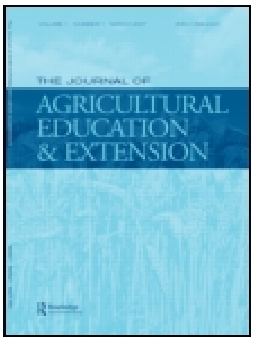
The Journal of Agricultural Education and Extension

ISSN: 1389-224X (Print) 1750-8622 (Online) Journal homepage: https://www.tandfonline.com/loi/raee20



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To cite this article: Eric O. Gido, Kenneth W. Sibiko, Oscar I. Ayuya & Joseph K. Mwangi (2015) Demand for Agricultural Extension Services Among Small-Scale Maize Farmers: Micro-Level Evidence from Kenya, The Journal of Agricultural Education and Extension, 21:2, 177-192, DOI: 10.1080/1389224X.2013.872045

To link to this article: https://doi.org/10.1080/1389224X.2013.872045

Published online: 10 Jan 2014.

Journal of Agricultural Education and Extension
Vol. 21, No. 2, 177–192, April 2015

Routledge
Taylor & Francis Group

Demand for Agricultural Extension Services Among Small-Scale Maize Farmers: Micro-Level Evidence from Kenya

ERIC O. GIDO, KENNETH W. SIBIKO, OSCAR I. AYUYA and JOSEPH K. MWANGI
Department of Agricultural Economics and Agribusiness Management, Egerton University, P.O. Box 536-20115, Egerton, Kenya

ABSTRACT Purpose: *The objective of the study was to determine the level and determinants of demand for extension services among small-scale maize farmers in Kenya.*
Design/methodology/approach: *Based on an exploratory research design, primary data were collected from a sample of 352 households through face-to-face interviews. Focus group discussions were used to collect contextual data. The sample comprised of organic and conventional small-scale maize farmers in Bungoma County, Kenya. In data analyses, descriptive statistics and a zero inflated negative binomial regression were employed.*
Findings: *Results indicate that organic farmers had a mean of three contacts with extension providers compared to conventional farmers who had a mean of one contact during the year. Further, age of the household head, education level, farming experience, amount of off-farm income and credit received, group membership, land tenure and distance to the nearest extension service provider significantly influence the demand for extension services.*
Practical implications: *The major policy implication from the findings is that; whether farmers are organic or conventional, extension agents should customize their services according to their clients' socio-economic characteristics in order to improve demand for agricultural extension services.*
Originality/value: *The study contributes to knowledge by applying the count data models in modeling the determinants of demand for extension services at a micro-level.*

KEY WORDS: Demand, Extension services, Small-scale farmers, Zero inflated negative binomial, Maize, Kenya

Correspondence address: Eric O. Gido, Department of Agricultural Economics and Agribusiness Management, Egerton University, P.O. Box 536-20115, Egerton, Kenya. Tel: +254 724 415 131. Email: gidoeric@gmail.com

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http://dx.doi.org/10.1080/1389224X.2013.872045

1. Introduction

In developing countries, Kenya included, agricultural extension services are among the critical change agents required in transforming small-scale subsistence farming to a modern and commercial agriculture to promote household food security, improve income and reduce poverty (Kibet 2011). This is by providing advisory services to farmers in order to help them make rational farming decisions for efficient utilization of available productive resources (Katz 2002). Moreover, the agricultural sector in Kenya accounts for about 26% of the gross domestic product (GDP) and supports the livelihoods of approximately 75% of the population (KNBS 2010).

Agricultural extension plays a key role in disseminating knowledge and technologies as well as linking farmers with other actors in the economy. In addition, it provides farmers with important agricultural information, intended to increase their ability to optimize returns. The information provided to farmers through agricultural extension services include new seed varieties, crop and animal husbandry, pest and disease management and innovative technology use as well as marketing information (Kibet 2011; Muyanga and Jayne 2006).

During extension visits, extension providers deliver information based on the farming calendar, such that preliminary messages create a foundation for messages to be delivered during subsequent visits. Initially, the extension providers aim at improving basic production techniques, emphasizing land preparation, the timeliness of farm operations, crop spacing, plant population size, the use of improved seed varieties and the importance of weeding. Ensuing visits focus on more complex messages relating to fertilizer use, pest and disease control measures. Execution of the latter set of messages involves more expenditure in purchasing farm inputs and this requires higher investment by farmers (Robert, Evenson, and Mwabu 1998). To meet this expenditure, farmers are linked to financial service providers such as commercial banks, microfinance and agricultural finance institutions where they secure credit. During the visits, farmers are linked to possible market outlets and trained on post-harvest handling for their farm produce.

