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Findings from a survey in Western Kenya to determine the soil fertility replenishment technologies adoption rates

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Abstract

A survey on adoption levels of the existing soil nitrogen replenishing technologies amongst farmers in three counties in western Kenya was carried out in June 2011. Three farmer associations were Angurai Farmers Development Project (AFDEP), Bungoma Small-Scale Farmers Forum (BUSSFFO) and Mwangaza Farmer Group (MFAGRO). During the survey 223 farmers were interviewed with roughly a half of the households surveyed being members of farmer associations (FAs) and the other half being non-members, who acted as the control. Stratified random sampling technique was used. A repeated measures Analysis of Variance (RM – ANOVA) showed that various soil nitrogen replenishment technologies were adopted to various degrees, $F(4.39, 855.43) = 23.36$, $p<.001$). The findings of this study indicated that the available technologies most extensively used in the study area were the use of inorganic fertilisers (DAP), planting of improved legumes processing, Lab lab, Push Pull, and Super 2 Package. In second place, were technologies such as seed inoculation, foliar feed use, top dressing fertiliser (CAN) and use of improved legumes. The least used technologies were found to be Ua Kayongo (IR seed), MBILI intercropping, fortified compost, and use of Farm yard manure and liming. The results also indicated that generally, adoption of technologies was higher amongst farmer association members compared with non-members regardless of the county. Bungoma County had significantly highest level of technology adoption level compared to both Busia and Vihiga. Adoption of soil technologies was also found to be positively correlated with farmers' educational level but inversely related with their age.

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Introduction

The importance of agriculture to Kenya cannot be gainsaid, as it accounts for 65 per cent of Kenya's total exports and supports, directly or indirectly, the livelihoods of 80% percent of the Kenyan population, which live in rural areas (Government of Kenya, 2010). However, it faces a host of challenges. The decline of soil fertility, limited availability of resources to farmers, nutrient mining, and frequent drought in smallholder farming systems of western Kenya in particular and sub-Saharan Africa in general, are the greatest biophysical constraints to increased agricultural productivity and a major threat to food security (McClann, 2005; Kiptot, 2008; Sanchez *et al.*, 2009). According to the World Bank (2007), an estimated 75% of farmland in Sub Saharan Africa (SSA) is severely depleted of soil nutrients. On the other hand, Nandwa (2003) suggested a duality of causes responsible for the declining food production in Africa: land degradation manifested by soil fertility depletion especially in smallholder farming sector and a lack of an enabling socio-economic environment such as limited or access to credit facilities, inputs and implementation, markets and extension information.

Soil fertility depletion through intensive cropping, soil erosion, leaching, denitrification and volatilization, has been cited as a major cause of depressed agricultural productivity in Western Kenya (Obura *et al.*, 1999; Smaling *et al.*, 1997). To improve crop yields in Western Kenya's farmlands, it is therefore germane to adopt technologies that replenish crucial soil elements, particularly nitrogen (N) and phosphorus (P), that are often limiting in many agricultural systems (Okalebo *et al.*, 2006). Several technologies are available, such as, use of organic and inorganic fertilisers, soil erosion control measures, minimum tillage, and improved germplasm, combined with the knowledge on how to adapt these practices to local conditions, which aim at maximizing agronomic use efficiency of the applied nutrients and improving crop productivity. All these inputs need to be managed in accordance with sound agronomic principles (Vanlauwe *et al.*, 2010). Table 1 presents a summary of some of the most pertinent technologies.

Table 1. Soil fertility replenishment technologies.

Soil fertility technology	Potential impact on soil
1. Use of diammonium phosphate (DAP)	Provides both N and P, increasing this often limiting nutrients, but expensive and increase soil acidity (Nkamleu, 2007)
2. Grain legume processing	A value addition process that leads to planting of more legumes, increasing soil fertility
3. Lab lab relay cropping	Intercrops with the second planted after the first has reached physiological maturity (Smaling *et al.*, 1997).
4. Push pull	A strategy to control pests by using repellent "push" and trap "pull" plants (Smaling *et al.*, 1997).
5. Seed inoculation	Coating of planting seeds with bacteria to improve nitrogen fixation by legumes (Sanginga and Woomer, 2009).
6. Foliar feed use	Application of nutrients to plants directly through foliage
7. Top dressing fertiliser	A nitrogenous fertiliser to boost crop growth
8. Ua Kayongo	Maize variety resistant to striga weed (Vanlauwe *et al*, 2010).
9. MBILI	Acronym for 'Managing Beneficial Interactions in Legume Intercrops" uses double rows of each crop
10. Fortified compost	Adding deficient nutrients in composts
11. Liming	Additives that reduces acidity of the soil

