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Influence of education levels on dissemination of soil fertility management information in the central highlands of Kenya

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Abstract

Inadequate links between researchers and farmers has resulted in low uptake of research advances recommended to improve food security in the central highlands of Kenya. Access to timely and accurate information by extension agents and farmers is paramount in dissemination of soil fertility management practices. Hence, the study sought to investigate the effect of education levels on communication channels used to disseminate soil fertility technologies in the Central highlands of Kenya. Questionnaires were used to elicit information from 105 extension agents and 240 farmers. About 50.5 % of the extension officers were certificate holders while 29.5 % were diploma holders from agricultural institutes. Majority of the farmers had attained primary education (59.6 %) while 25.8 % and 9.2 % had attained secondary and post secondary education, respectively. Research institutions were the most accessible sources of information on soil fertility management practices by extension agents while internet and scientific conferences were the least scored as accessible sources of soil fertility management information by extension agents. Education levels significantly influenced preference of individual approach methods by farmers. There was a significant positive relationship between education and accessibility of internet as a source of information on green manure. The implication of the study was that education levels influenced the mode of communication used in the transfer of soil fertility research outputs to the end users. Consequently, it is extremely important to consider education levels in selection of dissemination pathways used in agriculture.

Keywords: Communication channels, source of information, individual approaches, internet

1 Introduction

Soil fertility replenishment in sub Saharan Africa is critical to the process of poverty alleviation (Place *et al.*, 2003). In order to address this challenge, studies in the central highlands of Kenya and other areas in sub-Saharan Africa have identified soil fertility management interventions that would help the low resource farmers mitigate problems of food insecurity and improve resilience of the soils productive capacity (Bationo *et al.*, 2003). However, lack of suitable mechanisms for transferring the available knowledge on concepts and principles of soil fertility management technologies from re-

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searchers to extension agencies, farmers and other agricultural service providers, in ways that promote innovation and sustainable adoption is a major challenge in the region (Damisa & Igonoh, 2007). Farmer awareness of new crops and techniques is an essential first step toward their adoption.

Education is widely considered to be the most important form of human capital (Schultz, 2005). Low level of formal education is a barrier in disseminating useful information and the rate of adoption varies from farmer to farmer depending upon the situation and availability of information sources (Taley & Khadase, 2006). In particular, many economists have hypothesized that highly educated farmers tend to adopt productive innovations earlier than those who are relatively poorly educated (Basu *et al.*, 2002). Knight *et al.* (2003) have found that the schooling of the head of the household reduces risk aversion and encourages the adoption of agricultural innovations in rural Ethiopia. However, effective communication and dissemination of research results as a means of transferring technology to enable the end-users to adopt the new technology is also crucial (Sulaiman, 2002). A review of the literature (Huffman, 2000) showed that formal education or general intellectual achievement affected the choice of information channels about new technologies (Huffman, 2000). According to Akinbile (2003), the more literate farmers are, the more they are likely to comprehend technologies. Ajayi & Oloruntoba (2004) also found that adequate information is useful for farmers' adoption and continued usage of improved technologies. In general, farmers with higher education have better access to information and knowledge. Educated farmers also tend to possess higher analytic capability of the information and knowledge necessary to successfully implement new technology and realize expected results (Uematsu & Mishra, 2010). Studies on dissemination approaches that take into account the education levels of the clientele are rare. This study, therefore, seeks to assess the effect of education in dissemination of soil fertility management information.

2 Materials and Methods

2.1 Study area

The research was carried out in four districts including Maara, Meru South, Mbeere South and Embu in the central highlands of Kenya. The study area was chosen following an exploratory study where past research projects on soil fertility management practices had been conducted. The projects were undertaken by Kenyatta University, Tropical Soil Biology Fertility Institute (TSBF), Kenya Agricultural Research Institute (KARI) and Integrated Nutrient Management to attain sustainable productivity increases in East African farming Systems project (INMASP). The soil fertility management technologies developed included the use of animal manure, green manure, organic and inorganic fertilizers, crop rotation and use of composted manure. For the purpose of household interviews, Maara and Mbeere district were randomly selected from the four districts (Mbeere South, Embu, Meru South and Maara) in the central highlands of Kenya.