A well designed and implemented agricultural extension strategy can tremendously improve agricultural productivity (Romani 2003). In Kenya, extension services were initially supply driven and provided by the government through the Ministry of Agriculture where farmers' participation in the choice of services was limited thus rendering the service delivery ineffective. It is against this backdrop that the Kenyan government has been developing various programs and policies geared toward an effective service delivery system to farmers. Among them is the Strategy for Revitalization of Agriculture, which emphasizes the importance of agricultural extension in poverty reduction (G.o.K 2004a).

The government of Kenya has also been implementing the National Agricultural Extension Policy (NAEP) which advocates for demand driven extension services (G.o.K 2004a). NAEP was prepared to integrate both public and private service providers in resolving the complex and systematic issues faced by the rural farming communities. Furthermore, it was aimed at stimulating sustainable agricultural development through a more integrated and holistic approach based on the Agriculture Sector Investment Programme (ASIP) concept. According to G.o.K (2004b), NAEP has been used by the Ministries of Agriculture, Livestock and Fisheries as an instrument for facilitating extension under the National Agriculture and Livestock Extension Programme (NALEP). The NALEP was built on a partnership concept that entails deliberate investments and participation of various stakeholders in the agricultural sector. It also endeavored to make extension demand driven, increase efficiency in extension service provision and to put in place alternative funding.

Despite the above efforts, there has been declining effectiveness in agricultural extension service provision thus hindering agricultural growth in Kenya (Kibet 2011). This is because the shift from supply to demand driven extension service provision has been hindered by the complex and diverse nature of the socio-economic characteristics and agro-ecological conditions of small-scale farmers (Farrington 1998). A case in point is Bungoma County, in Kenya, where there is public provision of extension services to small-scale farmers by government agents. In addition, there are a number of non-governmental organizations (NGOs), such as SACRED Africa and One Acre Fund, which have extensively provided extension services to farmers engaged in organic farming. However, there is little empirical evidence on the level of demand for extension services among conventional and organic farmers as well as the farm and farmer's socio-economic characteristics that determine the demand for extension services. The main objective of the study was to determine the level and determinants of demand for extension services among small-scale maize farmers in Kenya. This study was aimed at filling this knowledge gap based on an exploratory study. From the results, various policy recommendations are drawn to enhance the efficiency and effectiveness of agricultural extension service provision with the aim of improving agricultural performance in Kenya. The study is built on primary data collected from conventional and organic small-scale maize farmers in Bungoma County, Kenya.

The rest of the research article proceeds as follows; section two presents the material and methods for the study and section three presents the results and discussion of descriptive and econometric estimation. Finally, the conclusion and policy recommendations derived from the findings are presented in section four.

2. Material and Methods

2.1. Study Area, Sampling and Data

The study was carried out in Bungoma County which covers approximately 2,068.5 square kilometers with a population of 1,630,934 people and a population density of 482 persons per square kilometer (KNBS 2009). The county is located between longitude 34° 21.4′ and 35° 04′ East and latitude 0° 25.3′ and 0° 53.2′ North with an altitude of between 1,200 and 2,000 meters above sea level. Bungoma County boasts a bimodal rainfall pattern; the long rains occur between March and July and short rains occur between August and October. The average annual rainfall ranges between 1,250 and 1,800mm while the mean annual temperatures range between 21 and 25°C (G.o.K 2005). The county is endowed with well-drained, rich and fertile arable land which supports small-scale agricultural production of the residents. Small-scale maize production is the major crop production activity in the area. However, poor agricultural practices and an ever-growing human population have resulted in declining agricultural productivity and soil degradation.

Based on an exploratory research design, a sample of 352 respondents was randomly selected from a population of small-scale maize farmers in Bungoma County using a multi-stage sampling technique. For comparison purposes, the sample was proportionately stratified into 195 organic and 157 conventional farmers. Primary data were collected through observations and interviews, using a semi-structured questionnaire administered during the months of April and May 2012. Two focus group discussions were also carried out to obtain contextual data.

2.2. Analytical Framework

The study is anchored onto the expected utility theory since farmers in developing countries face uncertainty during production and multifaceted market imperfection. The framework postulates that decision-makers make choices in uncertain and risky environments by weighing the expected values of their utility. This means that the weighted sums are obtained by adding the utility values of outcomes multiplied by their respective probabilities (Davis, Hands, and Maki 1997). The assumption is that farmers maximize expected utility according to a Von Neuman Morgenstern utility function defined over the outcome wealth *(W)*. When faced with a choice between two options, the i^{th} farmer compares the expected utility of demanding (denoted by d) extension services EU_d *(W)* to the expected utility of not demanding (denoted by nd) extension services EU_{nd} *(W)*. While the direct measurement of farmers' perceptions and risk attitudes of extension services are unobservable, inferences for variables that control distribution and expected utility evaluation of demand for extension services are made (Davis, Hands, and Maki 1997). These variables are used as a vector '*X*' of attributes of the choices made by farmer *i and* ε_i is a random disturbance that arises from the unobserved variation in preferences, attributes of the alternatives and errors in optimization. Given the usual discrete choice analysis and limiting the amount of non-linearity in the likelihood function, EU_d *(W)*and EU_{nd} *(W)*may be written as:

