THE INTERNATIONAL JOURNAL OF HUMANITIES & SOCIAL STUDIES

Socio-Economic Factors Influencing Use of ICT Tools by Rural Agrientrepreneurs in Kenya

Dickson Otieno Okello
Faculty, Department of Agricultural Economics and Agribusiness Management,
Egerton University, Njoro, Kenya
Dave Mwangi Ireri
Faculty, Department of Agricultural Economics and Agribusiness Management,
Egerton University, Njoro, Kenya

Abstract:
Recently, there has been emergence in the use of modern Information Communication Technologies (ICTs) in the different operations of agrienterprises. This ranges from the provision of agricultural information to marketing of agricultural products through the use of cellular phones, radio and television. Despite the potential of these ICT tools to enhance efficiency in agrienterprises' operations, there is low capacity and usage of these tools in rural agrienterprises. The aim of this study was to determine and quantify the socio-economic factors influencing decision by smallholder agrientrepreneurs to use ICT tools in their agrienterprises, describe and characterize structure of ICT usage in rural Kenya. The study used multistage sampling to select a sample of 183 pineapple agrientrepreneurs in Gatundu North Sub-County, Kiambu County. Data was collected with the help of a structured questionnaire. Using multivariate probit model to evaluate the socio-economic factors influencing the decision to use ICT tools, the study found that age, education, household size, farm size, group membership, extension contact, credit access and installation of electricity significantly influenced the decision to use ICT tools in agricultural transactions. The study therefore recommends policy interventions to enhance access to credit, collective action, electricity access and reduction of illiteracy levels among agrientrepreneurs through training and extension services.

Keywords: ICT tools, Socio-economic factors, Agrienterprises, Agrientrepreneurs.

1. Introduction

Usage of Information and Communication Technologies (ICTs) is a relatively new method of disseminating agricultural information among smallholder agrientrepreneurs in vast majority of developing countries (FAO, 2012). Indeed, some areas of ICT application are receiving tremendous attention in Africa. Mobile phone, radio and television, for example, are gradually being used more widely in many areas of rural agrienterprises (Ajani, 2014). This is due to inadequate extension agents which has made ICTs to become more attractive option for delivery of extension information. This is also because they have the potential to reach many agrientrepreneurs with timely and accessible content.

Providing smallholder agrientrepreneurs with agricultural information could improve agrienterprises development, by helping them to grow more profitable crops. Which could sell for more income. Widespread ownership and usage of ICT tools in Sub-Saharan African countries could also mean that smallholder agrientrepreneurs have great opportunity to get timely, adequate and affordable agricultural information (Irungu*et al.,* 2015).

According to Steinfield *et al.* (2015), ICTs tools, such as mobile phones have emerged as a useful tool to obtain current agricultural information and help smallholder farmers to get market knowledge and insight. The most common information transmitted via ICTs are weather forecasts, price information, pests and diseases information and better farming practices. This ICT tool could also provide mobile banking and timely payments such as usage of *M-pesa* and *M-shwari* which has increased financial inclusion of smallholder farmers (Irungu *et al.,* 2015).

The integration of ICT into agrienterprises can help in the transformation of smallholder farmers from their current subsistence level, marked by low productivity and low added-value, to an innovative, commercially-oriented, internationally competitive and modern agricultural sector'(World Bank, 2014). Many researchers have been concerned with how ICTs could provide farmers with required information to make objective choices of profitable agrienterprises and niche markets (Fawole *et al.,* 2012; Macharia, 2013 and Ajani. 2014). However, there is under-utilization of ICTs for agricultural production and marketing. It is imperative to digitize agricultural production, processing and marketing in order for smallholder agrientrepreneurs to fetch high income from utilization of ICT tools.