The Maara district and Meru South lies in the Upper Midland Agro-ecological Zone (UM2-UM3) (Jaetzold *et al.*, 2006) on the eastern slopes of Mount Kenya at an altitude of 1500 m.a.s.l., with a annual mean temperature of 20 °C and a total bimodal annual rainfall ranging from 1200 to 1400 mm. The rainfall pattern is bimodal with the long rains (LR) from March to June and short rains (SR) occurring between October to December. The soils are mainly humic Nitisols (Jaetzold *et al.*, 2006) which are deep, well weathered with moderate to high inherent fertility that has declined over time with poor management. Mbeere South lies at the transition between the marginal cotton (LM4) and the main cotton (LM3) agro-ecological Zones (Jaetzold *et al.*, 2006) at an altitude of approximately 800 m.a.s.l. with an annual mean temperature ranging from 21.7 to 22.5 °C and average annual rainfall ranging from 700 to 900 mm. The rainfall is bimodal with long rains (LR) from mid March to June and short rains (SR) from late October to December hence two cropping seasons per year. The soils are predominantly Ferralsols and Acrisols (Jaetzold *et al.*, 2006). Embu lies at the transition between the lower highlands (LH1) and upper midlands (UM1) at an altitude of approximately 1480 m.a.s.l. with average monthly maximum temperature of 25 °C and the minimum is 14 °C. Total average annual rainfall ranges from 1200 to 1500 mm and the soils are humic Nitisols derived from basic volcanic rocks (Jaetzold *et al.*, 2006).

2.2 Data collection and analysis

A cross-sectional survey approach was used to collect data from farmers and extension agents. A farmer interview schedule, which consisted of both of open-ended and closed-ended questions, was used to elicit response from the farmers. Data collected from the farmers included farmers' socio-economic characteristics and sources of information on soil fertility management technologies utilized by the farmers. A standardized questionnaire was used to collect data from the extension workers. Data collected from the extension workers included training in soil fertility management practices and communication channels used by exten-

sion workers. A pilot study was conducted to test the suitability of the farmers' interview schedule and the questionnaires for the extension agents. A sample of 24 farmers from Maara and Mbeere district were randomly selected and interviewed. Twelve agricultural extension officers from the four districts (Mbeere South, Embu, Meru South and Maara) participated in the pre-test exercise. Those respondents who participated in the pre-test exercise were excluded in the actual survey. A sample size of 120 farmers was randomly selected from both Maara and Mbeere districts. Two hundred and forty (240) respondents were selected for the household interviews. Due to the diverse responsibilities of extension workers within the districts, total sampling of extension agents was applied. In total, 105 extension workers from four districts (Mbeere South, Embu, Meru South and Maara) were interviewed. Data collected was coded (Table 1) and processed using SPSS software for further analysis.

3 Results

3.1 Descriptive statistics of farmers

The average age of the farmers in Maara was 49 years while for Mbeere south district was 44 years (Table 2). There was a statistically significant difference in average farm size ($t = -7.803$, $P = 0.001$) where the average farm size of Mbeere South was larger (1.42 ha) compared to Maara district (0.7 ha).Majority of the household heads interviewed were male farmers and their main occupation was farming for both food and income.

3.2 Soil fertility management technologies practiced

The most commonly practiced soil fertility technologies were the use of inorganic fertilizers followed by crop rotation, animal manure then erosion control measures sequentially. Compost and green manure were the least practiced technologies (Table 3).

Table 1: *Codes used for the variables used in household interviews and extension questionnaires Variables used in household interviews.*

Variables used in household interviews	
Age of household head (No. of years)	Continuous Variable
No. of non formal trainings attended	Continuous Variable
Years of farming experience	Continuous Variable
Number of the groups	Continuous Variable
Total farm size (Hectares)	Continuous Variable
Gender	1 = Male, 2 = Female
Educational level of Household Head	1 = No formal education, 2 = Primary, 3 = Secondary, 4 = Post secondary education
Occupation of Household head	1 = Farming, 2 = Business, 3 = Employed
Why do you do farming?	1 = For food, 2 = For income, 3 = For both food and income
Ownership of title deed	1 = Yes, 2 = No
Do you have the following appliances? Radio	1 = Yes, 2 = No
Do you have the following appliances? Television	1 = Yes, 2 = No
To what extent do you prefer the following soil fertility management approaches?	1 = Do not prefer, 2 = Moderately prefer, 3 = Strongly prefer
Language preference	State 1 = Yes, 2 = No
Print media read to create your awareness on usage of green manure	State 1 = Yes, 2 = No
Variables used in extension questionnaire	
Age	Continuous Variable
Years of farming experience	Continuous Variable
Gender	1 = Male, 2 = Female
Education qualification	1 = Certificate, 2 = Diploma, 3 = Higher Diploma, 4 = Degree, 5 = Masters
Level of competency on SFM practices by extension agents in the Central Kenya	1 = Not competent, 2 = Least competent, 3 = Moderately competent 4 = Competent
Accessibility of sources of information related to soil fertility management technologies	1 = Not accessible, 2 = least Accessible, 3 = fairly accessible, 4 = Very Accessible