$$EU_d(W) = \alpha_d X_d + \varepsilon_{di} \tag{1}$$

$$EU_{nd}(W) = \alpha_{nd} X_i + \varepsilon_{ndi} \tag{2}$$

The expression of the difference in expected utility is:

$$\begin{aligned} EU_{di}(W) - EU_{ndi}(W) &= (\propto_d X_i + \varepsilon_{di}) - (\alpha_{nd} X_i + \varepsilon_{ndi}) \\ &= (\alpha_d - \alpha_{nd}) X_i + (\varepsilon_{di} - \varepsilon_{ndi}) \\ &= \alpha X_i + \varepsilon_i \end{aligned} \tag{3}$$

Where $\alpha = (\alpha_d - \alpha_{nd})$ and $\varepsilon_i = \varepsilon_{di} = \varepsilon_{ndi}$.

Therefore, if the expected utility from extension is higher, farmers would tend to demand more extension services. A preference for the demanding of extension services reveals if:

$$EU_{di}(W) - EU_{ndi}(W) > 0 \tag{4}$$

Whereas, a preference for not demanding extension services reveals if:

$$EU_{di}(W) - EU_{ndi}(W) < 0 \tag{5}$$

In this study, the demand for extension services is measured as the number of contacts the household had with extension service providers annually. The number of contacts with agricultural extension service providers (d_i) represents count data and thus count models would be appropriate in this study. Count models allow one to combine categorical (access to extension services or not) and count data (d_i) as opposed to Probit and Logit models where the dependent variable is a binary choice of access to extension services or not and the Tobit regression model which captures the demand for extension services (Akankwasa et al. 2012). In addition, Ganguly, Koebel, and Cantrell (2010) argue that the use of Tobit or Ordinary Least Square regression models in demand analysis when the dependent variable is a non-negative integer results in biased results which culminate in inaccurate policy recommendation.

The d_i is drawn from a Poisson distribution with parameter λ_I which is related to the regressor χ_i (Green 2002) and hence a Poisson regression model is primarily defined as:

$$prob\left(D_i = d_i \middle| x_i\right) = \frac{e^{-\lambda_i \lambda^{yi}}}{d_i^!}, \; d_i = 0, 1, 2, 3 \ldots \tag{6}$$

The most common formulation for $y_i$in equation 1 is the log-linear model defined as:

$$In \; \lambda_i = x_i^{'}\beta \tag{7}$$

The expected number of contacts with extension service providers by a household is given by:

$$E(d_i|x_i) = Var(d_i|x_i) = \lambda_i = e^{x_i'\beta^!}$$

or (8)

$$\frac{\delta E(d_i|x_i)}{\delta x_i} = \lambda_i \beta$$

The Poisson regression model is a non-linear regression but the parameters can be estimated using maximum likelihood techniques (Green 2002). However, due to extension services in Kenya being demand driven, a number of households may not demand any extension service and thus the data set may exhibit an ‘excess zeros’ problem which limits the use of the standard Poisson regression (Gurmu and Trivedi 1996). Lambert (1992) proposed a solution of excess zeros problem by presenting the zero-inflated Poisson (ZIP) regression. Further, the ZIP becomes unsuitable in cases where the dataset exhibits an over-dispersion problem meaning the conditional variance exceeds the conditional mean. Therefore, to overcome over-dispersion and excess zeros problems, the zero inflated negative binomial (ZINB) regression was employed. The ZINB has been used in previous studies on count data analysis (Minami et al. 2007; Sheu et al. 2004; Williams 2012; Yau, Wang, and Lee 2003). According to Minami et al. (2007), the probability function of the ZINB regression model is specified as:

$$f\left(y_i \middle| B_i, G_i, \beta_i, \gamma_i, \theta\right) = \begin{bmatrix} p_i + (1 - p_i)q(0|\mu_i, \theta) \\ (1 - p_i)q(y_i|\mu_i, \theta) \end{bmatrix} \quad \begin{matrix} for \; y_i = 0 \\ for \; y_i = 1, 2, \ldots \end{matrix} \tag{9}$$

where B_i is a row vector of covariates in imperfect state for the i^{th} observation while $G_i$is a row vector of covariates in perfect state for the i^{th} observation. The γ and β are parameter estimates for the imperfect (the distribution takes only the value of zero) and perfect (the distribution on the non-negative integers including the value zero) state covariates respectively, whereas θ represents the mean. Estimation of the ZINB regression is obtained by maximizing the log likelihood function (equation 9) with respect to λ,β and θ.

