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Socioeconomic Factors Influencing Levels of Knowledge in Soil Fertility Management in the Central Highlands of Kenya

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Abstract: This study aimed to first assess knowledge levels of the farmers in the use of manure, fertilizer and combinations of manure and fertilizer and secondly to identify the socioeconomic factors influencing the levels of knowledge in the use of animal manure, inorganic fertilizers and combination of animal manure and inorganic fertilizers in Meru South, Maara and Mbeere South districts of the central highlands of Kenya. Data were collected from a random sample of 300 households through face to face interviews using an interview schedule. The data was analyzed using descriptive statistics and binary logistic regression model. Results showed that 75% and 73% of the respondents had high levels of knowledge in use of manure and fertilizers, respectively, while 43% of the respondents had moderate levels of knowledge in the use of manure + fertilizers. Age of the household head (HHH), training in the use of animal manure and group membership significantly influenced household levels of knowledge in use of animal manure. In regard to levels of knowledge on fertilizer use, group membership, age of the HHH and total farm size were important explanatory variables while gender of the HHH, household size, training on manure + fertilizers, group membership and total farm size were important in influencing the levels of knowledge in use of manure + fertilizers. The implication of these results is that training and belonging to a group enhances level of knowledge on soil fertility management and development, so workers should focus on these two aspects.

Key words: Group, animal manure, inorganic fertilizers, training, knowledge levels, gender.

1. Introduction

Declining soil fertility is a critical challenge and one of the major biophysical constraints affecting agricultural productivity and environmental welfare in Sub-Saharan Africa (SSA). Despite past research recommending soil fertility management options in SSA, few of the recommendations have been put into use by the targeted end users mainly due to low levels of knowledge and understanding about these technologies. For instance, improved animal manure, mineral fertilizers and combined use of animal manure and mineral fertilizers have been developed, demonstrated and found to immensely improve soil fertility status as well as crop yields [1-6].

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In the central highlands of Kenya, like other livestock-arable farming systems in SSA, animal manure is one of the most widely used organic inputs being used by approximately 80% of the households. Due to its increased use in agricultural production, it has been found to be limited in both quality and quantity [7]. Inorganic fertilizers have been found to be another way of counterbalancing the low soil fertility in the SSA. However, many studies have reported that the amounts applied by farmers are quite minimal to sufficiently supply the crops with adequate nutrients. This is because fertilizers are expensive and many farmers in SSA cannot afford them due to their low incomes even though they are easy to use [8, 9]. These factors such as lack of credit, delays in delivery, poor transport and marketing infrastructure have been identified to individually or jointly constrain the optimal use of fertilizers. The integration of mineral fertilizers with organics encompassing their judicious manipulation in achieving productive and sustainable agricultural systems (integrated soil fertility management (ISFM)), has been identified to improve the agronomic efficiency of the external inputs used, reduce the risks of acidification and provide a more balanced supply of nutrients [2]. Studies have identified that no single component of sustainable soil fertility management can stand on its own in meeting the requirements of sustainable soil fertility management.

However, as several research studies have indicated, the level of awareness and knowledge of these soil fertility technologies remains largely low leading to low utilization of these soil fertility technologies [10, 11]. Access to information and knowledge levels of farmers is influenced by several factors. According to training influencing farmers' knowledge [12] leading to increased agricultural production and income generation. In Western Kenya, Nambiro et al. [13] noted that farmers' membership to local groups was also associated with a positive and significant effect on access of information to demand-induced extension thus increasing their knowledge levels. Age of the household heads as well as their farming experiences were found to increase with an increase in age of the farmers [13]. Other demographic variables affecting knowledge levels are gender and age of household head. For example, gender of the household head was identified to influence the farmers' levels of knowledge on soil fertility technologies [14] in Southern Gour in Jordan while household size was a significant factor in explaining farmers' levels of knowledge on soil fertility technologies.

Most of the work involving soil fertility improvement has concentrated on testing soil fertility technologies and promoting use by farmers [7, 15]. However, levels of knowledge of various soil fertility technologies among the farmers remain largely unknown. In addition, socioeconomic factors influencing knowledge levels in the use of soil fertility technologies are useful in determining the level of technology adoption and utilization. Thus, this study was set out to assess first the levels of knowledge of farmers in use of soil fertility management and secondly to evaluate the socioeconomic factors influencing the smallholder farmers' levels of knowledge in use of soil fertility management (animal manure, inorganic fertilizers and animal manure + inorganic fertilizers) in the central highlands of Kenya.