There is limited empirical evidence on influence of socio-economic factors on usage of ICT tools by smallholder agrientrepreneurs. A number of empirical studies have analyzed the relationship between personal characteristic of farmers and information sources (Adeogun, Olawoye, and Akinbile 2010; Sife *et al.,* 2010 and Ali, 2012) and they have assumed that farmers' personal characteristics influence the usage of ICT tools. However, the socio-economic factors play a key role in the usage of different ICT tools. Therefore, this paper attempts to address this gap in the existing knowledge by providing a micro perspective on the influence of agrientrepreneurs socio-economic characteristics on usage of ICT tools.

2. Materials and Methods

2.1. Study area and Sampling Design
The study was conducted in Gatundu North sub-county, where farm households consist of highly commercialized agrienterprises and their production decisions are closely linked to their commercialization. The Sub-county borders Nairobi and Kajiado Counties to the south, Machakos to the east, Muranga to the north and north east and Nakuru to west. It extends between longitude 36° 31′ and 37 ° 15′ east and latitude 0° 25′ and 1° 20′ south. The average annual rainfall received by the sub-county is 1,200 mm per annum. The average temperature is between 7°C to 34°C. Agriculture is the major economic activity in the sub-county and it contributes 17.4% of population's income. The study area was chosen because majority of smallholder farmers households have withdrew from their traditional crops tea and coffee and ventured into commercial pineapple farming with intense use of ICT tools in marketing and accessing agricultural information (KHCP, 2013). Limited access to timely and accurate information has been identified as a major hindrance to the development of agrienterprises in the study area.

Multi-stage sampling approach was used to select the sampled households. The first sampling technique was purposive sampling which was used to select the Sub-County and the wards. Primary data were collected for analysis from sampled households in the four wards, namely, Kamwangi, Kanyoni, Gakoe and Kinungi. Data collectors were recruited and trained four about three days both in field and in class. The draft questionnaires were pre-tested after which necessary corrections and comments were addressed before administering interview. Then simple random sampling was used to select a sample of 183 smallholder agrientrepreneurs. Face-to-face interviews was conducted to the respondents using the pretested semi-structured questionnaires to elicit data on ICT tools usage, household socio-economic and institutional characteristics, production and marketing. Key ICT tools of interest were mobile phones, television and radio which were identified as the major ICT tools used in the study area (Okello *et al.,* 2011).

2.2. Econometric Model
The smallholder agrientrepreneurs reported that they used multiple ICT tools to access agricultural information. Therefore it was assumed that smallholder farmers were using these multiple ICT tools (mobile phones, television and radio) simultaneously for similar information needs. The proposed methodology will provide insight on the agrientrepreneurs' socioeconomic factors that lead to their usage of ICT tools. The null hypothesis of this research is that, there is no significant difference between the socioeconomic characteristics of agrientrepreneurs and their usage of ICT tools. This implies that agrientrepreneurs irrespective of their sex, household size, age, farm size and education will use a given ICT tool. The empirical specification of choice decision over the three ICT tools can be modelled in two ways, by either multinomial or multivariate regression analysis. The key underlying assumptions of multinomial models is that the error terms of the choice equations are mutually exclusive (Greene 2003). However, the choices among the three ICT tools are not mutually exclusive as agrientrepreneurs can access information from more than one ICT tool at the same time and therefore the random error components of the information sources may be correlated. To account for such short-comings, selection decisions were modelled using Multivariate Probit (MVP) model. The MVP model simultaneously regresses a combination of several correlated binary equations against a single vector of explanatory variables. Empirically the model can be specified as follows:

$$Y_{i1} = X'_{ij1}\beta_1 + \varepsilon_{i1}$$
$$Y_{i2} = X'_{ij2}\beta_2 + \varepsilon_{i2}$$
$$Y_{i3} = X'_{ij3}\beta_3 + \varepsilon_{i3}, (5)$$