$$L(\beta, \gamma, \theta | \gamma, B, G) = \sum_{i=1}^{n} \log f(y_i | B_i, G_i, \beta, \gamma, \theta) \tag{10}$$

Table 1 indicates the variables that were included in the ZINB model together with their hypothesized influence on demand for agricultural extension services chosen from an extensive literature review related to extension (Ayuya, Waluse, and Gido 2012; Chikwama 2010; Gido, Lagat, and Ithinji 2012; Neupane, Sharma, and Thapa 2002; Ofuoku and Agbamu 2012; Nambiro, Omiti, and Mugunieri 2006).

3. Results and Discussion

3.1. Descriptive Statistics

The socio-economic characteristics of farmers in Bungoma County are presented in Table 2 in terms of access to extension services (measured as the household's annual contacts with extension agents). The average household size for farmers who accessed extension and those who did not was eight and seven members respectively. Household size was significant at 1% level indicating that farmers with larger households tend to seek extension services to enhance knowledge and adoption of production enhancing technologies in order to cater for the household food requirement. There was a significant difference in the level of education of farmers, with those who accessed extension having

Table 1. Variables used in the ZINB model and their expected signs

Variables	Definition and measurement	Hypothesized sign
AccExtn	Number of contacts with extension agents	
EducLevel	Number of years of formal education of the household head	±
Age	Age in years of the key decision-maker (continuous)	±
Gender	Gender of the key decision maker (dummy 1=male, 0=female)	±
H/hSize	Number of household members (continuous)	±
FarmSize	Size of the farm in hectares (continuous)	±
FmgExp	Farming experience of the household head in years (continuous)	+
Off-famInc	Annual off-farm income received in thousand KES (continuous)	–
LdTenure	Land ownership (dummy 1=owned by title deed, 0=otherwise)	+
GrpMship	If the household head is a member of a famer-related group or association (dummy 1=member, 0=otherwise)	
Credit	Amount of credit received in thousand KES (continuous)	+
Training	Number of training sessions attended (continuous)	+
SlopErosn	If the slope of the land leads to soil erosion (1=yes, 0=otherwise)	+
FmDista	Distance from farm to the nearest extension service provide in km (continuous)	–
Perception	Farmer perception toward agricultural extension services (1=positive 0=otherwise)	+

Table 2. Farmers' socio-economic characteristics

	Mean			
Continuous variables	No access	Access	Overall sample	t/chi-square value
Age (years)	47.49	46.27	46.98	0.537
Household size (number)	6.60	8.06	7.21	–4.612***
Education level (years)	12.86	14.86	13.7	–4.612***
Farm size (ha)	2.00	1.80	1.92	0.977
Experience (years)	13.90	11.31	18.45	2.480**
Training (number)	1.71	3.54	2.48	–3.225***
Farm distance (km)	1.43	0.75	0.93	1.731*
Off-farm income (KES)	37,775.86	44,420.63	40,566.67	–0.390
Credit amount (KES)	8,850.57	11,809.52	10,093.33	–0.494
% of male headed households	73.60	77.80	75.30	0.349
% of households belonging to group	60.90	69.80	64.70	1.273
% of households owning land by title deed	56.30	88.90	70.00	18.455***
% of households with positive perception on agricultural extension	50.60	73.00	60.00	7.667***
% of households who perceive that the slope of their land leads to soil erosion	46.00	58.70	55.30	0.507

Notes: ***, **, * significant at 1%, 5% and 10% levels respectively.

a mean of 15 years as compared to 13 years for those who did not. Farmers with a higher level of education are more likely to have a high affinity for farming knowledge compared to their counterparts. The mean years of farming experience for farmers who accessed extension and those who did not was 11 and 14 years respectively. This implies that farmers with few years of experience in farming are more likely to demand extension services to compensate for their shortfalls in farming knowledge.

The number of off-farm trainings was four for those who accessed and two for those who did not access extension. This is because farmers who accessed extension services obtained information about future training sessions from extension providers and were able to plan to attend, even when cost was involved. Farmers who accessed extension services were located about 0.75km from the nearest extension service provider while those who did not access were located 1.4km away. This could be attributed to the higher cost involved in reaching the extension service provider when needed. Security of tenure in land ownership guarantees farmers secure credit and also motivates them to make long-term investment decisions. There was a significant relationship between demand for extension services and land tenure. Farmers' positive perception of the importance of extension services was significantly related to extension service.