Table 2: *Descriptive statistics of farmers in Maara and Mbeere South districts.*

Descriptive statistics of farmers	*Districts*	
	Maara (n=120)	*Mbeere South (n=120)*
Average age of household head (Years)	48.9±13.52	44.1±12.48
Average number of non formal trainings attended	1. 8±0.73	1.4±0.78
Average years of farming experience	2.3±0.71	2.2±0.81
Average number of groups	1.1±0.95	1.0±1.1
Average farm size(Hectares)	0.7±0.4	1.42±0.93
Gender (%)		
Male	85.8	58.3
Female	14.2	41.7
Occupation of household head (%)		
Farming	85.0	83.3
Business	3.3	4.2
Employed	11.7	12.5
Why do you do farming (%)		
For food	25.8	13.3
For income	2.5	1.7
For food and income	71.7	85.0

Values are arranged as averages, followed by standard deviations

Table 3: *Soil fertility management technologies practiced by farmers in central Kenya.*

Soil Fertility Management	*Farmers who practice the technology n=240*	
	Frequency	*Percentage*
Animal manure	220	91.7
Green manure	53	22.1
Inorganic fertilizers	229	95.4
Combined organic & inorganic fertilizers	214	89.2
Erosion control measures	217	90.4
Compost	73	30.4
Legumes	152	63.3
Crop rotation	221	92.1

3.3 Relationship between age and education levels of extension agents in central Kenya

The majority (61.5 %) of farmers with no education were from Maara district while 59.1 % of the farmers who had attained post secondary education were from Mbeere district (Table 4). However, 59.6 % of the farmers in both districts were primary school drop outs. A higher percentage (72.1 %) of the farmers was male farmers while 27.9 % were female farmers. Only 9.2 % and 9.0 % of the male and the female farmers respectively had attained secondary education. There was a significant relationship (χ^2=12.432, P=0.006) between education and possession of title deeds where a higher percentage (81.8 %) of the farmers who had attained post secondary education also possessed land title deeds. However, about half of the farmers (51.7 %) did not possess title deeds (Table 4).

3.4 Language preference

There was a significant relationship (χ^2=37.483, P=0.001) between preference of English in training on soil fertility technologies and education where majority of the farmers with no formal education (100 %) and primary education (65 %) did not prefer English. On the other hand, Kiswahili was only preferred by 30.8 % of the farmers who had no education and 18.9 % of farmers with primary education. There was no significant relationship (χ^2=4.821, P=0.185) between preference of vernacular language and education. Nearly all farmers (99.6 %) preferred vernacular as a communication language of soil fertility technologies (Table 5).

Table 4: *Relationship between education levels and socio-demographic characteristics of farmers in Maara and Mbeere South districts.*

Level of education	*District*		
	Maara	*Mbeere South*	*Total*
No formal education	8 (61.5)	5 (38.5)	13 (5.4)
Primary education	70 (49)	73 (51)	143 (59.6)
Secondary education	33 (53.2)	29 (46.8)	62 (25.8)
Post secondary education	9 (40.9)	13 (59.1)	22 (9.2)
Total	120 (50)	120 (50)	240 (100)
Chi square	χ^2=1.741, df=3, P=0.628 NS		
	Gender		
	Male	*Female*	*Total*
No formal education	9 (5.2)	4 (6)	13 (5.4)
Primary education	102 (59)	41 (61.2)	143 (59.6)
Secondary education	46 (26.6)	16 (23.9)	62 (25.8)
Post secondary education	16 (9.2)	6 (9.0)	22 (9.2)
Total	173 (100)	67 (100)	240 (100)
Chi square	χ^2=0.235, df=3, P=0.972 NS		
	Possess title deed		
	Yes	*No*	*Total*
No formal education	7 (53.8)	6 (46.2)	13 (100)
Primary education	60 (42)	83 (58)	143 (100)
Secondary education	31 (50)	31 (50)	62 (100)
Post secondary education	18 (81.8)	4 (18.2)	22 (100)
Total	116 (48.3)	124 (51.7)	240 (100)
Chi square	χ^2=12.432, df=3, P=0.006 S		