2. Methods

2.1 Description of the Study Area

The study was carried out in Meru South, Maara District and Mbeere South Districts in the central highlands of Kenya. Meru South and Maara Districts lay in the upper zones-LH1, UM1, UM2, middle zones-UM3 and lower zones-LM3, LM4, LM5 [16] on the eastern slopes of Mount Kenya at an altitude that ranges from 600 m in the lower areas to 5,200 m above sea level at the peak of Mt. Kenya. They have an annual mean temperature of 20 °C and total annual rainfall ranging from 1,200 mm to 1,400 mm. The rainfall is bimodal with long rains (LR) from March to June and short rains (SR) from October to December. The soils are mainly humic Nitisols [16] which are deep, well weathered with moderate to high inherent fertility but this has declined over time with poor management. Meru South has a population density of 205 persons/km^2 while Maara District has a population density of 230 persons/km^2 [17]. Both districts majorly have smallholdings ranging from 0.1 ha to 2 ha with an average of 1.2 ha/household [17]. This has led to the exploitation of decreasingly productive lands and increasing soil erosion potential.

Mbeere South District lies in the lower midland 3, 4 and 5 (LM3, LM4 and LM5), upper midland 1, 2, 3 and 4 (UM1, UM2, UM3 and UM4), and inner lowland 5 (IL5) [16] at an altitude of approximately 500-1,200 m above sea level. It has an annual mean temperature ranging from 21.7 °C to 22.5 °C and average annual rainfall ranging from 700 mm to 900 mm. It has a population density of 105 persons/km^2 with an average farm size less than 5.0 ha/household [17]. The rainfall is bimodal with LR from mid March to June and SR from late October to December hence two cropping seasons per year. The soils are predominantly Ferralsols and Acrisols [16].

Mukuuni sub-location in Meru South District, Magumango sub-location in Maara District and Gachoka sub-location in Mbeere South District were purposively selected for the study. The study sample size was determined by sample size calculator software [18].

2.2 Methods of Data Collection

Sample sizes of 100 households were selected from each of the three districts at a confidence level of 95% and confidence interval of 9.8% forming a total sample size of 300 smallholder farmers. Prior to data collection, enumerators were trained and a pilot study was conducted to test the suitability of the farmers' interview schedule. The pilot study involved five farmers from each site that had been randomly selected. Results revealed that most farmers were aware of the use of animal manure and inorganic fertilizers separately and had little knowledge on the combined use of animal manure and inorganic fertilizers.

2.3 Data Analyses

After the interviews were completed, questionnaires were examined to ensure they were completed and consistently filled. The response questions were numerically coded and responses were stored in a database template using statistical package for social sciences (SPSS) computer software. Descriptive statistics such as frequency and percentages were used to summarize the data. Cross tabulations for categorical variables was used to test for association using Pearson chi-square statistics.

In testing the farmers' knowledge levels on soil fertility technologies, a five Likert scale analysis of 28 items test was used. Each construct was subjected to reliability measurement using Cronbach's alpha test. All the constructs had a Cronbach's alpha coefficient greater than 0.7 [19] and hence all the constructs were reliable for the knowledge research model. All the test items were examined and since the "Corrected Item-Total" correlations of all the items were above 0.50 [20]. The respondent's score on the final scale was obtained by summing up the weights and finding the averages of the alternatives the respondents checked. The assigned high scores indicate high levels of knowledge in soil fertility (animal manure, inorganic fertilizers and manure + fertilizers) while low scores indicate low levels of knowledge in soil fertility following [21, 22]. For perception on knowledge levels, positive statements were assigned scores as: strongly agree = 5, agree = 4, neither agree nor disagree = 3, disagree = 2, strongly disagree = 1.

Decision:

$$\frac{\sum f}{f} = \frac{5+4+3+2+1}{5} = \frac{15}{5} = 3$$

The mean of each application represented the overall mean knowledge levels of the study population per technology. A mean ≥ 3.0 was defined as positive while a mean < 3.0 was defined as negative. In order to dichotomize the levels of knowledge to be used in the logistic regression, mean knowledge value greater than or equal to 3 represented high knowledge levels while mean knowledge values less than 3 represented low knowledge levels. In order to obtain the descriptive statistics influencing the knowledge levels of the soil fertility technologies (animal manure, inorganic fertilizers and animal manure + inorganic fertilizers), the weighted means were transformed to whole numbers so that mean knowledge levels < 3 represented low levels of knowledge, those equal to 3 represented moderate levels of knowledge while those mean knowledge levels > 3 represented high levels of knowledge.