3.2. Farmers' Demand for Extension Services

In general, organic farmers had a mean of three contacts with extension service providers during the year compared to conventional farmers who had a mean of one contact. Further assessment of the farmers' level of access to extension services between organic and conventional farmers is presented in Figure 1. On average, all conventional farmers

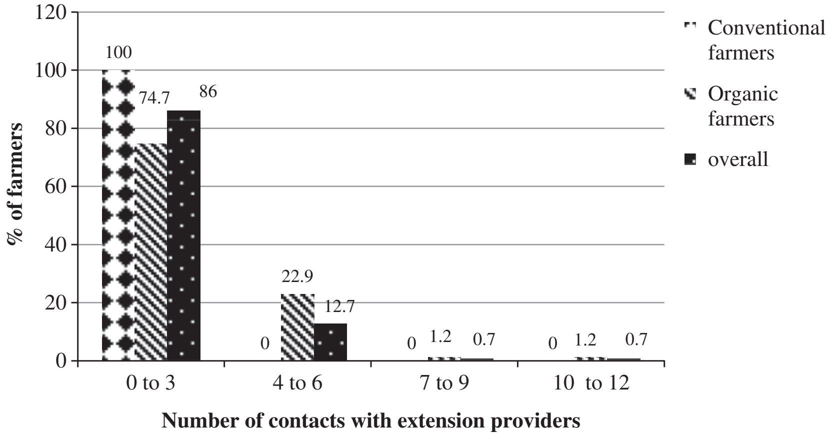

Figure 1. Farmers' level of access to extension

met extension agents at most three times, compared to organic farmers, of whom 74.7% accessed at most three contacts, 22.9% accessed between four and six contacts, 1.2% accessed seven to nine contacts and 1.2% of them accessed nine to 12 contacts.

3.3. Factors Influencing Demand for Extension Services

The standard Poisson model was first estimated (Appendix 1) and the results of the goodness of fit were significant in both categories, implying that the data did not fit the models well. This could be an indication of a potential over-dispersion problem. The ZIP model was then estimated (Appendix 2) and the Vuong test was statistically significant in all three categories indicating that the ZIP models were better than the standard Poisson models. The next step was comparison between the ZIP and the ZINB models and thus the ZINB models for all three categories were estimated. The ZINB model was estimated and the results are presented in Table 3 and were tested for statistical suitability in two ways. First, the likelihood ratio tests for the alpha had significant chi-square values in all three categories implying that the ZINB model was preferred to the ZIP model. Second, the Vuong test was significant across the three categories of farmers, indicating the appropriateness of the ZINB model relative to the negative binomial model. Hence, the ZINB model was found to be a suitable model to estimate the determinants of demand for extension services. The results in Table 3 indicate that eight variables (age of the household head, education level, farming experience, perception towards agricultural extension services off-farm income amount of credit received, group membership, land tenure and distance to the nearest extension service provider) influenced the demand for extension services.

Higher *education level* of the household head was positive and significantly associated with higher demand for extension services in all three categories. This is plausible, because higher levels of education tend to build the innovativeness of the farmer as well as improve on their information processing which is important in the adoption of improved agricultural production. Further, higher education gives farmers the ability to understand when they need new information and where to obtain this information from. These results are consistent with those by Nambiro, Omiti, and Mugunieri (2006) who

Table 3. Zero Inflated Negative Binomial (ZINB) model results on factors influencing farmers' demand for extension services

	Overall			Conventional farmers			Organic farmers		
Variable	Coef.	Std. Err.	P>|z|	Coef.	Std. Err.	P>|z|	Coef.	Std. Err.	P>|z|
Gender	0.292	0.258	0.259	0.189	0.180	0.296	0.900	0.161	0.993
Age	0.012	0.015	0.451	0.028	0.011	0.008***	–0.033	0.041	0.415
EducLevel	0.262	0.057	0.000***	0.128	0.055	0.0210**	0.230	0.162	0.0540*
H/hSize	0.093	0.063	0.137	–0.059	0.042	0.160	–0.394	0.389	0.311
FmgExp	–0.013	0.012	0.302	–0.010	0.008	0.251	0.094	0.060	0.007***
Perception	0.001	0.208	0.996	0.390	0.156	0.012**	0.229	0.914	0.802
FarmSize	–0.039	0.111	0.722	–0.040	0.080	0.614	0.230	0.408	0.573
LnOff-famInc	–0.228	0.273	0.403	–0.435	0.180	0.016**	0.443	0.873	0.612
Training	0.010	0.035	0.777	–0.001	0.022	0.981	0.023	0.189	0.902
LnCredit	0.050	0.025	0.049**	0.015	0.018	0.397	0.266	0.124	0.032**
GrpMShip	0.508	0.254	0.045**	0.344	0.199	0.085*	0.487	0.827	0.056*
LdTenure	0.680	0.361	0.060*	0.535	0.271	0.049**	0.158	0.852	0.853
FamDista	–0.159	0.093	0.085*	–0.291	0.173	0.092*	–0.016	0.107	0.882
SlopErosn	0.124	0.248	0.617	0.113	0.169	0.503	0.672	1.081	0.534
Constant	–5.200	1.263	0.000	0.426	1.121	0.704	–4.717	0.165	0.992
Inalpha	–1.295	0.667	0.052	–16.143	1118.528	0.988	–26.436	7.246	0.983
Alpha	0.274	0.183		0.000	0.000		0.000	0.000	
Likelihood-ratio test	Chibar2(01) = 7.53,			Chibar2(01) = 0.001,			Chibar2(01) = 0.006		
	Pr>=chibar2 = 0.0030***			Pr > = chibar2 = 0.0242**			Pr>=chibar2 = 0.0501*		
Vuong test	z = 0.80, Pr>z = 0.0117***			z = 0.99, Pr > = 0.0160**			z = 0.289, Pr>z = 0.0060***		