However, adoption of these technologies among smallholder farmers is often low and unsustainable (Dar and Twomlow, 2007). Several explanatory factors have been suggested. Lack of awareness of the technologies is one of the factors contributing to low adoption and is exacerbated by the wide communication gaps between researchers and farmers (Odendo *et al.*, 2006). Education level has also been mentioned as one of the factors significantly influencing access to integrated soil fertility management practices (ISFM) information and knowledge and its subsequent adoption (Marenya and Barrett, 2007; Sanginga and Woomer, 2009). Farmers' age has been found to increase as well as decrease the probability of adoption. On the other hand, group membership speeds up technology adoption by enabling farmers to learn about a technology via other farmers and from other development agencies (Nkamleu, 2007). In addition, farmer groups and farmer field schools foster solidarity and shore up in-group morale (Ramisch *et al*., 2006).

Sub optimal levels of N, P, and organic matter and high soil acidity characterise the highly weathered and leached soils in the croplands of Western Kenya. Although there is a multitude of soil types in Western Kenya, Acrisols (Ultisols: US Soil Taxonomy), Nitisols and Ferralsols (Oxisols: US Soil Taxonomy) are the most dominant (Jaetzold *et al*., 2006). Since the soils differ in their physical and chemical properties, it is essential to consider the prevailing heterogeneity in soil conditions that could possibly influence the effectiveness of applied technologies in the region. Sileshi *et al.* (2010) stated that specific agricultural technology could improve the site-specific targeting of technology options in heterogeneous farming environments, thus increasing technology adoption by farmers. The factors responsible for and the scope to which soil fertility replenishment technologies in Western Kenya have been adopted have not been well investigated.

The objective of this study was to evaluate adoption status of the available soil fertility replenishment technologies amongst farmers in Bungoma, Busia and Vihiga Counties.

Materials and methods

Description of Study Sites

The study was carried out in three areas in western region of Kenya: Bungoma south sub county in Bungoma County (henceforth referred to as Bungoma), Teso sub county situated within Busia County (hence referred to as Teso), and Vihiga Sub county in Vihiga County (henceforth called Vihiga). The region, located west of the Eastern Rift Valley, lies between coordinates 0^o 30' North and 34^o 35' East. The altitude ranges from 2000m above sea level around Mount Elgon to 1300m in Busia. Rainfall distribution in the region is bimodal, ranging from 1000mm to 2000mm. While soils in Bungoma are a variety of nitisols, ferralsols and acrisols, they are mainly the last two in Busia whereas Vihiga has chiefly dystric acrisols and humic nitisols.

Sampling Method

This study used a descriptive survey design, which enabled it to obtain requisite information from a large segment of small-holder farmers over a short period. The target population was 996 farmers (498 members of farmer associations and a similar number of neighbouring non-members). The farmer associations were Angurai Farmers Development Project in Teso, Bungoma Small-Scale Farmers Forum in Bungoma, and Mwangaza Farmers Group in Vihiga. With respect to counties, the target population was 418, 359, and 219, farmers from Bungoma, Vihiga, and Teso, respectively. Sampling both members and non-members of farmer associations was relevant to enable comparison of the rates of adoption of technologies between the two groups. This study collected data from 223 farmers, according to the formula and correction for sampling from small population outlined in (Noordzij *et al.*, 2010; Kothari, 2004). Stratified random sampling was used to select the 223 respondents. To ensure a proportionate representation of all farmers in the three study areas, the sample contributed by each county was weighted according to farmers' target population in the county. Accordingly, 94, 80, and 49 farmers were selected from Bungoma, Vihiga and Teso, respectively. Sampling frames of all the farmers in the three study sites were obtained from their respective area chiefs' offices and used to select farmers for the study using simple random sampling, which was accomplished with the help of a table of random numbers. However, one leader from each of the farmer associations was included purposively in the study, in order to obtain their insights' about the study questions.

Field Study and Data Collection

Field study was conducted in June of 2011. Data was collected using structured interviews, administered by the researcher and three trained enumerators. The level of adoption of soil replenishment technologies ranged on a scale of 1 (representing zero adoption) to a scale of 3 (denoting maximal adoption).