Logistic regression analysis was used to determine significant socioeconomic factors influencing the farmer's levels of knowledge in soil fertility technologies. The logistic regression was considered appropriate due to the dichotomous nature of the dependent variable, knowledge levels. A value of 0 was assigned if the farmer's knowledge level was low and a value of 1 if knowledge level was high giving the regression of non-linear form [23]. All variables were transformed, coded and included into the logistic regression model to determine which factors/variables significantly affected the knowledge levels in animal manure, inorganic fertilizers and a combination of animal manure and inorganic fertilizers (the soil fertility management technologies) (Table 1).

3. Results and Discussion

3.1 Results

3.1.1 Use of Soil Fertility Technology in Relation to Farmers' Levels of Knowledge

Use of animal manure: There was a significant relationship between use of animal manure and levels of knowledge in animal manure (χ^2 = 8.059, P = 0.018). Majority of the users (77%) had high levels of knowledge while minority of the users (3%) having low levels of knowledge in use of animal manure (Table 2). This implies that users of animal manure are likely to have higher levels of knowledge than the non users.

Use of inorganic fertilizers: There was no significant relationship between use of inorganic fertilizers and levels of knowledge in inorganic fertilizers (χ^2 = 0.345, P = 0.841). Majority (73%) of the farmers who used inorganic fertilizers had high levels of knowledge while only 2% of the farmers had low levels of knowledge in the use of inorganic fertilizers. For the farmers who did not use inorganic fertilizers, majority (69%) had high levels of knowledge while only 4% of the farmers had low levels of knowledge in use of inorganic fertilizers (Table 2). This implies that both the users and non users of inorganic fertilizers are adequately knowledgeable in use of inorganic fertilizers in the study area.

Use of animal manure + inorganic fertilizers: There was no significant relationship between use of manure + fertilizers (χ^2 = 3.408, P = 0.182). 46% of the farmers who used and 42% of those who did not use combined animal manure and inorganic fertilizers had moderate levels of knowledge (Table 2). This implies that both the users and non users of combined animal manure and inorganic fertilizers were not well equipped with adequate knowledge in combined use of animal manure and inorganic fertilizers in the study area thus the need for intensified training on the technology.

3.1.2 Socioeconomic Factors Influencing Knowledge Levels of Animal Manure Technology in the Central Highlands of Kenya

The results of the logistic model are presented in Table 3. The model was significant at P < 0.01 and correctly predicted knowledge levels of 75% of both users and non users in use of animal manure. Three variables: age of the household head, training in the use of animal manure and group membership were significant in explaining the knowledge levels in the use of animal manures in the central highlands of

Kenya. The three variables positively influence knowledge levels implying that age, group membership and training positively influence the knowledge levels of animal manure technology use (Table 3).

Table 1 Definition of independent variables predicted to influence the knowledge levels of soil fertility (animal manure, inorganic fertilizers and manure + fertilizers) technologies in central highlands of Kenya.

Variables	Definition
Dependent variables	
Knowledge level (Animal manure, inorganic fertilizers and a combination of manure and fertilizers)	0 Low level 1 High level
Independent variables	
Age of the household head (years)	Continuous variable
Gender of the household head	0 Male 1 Female
Education level	1 No education 2 Primary level 3 Secondary level 4 Tertiary level
Years of farming experience	1 < 10 years 2 11-20 years 3 > 20 years
Mature cattle (number)	Continuous variable
Household size (number)	Continuous variable
Group membership	1 Yes (belonging to a group) 0 No (not belonging to a group)
Total farm size (acres)	Continuous variable
Training in animal manure, inorganic fertilizers and manure + fertilizers	1 Trained 0 Not trained

Table 2 Levels of knowledge on the use of animal manure, inorganic fertilizers and combined use of animal manure and inorganic fertilizers.