Notes: ***, **,* indicates significant at 1%, 5% and 10% levels respectively. The significant likelihood ratio test for alpha = 0 indicates that the ZINB model is preferred to the ZIP model. The statistical significance of the Vuong test indicates that the zero-inflated model is preferred to the ordinary negative binomial regression model.

found that illiteracy of the household head was associated with a diminished likelihood of seeking advice from extension agents. According to Berger, Delancey, and Mellencamp (1984) ‘educated farmers may also pressure the agricultural extension system and policy makers to deliver the services they need and ensure the services are useful to their unique situations’.

Farmers who received larger amounts of *credit* showed a significant likelihood of higher demand for extension services in the overall sample and among organic farmers. This implies that the amount of credit received increases the farmer’s ability to pay for the transaction costs associated in accessing the agricultural extension services. Credit could also be used to purchase farm inputs and to undertake investments that could be used to implement projects proposed by the extension service providers. On organic farms, credit is important since the system is more labor intensive in the implementation of organic techniques and thus credit is essential in catering for such labor costs. Further, the debt servicing requirement of the loan motivates the farmer to seek productivity enhancing knowledge and technologies through extension providers.

The expected number of agricultural extension contacts was further influenced by the predictor *group membership* in all three categories. This indicates that being in a farmer group is associated with increased demand for extension services. Membership in farmer related groups and organizations increases the ease with which extension agents reach members, reduces the cost of service delivery through economies of scale and guarantees a higher number of contacts between members and service providers. Groups could also provide security in microfinance institution to the members hence enabling them to implement the ideas they get from extension service providers. According to Ofuoku and Agbamu (2012) most farmers in Delta State, Nigeria joined farmer associations mainly with the objective of accessing extension services, credit facilities and information. This is based on the fact that extension agents are few in number compared to the demand for extension services, necessitating group activity so as to reach many farmers at once.

Land tenure is understood to mean the legal regime in which land is owned by a farmer, who is said to ‘hold’ the land. The results indicate that holding a land title deed was associated with an increased expected number of extension contacts in the overall sample and among the conventional farmers. Farmers with title deeds tend seek and use more extension information than those without. This could imply that security of land tenure enhances farmers in long-term investment projects which might require a higher number of extension services because of the capital involved. Where farmers lack access to security and control of land it reduces their interest in investing in new and innovative technologies for intensive agricultural production hence decreasing the demand for extension services (Christoplos 2010).

The results further show that *distance* to the nearest agricultural extension service provider negatively influenced the likelihood of a higher demand for extension services in the overall sample and among conventional farmers. This implies that farmers distant from the extension service providers are less likely to seek extension services. This raises an important policy issue on accessibility to extension service providers by distant farmers which is further aggravated by poor road infrastructure in the study area, thus limiting the number of extension services received. Similarly, Nambiro, Omiti, and Mugunieri (2006) observed that the distance to the nearest market and access to communication services significantly influenced access to agricultural extension services.

Some predictor variables only showed a significant influence among conventional or organic farmers. The *age of the household head* showed a positive significant association with the expected demand for extension services among conventional farmers. The results indicated that older farmers are likely to rely more on the advice from locally available extension agents possibly due to their limited number of alternative sources of agricultural information. Contrary, younger farmers are more likely to embrace information communication technologies (ICTs) to obtain agriculture information with ease. This was further affirmed during the focus group discussion in the study area.