Where, i = agrientrepreneur identification, Y_{i1} = 1, if agrientrepreneur uses radio to access agricultural information (0 = otherwise), Y_{i2} = 1, if agrientrepreneur uses television to access agricultural information (0 = otherwise), Y_{i3} = 1, if agrientrepreneur uses mobile telephony to access agricultural information and to undertake transactions such as marketing produce, mobile banking and mobile money transfers (0 = otherwise), X'_i = Vector of socio-economic factors influencing use of ICT tool, β_j = Vector of unknown parameters (j = 1, 2, 3), and ε = is the error term. Socio-economic factors influencing use of ICT tools can be tested by running three different independent binary probit or logit models by assuming that error terms are mutually exclusive. However, the decision to use different ICT tools may be correlated, thus the elements of error terms might experience stochastic dependence. In this situation, a multivariate probit model of the following form is used to test the hypothesis:

$$Y_{i1} = X'_{ij}\beta_j + \varepsilon_{ij}, (6)$$

Where Y_{ij} (j =1….,3) represent the three different ICT tools faced by the ith agrientrepreneurs (i = 1.....183), X'_{ij} is a 1 × k vector of observed variables that affect the choice decision of agrientrepreneur, β_j is a k × 1 vector of unknown parameters (to be estimated), and ε_{ij} is the unobserved error term. It assumed that the error terms (across j = 1… m alternatives) are multivariate and are normally distributed with mean vector equal to zero, the unknown parameters in Equation (6) are estimated using simulated maximum likelihood. All the three pairs of the estimated correlation coefficients were statistically significant from zero implying a strong

interdependence among the three ICT tools in usage to access agricultural information. The Wald test $\left[\chi^2(54) = 124.98, \quad p \prec 0.0001 \right]$ implied that the data was fairly fit for MVP model and the likelihood ratio test $\left[\chi^2(3) = 36.51, \quad p \prec 0001 \right]$ of the independence of multiple usage of various ICT tools was strongly rejected. This indicates that multiple use of different ICT tools among households is not mutually independent. The explanatory variables were derived from review of past studies on usage of ICT tools (Barret, 2008; Okello *et al.,* 2010; Jenkins *et al.,* 2011 and Sekabira, 2012).

3. Results and Discussion

3.1. Descriptive Statistics
Descriptive statistics of variables used in the econometric model are presented in Table 1. For comparison, we differentiate between users of the three ICT tools (mobile phones, television and radio). The upper part of the table shows the means of the continuous variables while the lower part shows the frequencies and percentages of the categorical variables used. The results show the demographic and economic characteristics of the users of these ICT tools.

Variables	Definition of variables and their measurements	Mobile phone (n=157)		Television (n=106)		Radio (n=144)	
	Continuous Variables	**Mean**	**S.E**	**Mean**	**S.E**	**Mean**	**S.E**
Age	Age of the decision maker in years	39.61	0.843	37.79	0.992	41.21	0.100
Hsize	Number of family members in the household	4.31	0.135	4.12	0.151	4.32	0.145
Fsize	Farm size owned by household (in acres)	1.75	0.099	1.95	0.130	1.79	0.110
Econt	Number of extension contacts from extension agents	1.05	0.088	1.26	0.114	1.01	0.093
Dist	Distance to the nearest output market in kilometres	9.20	0.949	8.88	1.159	8.27	0.948
	Categorical variables	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**
Gen	Percentage of male decision makers	99	63.06	64	60.38	88	61.11
Acc	Percentage of respondents with access to credit	107	68.15	81	76.42	86	59.72
Grpmember	Percentage of respondents who are members of farmer groups	115	73.25	78	73.58	98	68.06
Inst	Percentage of respondents who have installed electricity in homestead	122	77.71	91	85.85	98	68.06
ICTtrn	Percentage of respondents who had access to ICT training	92	58.60	69	65.09	81	56.25

Table 1: Description and expected sign of the variables used in regression model.

	Use TV	**Use Radio**	**Use Phone**
Use TV	1.000		
Use Radio	0.367***	1.000	
Use Phone	0.256***	-0.100***	1.000

Table 2: Correlation coefficients for MVP regression equations
*** represents significance at 1%

3.2. Results of Multivariate Probit Model
This section presents the estimation results on the socio-economic factors influencing the use of ICT tools by smallholder agrientrepreneurs. The regression results of multivariate probit model are presented in Table 3.