Level of knowledge of animal manure	Use of animal manure		Total
	Use animal manure (%)*	Do not use animal manure (%)	
Low	7 (3)	4 (10)	11 (4)
Moderate	52 (20)	12 (30)	64 (21)
High	201 (77)	24 (60)	225 (75)
Total	260 (87)	40 (13)	300 (100)
Level of knowledge in Inorganic fertilizers	Use of inorganic fertilizers		Total
	Use inorganic fertilizers (%)	Do not use inorganic fertilizers (%)	
Low	6 (2)	1 (4)	7 (2)
Moderate	69 (25)	7 (27)	76 (25)
High	199 (73)	18 (69)	217 (73)
Total	274 (91)	26 (9)	300 (100)
Level of knowledge in manure + inorganic fertilizers	Use of manure + inorganic fertilizers		Total
	Use manure + fertilizers (%)	Do not use manure + fertilizers (%)	
Low	6 (9)	41 (18)	47 (16)
Moderate	32 (46)	98 (42)	129 (43)
High	31 (45)	92 (40)	124 (41)
Total	69 (23)	231 (77)	300 (100)

*Values in parentheses are in percentages.

Table 3 Socioeconomic factors influencing knowledge levels of animal manure technology in the central highlands of Kenya.

Independent variables	B	S. E.	Wald	Sig.	Exp (B)
Age of household head	0.028**	0.013	4.855	0.029	1.028
Gender of household head	-0.931	0.849	1.203	0.273	0.394
Education level	0.699	0.615	1.291	0.256	2.011
Training in animal manure	0.509*	0.286	3.157	0.076	0.601
Total farm size	-0.374	0.236	2.517	0.113	0.688
Years of farming experience	0.123	0.696	0.031	0.860	1.130
Number of mature cattle	0.001	0.068	0.000	0.993	1.001
Household size	0.079	0.076	1.100	0.294	0.924
Group membership	0.304**	0.124	6.008	0.014	1.355

N = 300, **significant at 5% probability level, *significant at 10% probability level.

3.1.3 Socioeconomic Factors Influencing Knowledge Levels of Inorganic Fertilizers Technology in the Central Highlands of Kenya

The results of the logistic model developed to determine factors influencing knowledge levels in the use of inorganic fertilizer was significant at $P < 0.01$ and correctly predicted knowledge levels of 73% of both users and non users of inorganic fertilizers. Three variables: group membership, age of the household heads and total farm size are significant in explaining the knowledge levels on inorganic fertilizers in the central highlands of Kenya. Group membership positively influences the knowledge level of inorganic fertilizers while age and farm size negatively influence the knowledge levels of inorganic fertilizers (Table 4)

3.1.4 Socioeconomic Factors Influencing Knowledge Levels of Combined Animal Manure and Inorganic Fertilizers Technology in the Central Highlands of Kenya

The logistic model for explaining factors influencing knowledge levels in combined use of animal manure and inorganic fertilizers was significant at $P < 0.01$ and correctly predicted knowledge levels of 79% of both users and non users of animal manure combined with inorganic fertilizers. Five variables: gender of the household head, household size, training on combined use of animal manure and fertilizers, group membership and total farm size are significant in explaining the knowledge levels on inorganic fertilizers in the central highlands of Kenya. Three variables (group membership, household size and training) positively influence knowledge levels while two variables (gender of the household head and total farm size) negatively influence the knowledge levels of combined use of animal manure and inorganic fertilizers (Table 5).

3.2 Discussion

Training on use of animal manure technology significantly ($\beta = 0.509$, $P = 0.076$) influenced levels of knowledge in animal manure (Table 3) implying that knowledge levels in animal manure increases with an increase in training. Training in the combined use of manure and fertilizers also positively ($\beta = 0.598$, $P = 0.066$) influenced households levels of knowledge on combined use of animal manure and inorganic fertilizers at $P < 0.01$ (Table 5). This implies that knowledge on combined use of animal manure and inorganic fertilizers increases with an increase in trainings. The implication is that the more trained the households were the more knowledgeable they were likely to be. Training is an important component of instilling skills and hence builds capacity of the target group. In management of natural resources, training is also a vehicle by which profitable and resource conserving land management is locally promoted and widely adopted. The results concur with a study by Durojaiye and O'Meara [24] who noted that there was a significant improvement in the knowledge level on animal manure for farmers after attending training. Similarly, Mapiye et al. [25] noted that training

Table 4 Factors influencing knowledge levels of inorganic fertilizers technology in the central highlands of Kenya.