N.B: Numbers in parentheses give the percentage of respondents

Table 5: *Relationship between language preference and levels of education of farmers in central Kenya.*

Level of Education	*English n=240*		*Kiswahili n=240*		*Vernacular n=240*	
	Yes	*No*	*Yes*	*No*	*Yes*	*No*
No formal Education	0 (0)	13 (100)	4 (30.8)	9 (69.2)	13 (100)	0 (0)
Primary	50 (35)	93 (65)	116 (81.1)	27 (18.9)	143 (100)	0 (0)
Secondary	51 (82.3)	11 (17.7)	60 (96.8)	2 (3.2)	62 (100)	0 (0)
Post secondary education	20 (90.9)	2 (9.1)	21 (95.5)	1 (4.5)	21 (95.5)	1 (4.5)
Total	121 (50.4)	119 (49.6)	201 (83.8)	39 (16.3)	239 (99.6)	1 (0.4)
Chi square	χ^2=37.483, P=0.001		χ^2=62.722, P=0.001		χ^2=4.821, P=0.185	

N.B: Numbers in parentheses give the percentage of respondents

3.5 Possession of radio and television sets

About 86 % of farmers owned radios while 28.3 % of the farmers owned television sets (Table 6). Only 7.7 % of the farmers with no education possessed television sets. Conversely, 63.6 % of the farmers with post secondary education standards possessed a television set. There was no significant relationship between ownership of radio and education but chi-square results revealed a significant relationship (χ^2=36.009, P=0.001) between education and possession of television sets implying that more educated farmers were more likely to own television sets than less educated farmers.

3.6 Types of print media used by farmers on green manure

There was a significant relationship (χ^2=13.915, P=0.003) between education and farmers who had read manuals on green manure. More farmers (32.9 %) with primary education had read posters compared to 10.5 % of the farmers who had read manuals. In addition, a higher percentage (29.6 %) of farmers had read posters on green manure than manuals (15.8 %) (Table 7).

3.7 Preference of extension approaches by farmers

A higher percentage (67.1 %) of farmers strongly preferred individual farmer interaction compared to group approach (44.2 %) and mass media (13.3 %). However, 46.2 % of the farmers with no education did not prefer mass media while a majority (61.5 %) strongly preferred individual farmer interaction. There was a positive significant correlation (r=0.154, P≤0.01) between education and preference for individual farmer interaction implying that the more educated the farmer the higher the preference (Table 8).

3.8 Extension agents

The average age of extension agents ranged between 45 and 47 years in all districts. The majority (73.9 %) of extension agents in Meru South were male while 63.2 % of the extension agents in Embu were female. There was no statistically significant difference in the average years of experience and age between the districts (Table 9). On the other hand, the majority of the extension agents in all the districts were certificate holders.

Table 6: *Relationship between education levels and possession of radio and television sets by farmers in central Kenya.*

Level of Education	*Do you have the following appliances?*					
	Radio n=240			*Television n=240*		
	Yes	*No*	*Total*	*Yes*	*No*	*Total*
No formal education	11(84.6)	2(15.4)	13(100)	1(7.7)	12(92.3)	13(100)
Primary education	122(85.3)	21(14.7)	143(100)	24(16.8)	119(83.2)	143(100)
Secondary education	57(91.9)	5(8.1)	62(100)	29(46.8)	33(53.2)	62(100)
Post secondary education	17(77.3)	5(22.7)	22(100)	14(63.6)	8(36.4)	22(100)
Total	207(86.3)	33(13.8)	240(100)	68(28.3)	172(71.7)	240(100)
Pearson Chi-Square	χ^2=3.320, df=3, P=0.345			χ^2=36.009, df=3, P=0.001		

Table 7: *Farmers who had read posters and manuals to acquire information on green manure in central Kenya.*

