049 | 0.060 |
| Education level (Years of schooling) | 0.017*** | 0.005 | 0.001 |
| Group membership (Yes=1) | 0.387*** | 0.041 | 0.000 |
| Distance to the nearest extension service provider (Km) | -0.010*** | 0.003 | 0.000 |
| Distance to the nearest motorable road (Km) | -0.016 | 0.023 | 0.488 |
| Size of land under cropping (acres) | 0.033*** | 0.012 | 0.005 |
| Land size (acres) | 0.002 | 0.003 | 0.476 |
| Log value of assets | 0.100*** | 0.037 | 0.006 |
| Log of Income | 0.235 | 0.303 | 0.438 |
| Ownership of a mobile phone (Yes=1) | 0.230*** | 0.071 | 0.001 |
| ***Regional Dummies*** | | | |
| Lower Highlands | 0.268*** | 0.082 | 0.001 |
| Lower Midlands 1-2 | 0.179** | 0.086 | 0.038 |
| Lower Midlands 3-6 | -0.009 | 0.083 | 0.918 |
| Upper Highlands | 0.085 | 0.090 | 0.344 |
| Upper Midlands 0-1 | 0.183** | 0.089 | 0.039 |
| Upper Midlands 2-6 | -0.019* | 0.083 | 0.820 |
| _cons | -3.642 | 1.879 | 0.053 |
| Number of observation | 5785 | | |
| LR chi2(17) | 326 | | |
| Prob > chi2 | 0.000 | | |
| Pseudo R2 | 0.052 | | |
| Log likelihood | -2929.21 | | |

Source: 2014 TAPRA II household survey data