In addition, the farmers' positive *perception* towards agricultural extension services was associated with an increase in demand for extension services among conventional farmers. This suggests that a positive change in the level of a farmer's perception motivates the farmer to seek more extension contacts. Change in perception could be attributed to farmers reaping more benefits from their farming activities as a result of the new information and guidance from extension service providers. However, it should be noted that this is only possible if the farmers implement the ideas proposed by the extensions service providers. Similar findings were reported by Gido, Lagat, and Ithinji (2012) and Neupane, Sharma, and Thapa (2002) indicating that as farmers' confidence in the extension services increases they seek advice from the service providers more regularly when making farming decisions.

Further, results among conventional farmers revealed that an increase in the amount of *off-farm income* earned significantly reduced the expected number of contacts with extension agents. This is perhaps due to farmers' increase in their involvement in off-farm activities, which are expected to increase their amount of off-farm income; they tend to reduce the time available for agricultural activities. For this reason, there is no motivation to seek information to enhance agricultural productivity from extension agents since they have alternative sources of income. In addition, there is a likelihood that the time frame within which extension agents are available to offer extension services coincides with the farms' off-farm activities, hence they are unable to meet regularly thus reducing the number of contacts. There is no consensus among researchers on the role played by off-farm income in enhancing agricultural development in developing countries. For instance, Chikwama (2010) also found a negative influence of off-farm income on extension contacts and argued that off-farm activities create competition for family labor and reduce the number of contacts farmers have with extension agents due to their unavailability on the farm. On the contrary, Odendo, Obare, and Salasya (2009) and Reardon et al. (1997) found that off-farm income had a positive impact on adoption of organic fertilizers and agricultural productivity respectively.

On the other hand, *farming experience* was significant and positively influenced the demand for extension services among organic farmers only. This suggested that as farmers gain more farming experience, the number of demand and supply driven extension contacts increases. From the demand perspective, more experienced farmers have been able to evaluate the usefulness of the extension information received in the past, thus guiding their future demand for the extension services. Whereas, from the supply perspective, more experienced farmers are well-known by the extension service agents, who will always provide them with advice on new technologies, even without the farmer seeking it. Such farmers become contact persons and are often identified to host agricultural activities such as farmer field days and demonstrations aimed at disseminating agricultural information to other farmers in their neighborhood.

4. Conclusion and Policy Implications

Agricultural extension systems serve to link farmers to the fast expanding agricultural technology and information frontier. To achieve this, the extension system could either be demand or supply driven. The success of either extension system will depend on how efficiently and timely it gets the needed information to the targeted farmers and how flexible it is to their situations. Among all the farmers in Bungoma County, education level, access to credit, land tenure and group membership were found to influence positively while farm distance to the service providers negatively influenced farmers' demand for extension services. Peculiar determinants of demand for extension found among conventional farmers were age of the household head, perception toward extension services and off-farm income. Among organic farmers, years of farming experience was found to be the unique determinant of demand for extension services.

Higher education levels were found to increase the demand for agricultural extension services among farmers. Therefore, the policy approach adopted in the Kenyan context of promoting only demand driven extension may be inefficient and ineffective since the less educated farmers may be left out of the extension system. It may be more important for the extension providers to come up with a framework where supply and demand driven extension are offered with the former intended for the less educated farmers who, in most cases, form a large proportion of the farming population.

A policy for strengthening agricultural credit systems in the rural areas is an important way to promote intensive use of the extension services by farmers. The credit provided would enable farmers to pay for any transaction costs involved in getting in touch with the extension service providers as well as the cost of making the investments recommended thereof. Alternatively, moving the extension closer to the farmers by investing in appropriate ICT and transportation infrastructure would help in reducing the transaction costs incurred by the farmers in accessing the much-needed extension services. This could be achieved through creation of satellite information centers which are ICT enabled. In addition farmers should be sensitized to organize themselves into more effective agricultural related groups through which extension can be provided efficiently and effectively. Furthermore, agricultural groups increase the likelihood of knowledge transfer and provide a forum for farmers to remind one another on the training among members.

Further, the contribution of demand driven extension to the success of Kenyan small-scale agriculture can be attained through implementation of land policy reforms that ensure that farmers acquire rights with ease. This will increase investments in agricultural technologies, including more demand for extension services, as land rights reduce uncertainty associated with insecure land tenure. Though all farmers cannot hold title to land, entering into legally enforceable lease agreements may help farmers to make medium-term investments in the leased land.

Taking into consideration farmers' unique characteristics might have an important policy implication in ensuring that all farmers have access to extension education. Among the conventional farmers, the elderly farmers, those with a positive perception toward extension services and those with less off-farm income had a high demand for extension services compared to their counterparts. On the other hand, organic farmers with few years of farming experience tend to have low demand for extension services. This means that the extension system needs also to consider the peculiar circumstances and situations of the agricultural households so as to transform the agricultural sector in Kenya as opposed to assuming that all farmers face the same circumstances.