Level of Education	*Posters*		*Manuals*	
	Yes	*No*	*Yes*	*No*
No formal education	1 (7.7)	12 (92.3)	0 (0)	13 (100)
Primary education	47 (32.9)	96 (67.1)	15 (10.5)	128 (89.5)
Secondary education	17 (27.4)	45 (72.6)	17 (27.4)	45 (72.6)
Post secondary education	6 (27.3)	16 (72.7)	6 (27.3)	16 (72.7)
Total	71 (29.6)	169(70.4)	38 (15.8)	202 (84.2)
Pearson Chi-Square	χ^2=3.927, P=0.270		χ^2=13.915, P=0.003	

Table 8: *Relationship between extension approach preference and level of education of farmers in central Kenya.*

Approach	*Preference*	*No formal education*	*Primary*	*Secondary*	*Post secondary education*	*Total*	*r*
Individual farmer interaction	Do not prefer	23.1	9.8	6.5	–	8.8	0.154 *
	Mildly prefer	15.4	28.0	22.6	9.1	24.2	
	Strongly prefer	61.5	62.2	71.0	90.9	67.1	
Group approach	Do not prefer		9.1	3.2	13.6	7.5	0.909
	Mildly prefer	53.8	46.9	51.6	45.5	48.3	
	Strongly prefer	46.2	44.1	45.2	40.9	44.2	
Mass media	Do not prefer	46.2	56.6	59.7	36.4	55.0	0.92
	Mildly prefer	23.1	30.8	29.0	50.0	31.7	
	Strongly prefer	30.8	12.6	11.3	13.6	13.3	

* significant P=0.05, n=240

Table 9: *Descriptive statistics of extension agents in central Kenya.*

Descriptive statistics of extension agents	*Districts*			
	Maara south (n=19)	*Meru south (n=23)*	*Mbeere south (n=25)*	*Embu (n=38)*
Average age (Years)	45.3±7.60	48.4±3.97	46.0±7.19	47.7±6.21
Average years of experience	3.1±1.19	3.91±0.29	3.6±1.00	3.6±0.884
Gender (%)				
Male	47.4	73.9	64.0	36.8
Female	52.6	26.1	36.0	63.2
Educational level (%)				
Certificate	47.4	56.5	56.0	55.3
Diploma	21.1	30.4	32.0	31.6
Higher Diploma	0	0	4.0	0
Degree	26.3	8.7	8.0	10.5
Masters	5.3	4.3	0	2.6

Values are arranged as averages, followed by standard deviations

3.9 Relationship between age and education levels of extension agents in central Kenya

The majority (88.2 %) of extension agents who were between 51–60 years were certificate holders while 66.7 % of those between 20–30 years and 41.7 % of those between 31–40 years were degree holders. Only 2.9 % of the extension agents were holders of masters' degree (Table 10) There was a significant negative relationship (χ^2=58.038, P=0.001) between education and age of the extension agent.

3.10 Competency of extension agents on soil fertility management practices

The majority (57.1 %) of extension agents were competent in soil erosion control measures while 54.1 % and 54.3 % were competent in crop rotation and animal manure respectively. About 5.5 % of the sampled farmers was not competent in mineral fertilizers and combined organic and inorganic fertilizers. A higher percentage (46.2 %) of the extension agents were moderately competent in compost knowledge. Extension agents were most competent in soil erosion control measures with mean score of 3.5 but were least competent in knowledge on green manure with mean score of 2.9 (Table 11).

Table 10: *Relationship between age and education levels of extension agents in central Kenya.*

Age categories	*Education levels*					
	Certificate	*Diploma*	*Higher Diploma*	*Degree*	*Masters*	*Total*
20–30 years	0(0)	1(33.3)	0(0)	2(66.7)	0(0)	3(100)
31–40 years	1(8.3)	3(25.0)	1(8.3)	5(41.7)	2(16.7)	12(100)
41–50 years	26(46.4)	24(42.9)	0(0)	5(8.9)	1(1.8)	56(100)
51–60 years	30(88.2)	3(8.8)	0(0)	1(2.9)	0(0)	34(100)
Total	57(54.3)	31(29.5)	1(1.0)	13(12.4)	3(2.9)	105(100)

χ^2=58.038, df=12, P=0.001

Table 11: *Level of competency on soil fertility management practices by extension agents in Central Kenya.*