Data Analysis

Descriptive statistics, for instance, frequencies and means were used to describe, summarize, and organize the data. A Repeated Measures - Analysis of Variance (RM – ANOVA) was conducted to determine whether farmers adopted the various soil fertility technologies to the same degree. On the other hand, multivariate – ANOVA was used to establish whether farmers' gender, age, education level, county of residence and membership to farmer association influenced the level of use of the technologies. Multiple comparisons amongst pairs of means were carried out by Bonferroni tests.

Results

Sample Household Characteristics

The household characteristics of the farmers investigated in the study are presented in Table 2. Of the 223 farmers investigated in this study, 131 (59%) belonged to farmers' associations whereas the rest did not. Proportion of farmers belonging to farmer associations was found to be similar in the three study sites ($\chi^2 = 5.06$, df=2, p=0.08).

Table 2. Sample household characteristics of members and non-member farmers in Western Province.

Characteristics	Non-members	Members	Average	χ^2 or t-value
Number (%)	92 (41.3)	131 (58.7)	223 (100)	
County of Residence				5.06
(1) Bungoma	31 (34.1)	60 (65.9)	91 (40.8)	
(2) Teso	19 (38.8)	30 (61.2)	49 (22.0)	
(3) Vihiga	42 (50.6)	41 (49.4)	83 (37.2)	
Respondents' gender (%)				57.58**
(1) Male	69 (75.0)	31 (23.7)	100 (44.8)	
(2) Female	23 (25.0)	100 (76.3)	123 (55.2)	
Mean age of household head (years)	53.15	51.08	52.05	2.08*
Farmer education				9.34*
(1)Farmers with no formal education	14 (16.1)	10 (10.3)	24 (13.1)	
(2) Farmers with primary education	55 (63.2)	58 (59.8)	113 (61.4)	
(3)Farmers with secondary or post-secondary education	18 (20.7)	29 (29.9)	47 (25.5)	
Mean farm size (acres)				
Households with title to land (%)	2.02	3.13	2.63	-3.06**
Households with off-farm income (%)	32 (34.8)	41 (31.3)	73 (32.7)	0.30
	34 (37.8)	51 (39.5)	85 (38.8)	0.069

Key: **, * Significant at one and five percent levels of probability, respectively. Values in parentheses are percentages.

The study found that membership to a farmer association was influenced by the farmer's gender (χ^2=57.58, df=1, p<.0001), with farmer associations likely to have predominantly female members (76%) compared to male members (24%). On the average, the study sampled slightly more female farmers (55%) relative to male (45%) farmers, because of the prevalence of the former in farmer associations.

Non-members were found to be significantly (t=2.09, df=183, p=0.038) older (mean age, 53.15 years) compared to members of farmer organisations (mean age, 51.08). The average age of a farmer in the three counties was 52 years, suggesting that fewer youth could be involved in farming. Members were also found to be better educated (30% had secondary or post-secondary education and 10% had no formal education) relative to non-members (21% had secondary or post-secondary while 16% had no formal education). However, majority of the farmers in the study had primary school level education (61.4%).

Generally, the study showed that farm sizes were significantly greater (t= -3.062, df=161.21, p=0.003) among members of farmer associations (mean, 3.13 acres) compared to non-members (mean acreage, 2.02 acres). However, farm sizes amongst the farmers in the study were quite small, averaging only about 2.63 acres. Very few farmers in the three counties (32.7%) possessed title deeds to their farms. Ownership of title deeds did not significantly differ (χ^2=0.298, df=1, p=0.585) between members (31.3%) and non-members (34.8%). Most households in the three counties relied on farming as their main source of income, with only 38.8% of the households having off-farm incomes.

Available Soil Fertility Replenishment Technologies

The survey recorded a variety of technologies, which contribute, directly or indirectly, to soil fertility in the study area. These included IR maize (Ua Koyongo) in the prevalent striga weed in the region, MBILI intercropping, use of inorganic fertilisers, such as, DAP, Fortified Compost, Push Pull technologies, Lab Lab relay fallow, and Super 2 Package. Others were use of Improved Legume and Grain processing tools, Seed inoculation, top dressing fertiliser technologies, use of Lime, and the use of Farmyard Manure, soil erosion control measures, retention of crop residues *in situ*, minimum tillage (conservation agriculture practices).