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Appendix 1. Standard Poisson model results on factors influencing farmers' demand for extension services

	Overall			Conventional farmers			Organic farmers		
Variable	Coef	Std. Err	P>|z|	Coef.	Std. Err	P>|z|	Coef	Std. Err	P>|z|
Gender	0.131	0.163	0.422	17.578	1672.755	0.992	0.059	0.164	0.717
Age	0.018	0.009	0.053*	–0.023	0.041	0.575	0.017	0.010	0.093*
EducLevel	0.216	0.037	0.000***	0.213	0.157	0.176	0.121	0.042	0.004***
H/hSize	0.049	0.031	0.115	–0.305	0.412	0.459	–0.027	0.036	0.450
FmgExp	–0.031	0.007	0.000***	0.088	0.057	0.118	–0.026	0.008	0.001***
Perception	0.136	0.127	0.281	–0.089	0.910	0.922	–0.243	0.140	0.083*
FarmSize	–0.003	0.065	0.967	0.066	0.451	0.885	0.084	0.071	0.240
LnOff-famInc	0.000	0.000	0.921	0.000	0.000	0.496	0.000	0.000	0.763
Training	0.035	0.015	0.019**	–0.021	0.205	0.920	0.040	0.016	0.014**
LnCredit	0.011	0.015	0.492	0.276	0.120	0.021**	–0.020	0.016	0.218
GrpMShip	0.287	0.172	0.095*	0.364	0.793	0.646	0.146	0.188	0.439
LdTenure	0.873	0.229	0.000***	0.375	0.821	0.648	0.536	0.247	0.030**
FamDista	–0.154	0.072	0.031**	0.002	0.115	0.987	–0.241	0.170	0.156
SlopErosn	0.226	0.165	0.170	0.978	1.117	0.381	–0.018	0.173	0.916
Constant	–4.991	0.735	0.000***	–21.845	1672.759	0.990	–0.965	0.985	0.327
Goodness-of-fit Chi2 = 192 Pr>=chibar2 =0 0.00***				=27.71, Pr > =chibar 2 = 0.03**			= 49.43, Pr>=chibar2 0.00***		

Notes: ***, **,* indicates significant at 1%, 5% and 10% levels respectively.
Since the goodness of fit chi-square is statistically significant in all of the categories it indicates that the data do not fit the models well.

Appendix 2. Zero-Inflated Poisson (ZIP) model results on factors influencing farmers' demand for extension services

	Overall			Conventional farmers			Organic farmers		
Variable	Coef.	Std. Err.	P>|z|	Coef.	Std. Err.	P>|z|	Coef.	Std. Err.	P>|z|
Gender	0.208	0.187	0.267	19.765	4990.804	0.997	0.167	0.181	0.356
Age	0.023	0.011	0.031	–0.023	0.041	0.576	0.030	0.011	0.008*
EducLevel	0.228	0.048	0.000***	0.213	0.157	0.176	0.110	0.053	0.038***
H/hSize	0.011	0.038	0.784	–0.305	0.412	0.459	–0.085	0.042	0.046
FmgExp	–0.008	0.008	0.327	0.088	0.057	0.118	–0.006	0.008	0.484
Perception	–0.064	0.146	0.661	–0.089	0.910	0.922	–0.321	0.152	0.035
FarmSize	–0.035	0.076	0.644	0.066	0.451	0.884	–0.037	0.079	0.638
LnOff-famInc	0.000	0.000	0.264	0.000	0.000	0.496	0.000	0.000	0.843
Training	0.003	0.018	0.887	–0.021	0.205	0.920	0.013	0.021	0.514
LnCredit	0.030	0.016	0.067*	0.276	0.120	0.021**	–0.001	0.018	0.963
GrpMShip	0.464	0.184	0.012**	0.364	0.793	0.646	0.467	0.198	0.018**
LdTenure	0.343	0.289	0.236	0.375	0.821	0.648	–0.485	0.274	0.076*
FamDista	–0.219	0.080	0.006***	0.002	0.115	0.987	–0.324	0.178	0.068*
SlopErosn	0.214	0.171	0.211	0.978	1.117	0.381	0.054	0.172	0.755
Constant	–3.858	0.949	0.000***	–24.032	4990.805	0.996	0.303	1.102	0.784
Inalpha	–16.143	8.528	0.988	–26.436	7.246	0.983	–1.295	0.667	0.052
Alpha	0.000	0.000		0.000	0.000		0.274	0.183	
Vuong test	z = 0.831, Pr>z = 0.011**			z = 0.102, Pr > = 0.020**			z = 0.321, Pr>z = 0.005***		

Notes: ***, **,* indicates significant at 1%, 5% and 10% levels respectively.
The significant Vuong test indicates that the zero-inflated Poisson model is better than the Poisson regression model in Appendix 1.