Independent variables	B	S. E.	Wald	Sig.	Exp (B)
Group membership	0.364**	0.117	9.752	0.002	1.440
Gender of household head	-0.571	0.384	2.207	0.137	0.565
Training in inorganic fertilizers	-0.283	0.275	1.061	0.303	0.753
Mature cattle	-0.059	0.075	0.609	0.435	0.943
Age of household head	-0.084*	0.048	3.039	0.081	0.919
Education level of household head	0.620	0.707	0.768	0.381	1.859
Household size	0.038	0.239	0.025	0.874	1.039
Years of farming experience	0.666	0.639	1.084	0.298	1.946
Total farm size	-0.138*	0.071	3.775	0.052	1.148

N = 300, **significant at 5% probability level, *significant at 10% probability level.

Table 5 Factors influencing knowledge levels of combined animal manure and inorganic fertilizers technology in the central highlands of Kenya.

Independent variables	B	S. E.	Wald	Sig.	Exp (B)
Gender of household head	-0.713*	0.425	2.819	0.093	0.490
Mature cattle	0.069	0.073	0.891	0.345	1.071
Total farm size	-0.122**	0.058	4.472	0.034	0.885
Age of household head	0.019	0.019	0.972	0.324	1.019
Education level	0.409	0.251	2.659	0.103	1.505
Group membership	1.254**	0.387	10.484	0.001	3.504
Household size	0.100*	0.059	2.860	0.091	1.105
Training in manure + fertilizers	0.598**	0.325	3.388	0.066	0.550
Years of farming experience	0.183	0.285	0.411	0.521	1.201

N = 300, **significant at 5% probability level, *significant at 10% probability level.

addressed the challenges on lack of knowledge by creating awareness. However, technologies training should suit the needs and resources were available to the target farmers.

Group membership positively influenced ($\beta = 0.304$, $P = 0.014$) the household levels of knowledge in animal manure and inorganic fertilizers (Tables 3 and 4). This implies that households belonging to groups are likely to be more knowledgeable in manure and inorganic fertilizer technologies than households that do not belong to any group. Group membership also positively ($\beta = 1.254$, $P = 0.01$) influenced households knowledge levels in combined use of animal manure and inorganic fertilizers (Table 5). This implies that knowledge on combined use of animal manure and inorganic fertilizers increases with participation in groups in central highlands of Kenya. This could be because the farmers in groups share their experiences and challenges, hence fostering a positive way forward. Moreover, groups could be effective in persuading members to try new technologies and encourage sharing of knowledge and experiences among the members. Membership of an organization provides a valuable learning and collective bargaining opportunity for farmers. According to Mapiye et al. [25], groups provide a means of collective action for farmers, and provide resources such as credit, labor and information. Stringer et al. [26] found that farmers who did not plant improved fallow attributed this to their being non-members in farmer groups and hence groups were needed in order to improve farmers awareness and knowledge on improved fallow. According to Odendo et al. [27], membership of an organization provides a valuable learning and collective bargaining opportunity for farmers where they are more likely to access to diverse information, including how to improve status of the soil. Farmers belonging to a local organization have a higher chance of accessing information on soil fertility management thus improving their knowledge levels whereas social organizations provide a forum for exchange of ideas. Likewise, Stringer et al. [26] notes that group membership increases the information on fertilizers which also improves its access. Membership into farmer groups enables individuals to have access to capacity building efforts such as training and study tours and to information pertaining to new agricultural technologies. Membership to groups has also been found to promote utilization of soil fertility management in Meru South District, Kenya [27].

Age of the household head positively (β = 0.029, P = 0.029) influenced knowledge levels in animal manure (Table 3). The results imply that the older farmers are more likely to be knowledgeable in the animal manure as compared to the young farmers. This could be due to accumulation of knowledge and experience of farming systems obtained from observation and experimenting with animal manure as a soil improvement technology over the years for the older farmers. Age of the household head also negatively (β = -0.084, P = 0.081) influenced levels of knowledge in inorganic fertilizers (Table 4). This implies that the younger farmers are more likely to be knowledgeable in inorganic fertilizers than the older farmers. This could also be as a result of the older farmers sticking to the traditional agricultural practices and being rigid to changes than the younger farmers who are more flexible to technological changes such as use of inorganic fertilizers. Explanation for this is that older farmers who have more experience in the use of available soil nutrient management technologies are in a better position to assess characteristics of new technologies than younger farmers [28]. The elderly farmers are more experienced as well as more knowledgeable in soil fertility technologies than younger farmers. However, according to Onweremadu and Mathew-Njoku [29], older farmers still hold tenaciously to traditional practices and therefore have a lesser likelihood of willingness to access information on new technologies. It may be also older farmers are more risk averse and less likely to be flexible than younger farmers and thus have a lesser likelihood of information utilization on new technologies. This may also be because younger farmers are often better disposed to trying new innovations and have lower risk aversion and longer planning horizons.