Level of Competency on SFM	*Not competent*	*Least competent*	*Moderately competent*	*Competent*	*Mean*	*Std. Deviation*
Erosion control measures	0(0)	7(7.1)	35(35.7)	56(57.1)	3.5	0.62
Crop rotation	0(0)	12(12.2)	33(33.7)	53(54.1)	3.4	0.71
Animal manure	1(1.1)	10(10.6)	32(34.0)	51(54.3)	3.4	0.7
Mineral fertilizers	5(5.5)	10(11.0)	30(33.0)	46(50.5)	3.3	0.93
Cover crops	3(3.1)	12(12.5)	44(45.8)	37(38.5)	3.2	0.86
Legumes	2(2.2)	16(18.0)	38(42.7)	33(37.1)	3.1	0.83
Compost	3(3.2)	14(15.1)	43(46.2)	33(35.5)	3.1	0.81
Combined organic & inorganic fertilizers	5(5.5)	13(14.3)	41(45.1)	32(35.2)	3.1	0.8
Green manure	9(11.4)	13(16.5)	33(41.8)	24(30.4)	2.9	1.02

n=105, N.B: Values in parentheses give the percentage of respondents

3.11 Relationship between characteristics of extension agents and competency in soil fertility management practices

Demographic factors influence the competency of extension agents on soil fertility management practices. Education was significantly and positively correlated with competency on mineral fertilizers. This implied that the more educated the extension agent, the more competent they were on mineral fertilizers. There was a significant positive relationship between years of experience and competency on green manure, compost and combined organic and inorganic fertilizers. This suggests that the more experienced the extension agents, the more competent they were on green manure, compost and combined organic and inorganic fertilizers. Gender was significantly and negatively correlated with competency on animal manure and combined organic and inorganic fertilizers. This implied that female extension agents were not as competent as male extension agents on animal manure and combined organic and inorganic fertilizers (Table 12).

3.12 Factors that determine accessibility of information sources

There was a positive significant relationship between gender and accessibility of research institutions as a source of information on green manure at the 0.05 probability level. This implies that female extension agents perceived research institutions as more accessible than men. Accessibility of the internet had a significant negative relationship with age (r=–0.345, P≤0.001), education level (r=0.368, P≤0.001) and years of experience (r=–0.344, P≤0.01) (Table 13). This implies that the older the extension agent, the lesser the accessibility of internet as a source of information on green manure.

Table 12: *Corelations between socio–demographic characteristics of extension agent's and competency on soil fertility management practices in Central Kenya.*

SFM practice	*Socio-demographic factors*			
	Age	*Gender*	*Education*	*Years of experience*
Mineral fertilizer	–0.07	–0.14	0.24 *	0.05
Animal manure	–0.10	–0.22 *	0.17	–0.01
Green manure	0.05	–0.14	0.07	0.27 *
Compost	–0.03	–0.18	0.18	0.22 *
Combined organic &inorganic fertilizers	0.05	–0.27 **	0.26 **	0.27 **
Cover crops	–0.13	0.03	0.08	0.08
Legumes	–0.10	–0.02	0.04	0.08
Crop rotation	0.001	–0.02	0.08	0.04
SEM	0.001	–0.17	0.18	0.10

n=105, * significant P=0.05, ** significant P=0.01

Table 13: *Relationship between sources of information on green manure and social–demographic factors of extension agent in Central Kenya.*

Source of information	*Socio-demographic factors*			
	Age	*Gender*	*Education*	*Years of experience*
Books	–0.054	0.091	0.130	–0.134
Research institution	–0.168	0.193 *	0.213 *	–0.178 *
Internet	–0.345 ***	0.071	0.368 ***	–0.344 **
Scientific conferences	–0.187 *	–0.132	0.231 *	0.049
Newsletters / Brochures	–0.185 *	0.006	0.173	–0.088

n=105, * significant P=0.05, ** significant P=0.01, *** significant P=0.001

4 Discussion

The majority of household heads had accessed education up to primary level in both Mbeere South (60.8 %) and Maara (58.5 %) districts. Schooling may boost the aptitude of farmers to acquire, process and analyse information disseminated by different sources.

This helps the farmer to make appropriate decisions through reading and analyzing in a better way. In his study, Katungi *et al.* (2006) revealed that educated farmers have greater access to information than uneducated farmers. According to Akinbile (2003), the more literate farmers are, the more they comprehend technologies. There was a significant relationship between possession of title deeds and education, where farmers who were more educated possessed title deeds more than less educated farmers. Insecurity of tenure can be a barrier to increased productivity, diminishing farmer's incentives to sustain resource use over time, thus reduce motivation to seek information on soil fertility management practices.