ICT tools	Mobile phones		Television		Radio	
Variable	Coeff.	Std. Err	Coeff.	Std. Err	Coeff.	Std. Err
Age (years)	-0.028*	0.016	-0.027**	0.013	-0.011	0.012
Sex (male=1)	0.207	0.423	-0.062	0.276	-0.324	0.263
Education (years)	0.144	0.170	0.338***	0.097	0.214**	0.095
Household size (members)	0.373**	0.152	-0.033	0.080	-0.043	0.077
Farm size (acres)	-0.005	0.158	0.291***	0.108	0.213*	0.116
Off farm income (KES)	-0.012	0.431	-0.350	0.264	-0.019	0.241
ICT training (yes=1)	-0.341	0.982	-0.465	0.488	-0.160	0.505
Group membership (yes=1)	1.928***	0.606	-0.219	0.271	-0.256	0.275
Extension contact(number)	0.619	0.613	0.633**	0.271	0.338	0.265
Credit access	0.219	0.467	0.528*	0.271	-0.390	0.277
Distance to market (km)	-0.015	0.018	-0.019*	0.010	-0.017*	0.009
Installed electricity (yes=1)	1.692***	0.532	0.715***	0.249	-0.568**	0.285
Constant	3.438	2.646	-1.305	0.932	2.387**	1.089
∂i	-1.094**	0.486	-1.771***	0.280	0.776	0.201
ρj	-0.798***	0.176	-0.647***	0.163	0.650***	0.116
Lr. Test for indep. Eqns. Rho21=rho31=rho32=0			Chi2(3) = 36.943		prob > chi2 = 0.0000	

Table 3: Multivariate probit results for socio-economic factors influencing use of ICT tools among smallholder agrientrepreneurs
*, **, *** = significant at 10%, 5% and 1% level, respectively

Age of the key decision maker had a negative effect on mobile phone and television usage with an additional age reducing their usage by 2.8% and 2.7% respectively. These results show that an additional year to the age of the household head is associated with less probability of that household to use mobile phones and television as sources of agricultural information. Older household heads perhaps would be less likely to adopt modern ICT tools such as mobile applications because they would believe that conventional sources of information are still the best. Jenkins *et al.* (2011) and Okello *et al.* (2010) found age had significant influence on usage of modern ICT facilities.

The education level of the household head had significant effect on television and radio usage as sources of agricultural information. An increase in education by one year enhanced television and radio usage by about 0.34 units and 0.21 units respectively. The results show exposure to education permits an individual farmer to control the rate of message input and develop the ability to store and retrieve information from television and radio usage. Education enables the individual farmers to know how to seek for and apply information on improved farm practices. This is because as the individual gained the ability to read, he is able to extend the scope of his experience through the audio-visual media. This is consistent with results of previous studies which showed education to be a catalyst of modernization by giving the individual access to information through modern technologies (Jenkins *et al.,* 2011).

Household size had a significant and positive effect on mobile phone usage with an additional family member increasing its usage by 37.3%. This could be due to households with large family size are likely to be under pressure to produce more, not only for family consumption but also for sale. The desire to produce more could lead to agricultural information seeking and usage of mobile phones. The findings were in conformity with Sekabira (2012) who found for every one person increase in family size, probability to adopt ICTs-based MIS by traders increased by 3.3%.

Farm size had a significant and positive effect on television and radio usage, with an additional acre increasing their usage by 29.1% and 21.3%, respectively. Therefore, farmers with larger land size are more likely to produce more leading to higher income. The higher income and desire to produce more could lead to agricultural information seeking through usage of television and radio. Olaleye *et al.* (2009) also found that increase in farm size increases the probability of a household in using agricultural technologies.

Group membership had a positive significant effect on use of mobile phones. The probability of using mobile phones as a source of information and for agricultural purposes is positive and significantly affected by a households' participation in a rural groups. Membership to group was expected a priori to contribute positively on ICT tools usage due to access and sharing of information among the members even without physical meeting. This is because farmers find it convenient to use mobile phone to share information, particularly if they are far apart. Further, this could be due to the relatively cheaper cost of calling and short media short message service (SMS). Barret (2008) found group membership influences farmers in the usage of modern technologies. With scarce or inadequate information sources and imperfect markets, groups such as traders and farmers' groups facilitate the exchange of information, and enable farmers to access inputs on schedule and overcome credit constraints.