Total farm size negatively (β = -0.138, P = 0.052) influenced households knowledge levels in inorganic fertilizers (Table 4). This implies that the levels of knowledge in inorganic fertilizers increase with a decrease in farm size. Total farm size also negatively (β = -0.122, P = 0.034) influenced households levels of knowledge in the combined use of animal manure and inorganic fertilizers (Table 5). This implies that the smaller the size of the farm is, the more knowledgeable the household is likely to be. This could be due to farmers trying to intensify agricultural production from their small pieces of land in order to leap the maximum benefits. The intensified agriculture calls for a lot of information regarding nutrient supply thus creating an opportunity for the farmers to take up learning about the fertilizers so as to improve their levels of knowledge. This leads to the households learning more and thus gaining more knowledge. These finding agree with those of Kebede et al. [30] who in a study carried out in Tegulet-Bulga District, Ethiopia, found that farm size have a significant effect in increasing information and adoption of soil fertility technologies.

Gender of the household head negatively influenced households levels of knowledge in combined use of animal manure and inorganic fertilizers (β = -0.713, P = 0.093) (Table 5). This implies that the male headed households from the study area are more likely to be knowledgeable on animal manure and inorganic fertilizers than the female headed household. Explanation for this observation is that males being the landowners and take almost all decisions including what information to access through extension services thus being more knowledgeable than their counterpart female headed households [13]. These results also agrees with Habtemariam [31], who found that male-headed households had better access to agricultural information than female headed households, which was attributed to negative influence of cultural norms and traditions. Shadiadeh [14] argued that women did not often get information due to time schedules that are not appropriate to women while men have numerous information delivery strategies.

Household size positively (β = 0.100, P = 0.091) influenced households levels of knowledge in the combined use of animal manure and inorganic fertilizers (Table 5). This implies that knowledge levels increases with an increase in household size in the central highlands of Kenya. The larger the household is, the more knowledgeable it is likely to be in the use of the technology. This could because various members of a household combine their individual knowhow on soil fertility, which in turn improves their overall household levels of knowledge. The higher number of family members leads to higher decision to take risks for participation in technology packages and this leads to increased chances of getting agricultural information and ISFM knowledge. Mapiye et al. [25] in a study in Chikomba district, Zimbabwe noted that household size influences utilization of soil fertility technologies through increase in knowledge base. Similarly, households with large numbers have more labour and need more food, both of which increase the tendency to learn more on how to conserve the soil in order to feed themselves [10].

4. Conclusions

The objective of this study was to determine the household socioeconomic factors influencing farmers' level of knowledge in the use of animal manure, inorganic fertilizer and combined use of manure + fertilizer. Results showed age of the household head, training in the use of animal manure and group membership as possible factors influenced household knowledge levels in the use of animal manure. On the other hand, group membership, age of the household heads and total farm size were important variables for explaining levels of knowledge in use of inorganic fertilizers. For use of a combination of animal manure and inorganic fertilizers, household size, gender of the household heads, training on combined use of animal manure and fertilizers, group membership and total farm size were the important explanatory variables.

The results of the study imply that levels of knowledge in use of animal manure were high in households that had attended training, belonged to farmer groups and in households with older farmers. For the levels of knowledge on the use of inorganic fertilizers, levels of knowledge were high in households that belonged to farmer groups, in households with younger farmers and in households with smaller farm sizes. In line with use of animal manure combined with fertilizers, knowledge was found to be high in households belonging to farmer groups, in households with smaller farm sizes, in households that had attended training, in male headed households and in households with larger family sizes. This implies that in order to improve the levels of uptake and utilization of soil fertility technologies in the central highlands of Kenya, more farmers training should be conducted and the farmers are encouraged to joining and actively participate in groups.

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