Level of Adoption of Available Technologies Amongst Farmers

The level of adoption of available technologies that had been tested over time by various researchers amongst farmers in the study area is presented in Table 3. The mean levels for the adoption ranged from 1.59 for liming to 2.35 for DAP ratings. Since none of the fertility technology mean was one or three, it implied that although farmers in the area practiced all the technologies, their use was not absolute. Results from ANOVA indicated that, overall, farmers in the study area had different rates of adopting the soil fertility technologies (F (4.39, 855.43) =23.36, $p<.001$). The Post hoc results are presented on Table 3 and Fig. 1. The study found that the most extensively used technologies were the use of inorganic fertilisers, for instance, DAP, grain legume processing, Lab lab, Push Pull, and Super 2 Package. In second place, were technologies such as seed inoculation, foliar feed use, Top dressing fertiliser and use of improved legumes. The least used technologies were found to be Ua Kayongo, MBILI intercropping, fortified compost, and use of Farmyard manure and liming.

Table 3. Adoption of available soil fertility technologies in the study area.

Technology (n=223)	Minimum rating	Maximum rating	Mean rating	Std. Dev.
1.Ua kayongo	1	3	1.96^a	.963
2.MBILI production	1	3	1.79^a	.923
3.Lime use	1	3	1.59^a	.872
4.Top dressing (N)	1	3	2.08^b	.926
5.Push pull	1	3	2.33^c	.896
6.Lab lab relay fallow	1	3	2.35^c	.882
7.Super 2 package	1	3	2.32^c	.905
8.Improved legume varieties	1	3	2.01^b	.941
9.Grain legume processing tools	1	3	2.35^c	.871
10.Seed inoculation	1	3	2.16^b	.940
11.Fortified compost	1	3	1.76^a	.929
12.DAP	1	3	2.35^c	.892
13.Foliar feed use	1	3	2.12^b	.939
14.Farmyard manure use	1	3	1.63^a	.871

Key: Std. Dev.=standard deviation. Means with similar letters in a column are not significantly different by the Bonferroni Test.

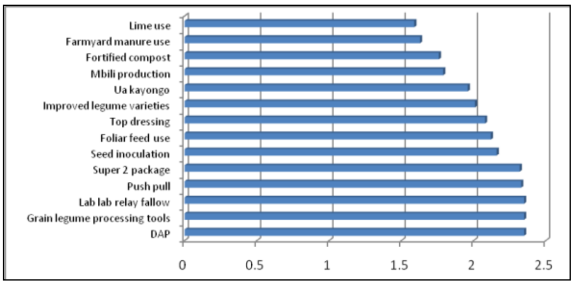

Fig. 1. Adoption of technologies, arranged from the least used to the most used.

Factors Affecting Adoption of Technologies

Multivariate – ANOVA was used to determine whether farmers' gender, age, education level, county of residence and membership to farmer association influenced the level of use of the technologies. Membership to farmer association significantly affected the adoption of eight out of 13 technologies, namely, Ua Kayongo, MBILI production, Push Pull, and Lab lab. Others were Super 2 Package, Improved legume varieties, Seed inoculation, and DAP (Table 4). The results indicated that generally, adoption of technologies was higher amongst members compared with non-members in all the counties. For instance, more members used Push pull, Lab Lab, Super 2 Package, Improved legume varieties, Ua Kayongo, MBILI production, Seed inoculation and DAP technologies compared to non-members.

Residency in a county significantly affected the adoption of all the technologies (Table 4). The results indicated that overall, Bungoma had significantly higher rates of technology adoption compared to both Teso and Vihiga. For instance, significantly more farmers in Bungoma used Top dressing fertiliser, Push pull, Lablab, Super 2 package, Improved legumes, Grain legume processing, Fortified compost, DAP, Foliar feed and Farm yard manure relative to those in Teso and Vihiga. Significantly more farmers in both Bungoma and Teso counties also embraced seed inoculation compared to Vihiga farmers. On the other hand, significantly more farmers in Teso and Vihiga compared with Bungoma adopted Ua Kayongo and MBILI production. Except for top dressing, the respondent's gender did not significantly influence the adoption of the technologies (Table 5). More male than female farmers were found to use top dressing technology. The level of education was found to be a strong antecedent for the use of technologies, significantly influencing the adoption of all the techniques (Table 5). More farmers with secondary or tertiary level education adopted all soil replenishment technologies relative to those with primary or no education. On the hand, adoption rates for Ua Kayongo, MBILI, liming, top dressing, super 2 package, improved legume varieties, seed inoculation, and DAP were higher among farmers with primary education compared to those with none. Farmers aged less than 40 years used more Push pull, Lab lab, super 2 package, fortified compost and foliar technologies in comparison with those over 40 years, suggesting that younger rather than older farmers are more likely to embrace soil technologies (Table 5).