The number of contact with extension service providers was significant and had a positive effect on usage of television as a source of agricultural information. An increase in extension contact by one enhanced television usage by 63%. Extension agents popularizes innovation by making farmers exchange ideas, experiences and makes it cheaper to source information. During survey, it was observed that farmers who had frequent contacts with extension agents had a higher probability of using television as a source of information. This is especially the fact that staff of some local television stations such as *Inooro* TV, *Njata* TV and *Utugi* TV were visiting farmers and offering them one to one extension services and encourage them to watch agricultural programmes they

broadcast. Mwaura *et al.* (2014) found that extension services helps farmers to adopt modern agricultural technologies, since it makes them aware of the availability and benefits of these technologies and their inherent characteristics.

Access to credit was significant and had a positive effect on television usage with an additional access to credit increasing its usage by 53%. It was observed that the move to digital broadcasting from analogue broadcasting brought several challenges to rural community in accessing agricultural information through television. Majority of rural farmers were not able to buy the digital set-top boxes thereby hindering them to use television as a source of agricultural information. Feder *et al.* (2000) found that household heads that have access to credit increases their likelihood of using modern ICT tools.

Distance to the nearest market place determines the ease at which commodities are accessible to consumers. This variable was significant and had a negative effect on television and radio usage with an additional distance to output market reducing the use of television and radio by 1.9% and 1.7% for a kilometer increase. This variable was found to be statistically different at 10% significance level. This was intriguing since distance to the nearest market, was expected to play an imperative role in increasing the likelihood of households in using ICT tools to access agricultural information. This is possibly due to smallholder farmers were mainly interested in making more profits, therefore they could not be interested in accessing information or marketing their produce through expensive ICT tools. Further, they would prefer selling their produce at farm gate which is cheaper than incur cost of using ICT tools in marketing. Sekabira (2012) found that with increasing distance to town centers farmers were less likely to use expensive ICT tools to market their produce.

Household electricity installation was significant and had a positive effect on usage of mobile phones and television but negative effect on use of radio as a source of agricultural information. Farmers who had installed electricity at their homes had a higher probability of using mobile phones and television by proportion of 1.69 and 0.72 respectively. However, it was unexpectedly observed installation of electricity reduced use of radio by 1.7%. This can be due to farmers have been using it for a number of years without the dependence of electricity because they could manage to buy dry cells. Electricity for powering ICT tools is the primary constraint to using ICT in their agrienterprises. Although generators and dry cells can be used as alternative sources of power, these alternatives were found to expensive and unaffordable by the rural majority of poor rural farmers. Since access to television requires electricity, it is difficult for the farmers to access information through this information communication tool. Samuel *et al.* (2005) found a positive correlation between mobile phones and television ownership and access to electricity. This is possibly because ICT tools are electricity dependent.

4. Conclusion and Recommendations

The aim of the study was to determine the socio-economic factors influencing the use of ICT among smallholder agrientrepreneurs. In achieving the objective, multivariate probit regression model was used to assess the socio-economic factors influencing the use of mobile phones, television and radio. Findings were that age, education, household size, farm size, group membership, extension contact, and credit access, installation of electricity, positively influenced the use of ICT tools. This rises policy concern on importance of socio-economic attributes of ICT tools users in dissemination of agricultural information and undertaking transactions. The study therefore recommends policy interventions to enhance access to credit, collective action, electricity access and reduction of illiteracy levels among agrientrepreneurs through training and extension services.