Nearly all the farmers from Maara and Mbeere South possessed radios, while less educated farmers were less likely to possess a television set. Gloy *et al.* (2000) found that mass media sources were useful in dissemination of agricultural technologies to farmers. Thus the information on ownership of these communication appliances is an important consideration in the use of communication channels to reach the prospective clientele. The majority of farmers preferred information to be presented in vernacular, Kiswahili, then English in a decreasing order. This implies that local language would be the best language to use in communication of soil fertility technologies as it will be understood by farmers across all the education levels. This agrees with previous studies by Oladoja *et al.* (2008) who recommended the use of local language by the change agent in order to communicate with farmers more effectively.

The majority of farmers strongly preferred individual farmer interactions, however there was significant correlation between education level and preference for individual farmer interactions. This implies educated farmers would like to be visited in their own individual farms or be given individual attention by the extension agents. The results agree with the findings of Bukenya *et al.* (2008) that more educated farmers are often more reluctant to learn with other farmers or in groups.

The key to effective teaching and successful extension delivery of soil fertility management practices lies with the competency of extension agents on soil fertility management practices. Extension agents were more competent on soil erosion control measures while they were least competent on green manure. The results also indicated that there was a positive but significant correlation between education and competency in usage of mineral fertilizers and combination of organic and inorganic fertilizers. This implies that the more educated the extension agents the more competent they were in usage of mineral fertilizers and combinations of organic and inorganic fertilizers. It is thus imperative that more information on mineral fertilizers and combinations of organic and inorganic fertilizers have to be made available to the extension agents for ultimate transfer to farmers, especially the certificate holders. Anderson (2008) explained that extension has a dual function in bridging blocked channels between scientists and farmers. It also has an important role to play in helping the research establishment tailor technology to the agro ecological and resource circumstances of farmers.

Based on these research findings, age, education and years of experience influenced the accessibility of information sources on green manure. Educational qualification showed a significant positive relationship with accessibility of the internet. This agrees with Adesope *et al.* (2007) who reported that educational qualification showed significant positive relationship with information technology. Zhang (2005) found that efficient usage of the internet is proportional to age, gender, and level of education. Similarly, Madadi *et al.* (2011) concluded that the level of usage of ICT had a positive and meaningful relationship with educational levels of farmers. This implies that more educated extension agents are more competent with computer technology and thus can easily access internet for information.

5 Conclusions

The findings from this study show that the education is quantitatively important in predicting the dissemination of soil fertility management information. Use of local language in communication of soil fertility technologies in the central highlands of Kenya may have a large impact on access and use of soil information. Further, in order to create awareness of the technologies to a wide range of farmers, radio may be more useful than other electronic appliances in up scaling soil fertility technologies especially in large-scale awareness creation. In addition, extension agents should increase their contact with farmers, especially with the more educated farmers. There is a need to improve access of the internet by extension agents as this will provide more recent and updated information on soil fertility technologies and facilitate dialogue and feedback to researchers. Nonetheless, agricultural extension agents should encourage smallholder farmers to use mass media as this is the most important vehicle to get the technologies right into the need of the grass-root people. However, a study should be conducted to investigate the perceived needs of farmers to effectively communicate soil fertility management information using mass media. Further research is essential to assess how other socio economic factors influence the preference of channels used in communication of soil fertility management information. Additional studies should also be conducted to further review the computer literacy of extension agents so as to understand their accessibility to internet information. The implication of the results in this case study is that agricultural stakeholders should consider education levels of the target audience in choosing the language, methodology and media for effective dissemination of soil fertility management information. Improved access to information is envisaged to increase adoption of soil fertility management practices which will consequently lead to increased crop production and contribute to reduction of extreme poverty.

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References

Adesope, O. M., Asiabaka, C. C. & Agumagu, A. C. (2007). Effect of personal characteristics of extension managers and supervisors on information tech-

nology needs in the Niger Delta area of Nigeria. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 3 (2), 4–15.

Ajayi, M. T. & Oloruntoba, A. (2004). Farmers' Adoption and Perception of major Agricultural Technologies Developed by International Institute of Tropical Agriculture (IITA). *Journal of Scientific and Industrial Studies*, 2, 14–18.

Akinbile, L. A. (2003). Farmers perception of effectiveness of Fisheries Extension Services in Nigeria. *Journal of Extension Systems*, 19 (1), 32–34.