Table 4. Effect of county and membership to farmer association on adoption of soil technologies.

Treatment	UK	MBILI	Lime	TD	PU	LA	SUPER	IL	LP	SI	COMP	DAP	Foliar
Member in FA													
Member	2.1	1.9	1.6	2.1	2.5	2.4	2.4	2.1	2.4	2.4	1.7	2.5	2.2
Non-member	1.8	1.6	1.6	2.1	2.2	2.2	2.2	1.9	2.3	1.9	1.8	2.3	2.1
F-value	7.64^{**}	9.45^{**}	2.21	.006	6.52^{*}	5.28^{*}	7.02^{**}	4.77^{*}	0.76	16.9^{**}	0.94	5.54^{*}	1.42
County													
Bungoma	1.64^{a}	1.45^{a}	1.84^{a}	2.40^{a}	2.60^{a}	2.74^{a}	2.74^{a}	2.39^{a}	2.61^{a}	2.49^{a}	2.03^{a}	2.68^{a}	2.35^{a}
Vihiga	2.23^{b}	1.97^{b}	1.36^{b}	1.85^{b}	2.21^{b}	2.19^{b}	2.03^{b}	1.67^{b}	2.22^{b}	1.87^{b}	1.59^{b}	2.13^{b}	2.05^{b}
Teso	2.12^{b}	2.05^{b}	1.59^{a}	1.90^{b}	2.07^{b}	1.90^{b}	2.10^{b}	1.95^{b}	2.07^{b}	2.10^{a}	1.56^{b}	2.15^{b}	1.83^{b}
F-value	9.35^{**}	9.01^{**}	9.23^{**}	4.81^{**}	6.13^{**}	15.5^{**}	15.3^{**}	12.9^{**}	6.34^{**}	11.1^{**}	7.26^{**}	5.45^{**}	4.1^{*}

KEY: UK Ua Kayongo; TD Top dressing; PU Push pull; LA lab lab; SUPER Super 2package; IL Improved legumes; LP legume processing; SI Seed inoculation; COMP Fortified compost; FA Farmer association. **, * Significant at one and five percent levels of probability, respectively. Means with similar letters in a column are not significantly different by the Bonferroni Test ($p<0.05$).

Table 5. Effect of farmer characteristics on adoption of soil technologies.

Treatment	UK	MBILI	Lime	TD	PU	LA	SUPER	IL	LP	SI	COMP	DAP	Foliar
Gender													
Female	1.94	2.16	1.73	2.17	1.75	1.72	1.75	1.99	1.65	1.96	1.94	2.38	1.89
Male	2.2	2.27	1.55	2.33	1.56	1.58	1.59	1.98	1.65	1.67	1.89	2.44	1.86
F-value	0.69	0.06	0.24	5.17^{*}	0.12	0.01	0.03	1.09	1.27	1.16	0.36	2.16	0.78
Education													
None	1.55^{a}	1.63^{a}	1.15^{a}	1.70^{a}	1.24^{a}	1.24^{a}	1.22^{a}	1.41^{a}	1.28^{a}	1.26^{a}	1.52^{a}	1.93^{a}	1.41^{a}
Primary	2.00^{b}	2.31^{b}	1.60^{b}	2.27^{b}	1.54^{a}	1.56^{a}	1.64^{b}	2.06^{b}	1.62^{a}	1.82^{b}	1.87^{a}	2.42^{b}	1.81^{a}
Secondary or t	2.70^{c}	2.72^{c}	2.17^{c}	2.65^{b}	2.29^{c}	2.23^{b}	2.13^{c}	2.38^{b}	2.08^{b}	2.37^{c}	2.35^{c}	2.79^{c}	2.44^{b}
F-value	19.3^{**}	20.0^{**}	18.8^{**}	16.0^{**}	26.2^{**}	22.2^{**}	14.7^{**}	16.5^{**}	10.7^{**}	18.3^{**}	12.6^{**}	14.0^{**}	18.7^{**}
Age													
< 40 years	1.67	1.33^{a}	1.67	2.67	2.00^{a}	2.00^{a}	2.33^{a}	2.33	2.33	2.33	2.67^{a}	2.33	2.67^{a}
40 – 50 years	2.02	2.21^{b}	1.67	2.23	1.61^{b}	1.60^{b}	1.56^{b}	1.87	1.66	1.77	1.79^{b}	2.39	1.84^{b}
Over 50 years	2.07	2.24^{b}	1.64	2.22	1.68^{b}	1.67^{b}	1.70^{b}	2.02	1.62	1.84	1.94^{b}	2.41	1.87^{b}
F-value	0.82	3.11^{*}	2.04	1.12	6.14^{**}	4.30^{*}	4.56^{*}	2.44	1.78	1.87	5.58^{**}	1.08	3.67^{*}

KEY: UK Ua Kayongo; TD Top dressing; PU Push pull; LA lab lab; SUPER Super 2package; IL Improved legumes; LP legume processing; SI Seed inoculation; COMP Fortified compost; FA Farmer association. **, * Significant at one and five percent levels of probability, respectively. Means with similar letters in a column are not significantly different by the Bonferroni Test ($p<0.05$).