5. References

i. Adeogun, S. O., J. E. Olawoye, and L. A. Akinbile. (2010). "Information Sources to Cocoa Farmers on Cocoa Rehabilitation Techniques (CRTs) in Selected States of Nigeria." Journal Media and Communication Studies 2 (1): 9–15.

ii. Ajani, E.N. (2014). Promoting the use of Information and Communication Technologies (ICTs) for Agricultural Transformation in Sub-Saharan Africa. Journal of Agricultural and food information, 15(1):42-53.

iii. Ali, J. (2012). Factors affecting the adoption of ICTs for farming decisions. Journal of Agricultural and food information, 13(1):78-96.

iv. Barrett, C.B. (2008). On the Relevance of Identities, Communities, Groups and Networks to the Economics of Poverty Alleviation. In: The Social Economics of Poverty: On Identities, Communities, Groups and Networks. Edited by Barrett C.B. London: Routledge.

v. FAO (2012). Framework on effective rural communication for development. FAO Rome

vi. Fawole, O.P., and Olajide., B.R. (2012). Awareness and use of Information and Communication Technologies by farmers in Oyo State Nigeria, Journal of Agricultural and food information, 13(4):326-337.

vii. Feder G., Lau L.J., Lin J.Y., and Luo X. (2000). The Relationship between Credit and Productivity in Chinese Agriculture: A Microeconomic Model of Disequilibrium. American Journal of Agricultural Economics. 72(2): 1151-1157.

viii. Greene, H. W. (2008). Econometric Analysis: Pearson Education Inc. New York University.

ix. Irungu, K.R.G., Mbugua, D., Muia, J. (2015). Information and Communication Technologies Attract Youth into profitable Agriculture in Kenya. East African Agricultural and forestry Journal, 1(81):24-33

x. Jenkins, B. (2011). "Developing Mobile Money Ecosystems." Washington, DC: IFC and the Harvard Kennedy School.

xi. Kenya Horticulture Competitiveness Project (2013). Horticulture Industry in Kenya. Horticultural Export Report.

xii. Macharia, J. (2013). 'M-farm, Mkulima Young Champions' In: ICT 4AG, International Conference, 4-8 November, 2013, Kigali, Rwanda.

xiii. Mwaura, S. N., Muluvi A. S. and Mathenge, M. K. (2014). African Leafy Vegetables and Household Wellbeing in Kenya: A Disaggregation by Gender. Current Research Journal of Social Science, 6 (4): 82-94.

xiv.   Okello, J.J. Ofwona, E. Mbatia, O.L.E and Okello, R.M. (2011). Using ICT to integrate   smallholder   farmers   into agricultural value chain; The case of DrumNet project in Kenya. International Journal of ICT and Research Development, 1(2): 23-37.

xv.   Olaleye, R.S., Gana, F.S., Umar, I.S., Ndanisa, M.A. and Peter, E.W. (2009) Effectiveness of Radio in the Dissemination of Agricultural Information among Farmers in Edu Local Government Area of Kwara State, Nigeria. Continental Journal of Agricultural Science 3(1):1–6.

xvi.   Samuel, J., Shah, N. and Hadingham, W (2005) Mobile Communications in South Africa, Tanzania and Egypt: Results from Community and Business Surveys. The Vodafone   Policy Paper Series, 2(1): 44–52.

xvii.   Sife, A.S. (2010). Contribution of mobile telephony, radio and television to rural livelihoods and   poverty   reduction   in Morogoro Region, Tanzania. PhD thesis, University of Dar es Salaam, Tanzania.

xviii.   Sekabira, J. Bonabana, W, Narathius, A. Haruna, A. (2012). Determinants for Adoption of ICT-Based Market Information Services by Smallholder Farmers and Traders in Mayuge District, Uganda. Journal of Agricultural Economics. 2(1):13-16.

xix.   Steinfield, C., and Wyche, S. (2015). Why don't farmers use cell phones to access market prices? Technology   affordances and barriers to market information services adoption in rural   Kenya.   Journal of Agricultural and food information, 22(2):320-333.

xx.   World Bank (2014). Financial Inclusion Data: Kenya country dashboard. http://datatopics.worldbank.org/financialinclusion/country/uganda. Accessed 12.01.2016.