Anderson, J. R. (2008). Agricultural Advisory Services, A background paper for "Innovating through science and technology". Agriculture and Rural Development Department, World Bank, Washington, DC.

Basu, K., Narayan, A. & Ravallion, M. (2002). Is literacy shared within households? Theory and evidence for bangladesh. *Labour Economics*, 8 (6), 649–665.

Bationo, A., Mokwunye, U., Vlek, P. L., Koala, S. & Shapiro, I. (2003). Soil fertility management for sustainable land use in the West African Sudano-Sahelian zone. In *Grain Legumes and Green Manures for Soil Fertility in Southern Africa: Taking Stock of Progress. Proceedings of a Conference (8–11 October, 2002), Leopard Rock Hotel, Vumba, Zimbabwe* (pp. 253–292). Soil fertility Network and CIMMYT, Harare, Zimbabwe.

Bukenya, M., Bbale, W. & Buyinza, M. (2008). Assessment of the Effectiveness of individual and group extension methods: A case study of Vi-Agroforestry Project in Uganda. *Research Journals of Applied Sciences*, 3 (3), 250–256.

Damisa, M. A. & Igonoh, E. (2007). An Evaluation of the Adoption of Integrated Soil Fertility Management Practices among Women Farmers in Danja, Nigeria. *Journal of Agricultural Education and Extension*, 13 (2), 107–116.

Gloy, B. A., Akridge, J. A. & Whipker, L. D. (2000). Sources of information for commercial farms: usefulness of media and personal sources. *International Food and Agribusiness Management Review*, 3, 245–260.

Huffman, W. E. (2000). Human Capital, Education, and Agriculture. Paper for Plenary Session III 24 International Congress of Agricultural Economist Berlin, Germany August 13-18.

Jaetzold, R., Schmidt, H., Hornetz, B. & Shisanya, C. (2006). *Farm Management Handbook of Kenya. Natural Conditions and Farm Information. 2nd Edition. Vol. II, Part C, East Kenya. Subpart C1, Eastern Province*. Ministry of Agriculture/GTZ, Nairobi, Kenya.

Katungi, E., Emeades, S. & Smale, M. (2006). Gender, social capital and information exchange in rural Uganda. CAPRi Working Paper 59. Washington, DC: CGIAR Systemwide Program on Collective Action and Property Rights.

Knight, J., Weir, S. & Woldehanna, T. (2003). The role of education in facilitating risk-taking and innovation in agriculture. *Journal of Development Studies*, 39 (6), 1–22.

Madadi, Y., Iravani, H. & Nooghabi, S. N. (2011). Factors effective on Familiarity and Usage of Information and Communication Technology (ICT), University College of Agriculture and Natural Resources, University of Tehran, Iran. *Procedia - Social and Behavioral Sciences*, 15, 3625–3632.

Oladoja, M. A., Adeokun, O. A. & Fapojuwo, O. E. (2008). Determining the Social Economic Factors Affecting Farmer's Use of Communication Methods for Information Sourcing in Oluyole Local Government Area of Oyo State, Nigeria. *Pakistan Journal of Social Sciences*, 5 (1), 51–56.

Place, F., Barrett, C. B., Freeman, H. A., Ramisch, J. J. & Vanlauwe, B. (2003). Prospects for integrated soil fertility management using organic and inorganic inputs: evidence from smallholder African agricultural systems. *Food Policy*, 28, 365–378.

Schultz, P. (2005). Productive Benefits of Improving Health: Evidence from Low Income Countries. Yale University. Econonomic Growth Center discussion paper 903.

Sulaiman, F. (2002). Communication Approach for Agricultural Agro-Ecosystem Zones: A Case Study in South Sumatra Province. *Indonesian Journal of Agricultural Science*, 3 (2), 43–51.

Taley, S. M. & Khadase, V. A. (2006). Communication Behaviour Attributed by the Farmers in the Adoption of Micro Irrigation Systems. Presented in the 7th International Micro Irrigation Congress Sept 10-16 2006 PWTC, Kuala Lumpur.

Uematsu, H. & Mishra, A. K. (2010). Net Effect of Education on Technology Adoption by U. S. Farmers. Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Orlando, FL, February 6-9, 2010.

Zhang, Y. (2005). Age, gender, and Internet attitudes among employees in the business world. *Computers in Human Behavior*, 21 (1), 1–10.