Discussion

Generally, adoption level of technologies was higher in members of farmer associations compared to non-members. This was in line with other studies, for instance, Odembo *et al.* (2010) and Kebeney *et al.* (2015), in which membership in groups accelerated the adoption of soil fertility technologies. Group membership speeds up technology adoption by enabling farmers to learn about a technology via other farmers and from other development agencies (Nkamleu, 2007). Ramisch *et al.* (2006) found that farmer groups are a popular source of knowledge as they foster solidarity and build in-group morale. In addition, farmers rely on information gained through interaction with peers i.e. their own experience before they make important decisions. Members in associations have the added advantage of buying inputs collectively at cheaper prices and this enhances technology adoption. Thus, group membership to FAs has potential that could be utilized for technology and information dissemination to enhance adoption because of their wider scope of operation. In that perspective, an extension officer is able to reach more farmers in a group than individual farmers at a given period.

The results indicated that overall, Bungoma County had significantly higher rates of technology adoption compared to both Busia and Vihiga counties. Different technologies address the needs of the soil differently in specific soils and productivity per unit area. Soil fertility technologies that lead to high yields have a higher rate of adoption (Sileshi *et al.*, 2010). This could have led to differences that occur in adoption of technologies counties. An example is Ua Kayongo that has higher adoption level in Busia and Vihiga because of higher infestation of *striga* due to low soil fertility than in Bungoma with higher soil fertility and lower *striga* infestation. In addition, membership of farmer associations was more extensive in Bungoma than in Vihiga or Teso. Given the beneficial effect of membership to farmer association with respect to adoption of soil management technologies, this could indirectly explain the higher adoption rates in Bungoma.

Overall, the respondent's gender did not significantly influence the adoption of the technologies. Odembo *et al.* (2010) have argued that gender *per se* might not heavily influence adoption of farm technologies. Rather, differences between men and women could arise from inherent resource inequities, in which women generally have lesser access to and control of critical resources, for instance, capital, land, labour, and information. For instance, this study found that the rate of adoption of top dressing technology (which involves the use of resource intensive nitrogenous fertiliser) is greater among males compared with females, suggesting that men might adopt resource intensive soil technologies more readily than female.

Education highly influenced adoption of technologies, with more literate farmers comparatively using more technologies. This finding was similar to that by Kebeney *et al.* (2015) and Odembo *et al.* (2010). The positive effect of education on adoption of soil technologies might be two-fold: by increasing the knowledge and understanding of farmers about the techniques and secondly, better educated farmers are likely to have more disposable incomes, which could be crucial in financing some of the resource intensive technologies, such as, grain legume processing, liming, and DAP.

The negative influence of age on adoption in the current study is consistent with the findings of Odera *et al.* (2000) in Kenya who found age to negatively influence adoption of soil fertility replenishment practices. As household heads grow older, their risk aversion increases and adapt less swiftly to new technologies. Increase in age also degrades the ability for the household head to participate in strenuous manual activities such as application of mineral fertilizers decline and this could reduce the speed of the adoption of labor-intensive technologies. Lastly, in this study, younger farmers belong to farmer associations, which have higher levels of technology adoption.

Conclusion

Farmer associations are one of the most popular and suitable means of communicating and disseminating soil fertility technology information and knowledge hence should continue to be promoted. From findings of this study, technology adoption was enhanced by FA membership. Farmers are able to collectively acquire inputs at reduced rates through associations. Also information dissemination by various service providers is faster in members in a group than non-members. Therefore, the number of FAs should be increased and strengthened and in order to boost uptake of soil fertility technologies. Special emphasis needs to be placed on farmer education and their wealth status. Educated farmers are likely to be better equipped to utilize alternative channels for faster and more efficient information and knowledge access. Since age has a negative influence on soil technology adoption, relevant institution should come up with policies on land resource use and ownership. This will lead to higher youth involvement in agriculture.

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