

Factors influencing levels of knowledge in soil fertility management in the central highlands of Kenya

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Abstract

Soil nutrient depletion is one of the major biophysical constraints affecting agricultural production in Sub Saharan Africa. Despite past research developing soil fertility management options, few of the recommendations from this research have been put into use by the targeted end users mainly due to low levels of knowledge and understanding about these technologies. This study attempted to identify the knowledge levels of the farmers and the socioeconomic factors influencing the levels of knowledge for effective and enhanced uptake and utilisation of these technologies in Meru South, Maara and Mbeere South districts of the central highlands of Kenya where 300 farmers were randomly selected. Results show that 75% of the respondents in the study area had high levels of knowledge in use of manure, 73% of the respondents had high levels of knowledge on the use of fertilisers while 43% of the respondents had moderate levels of knowledge in the use of manure + fertilisers. A Logistic regression model identified age of the household head, training in the use of animal manure and group membership to significantly influence household levels of knowledge in use of animal manure. On knowledge in the use of fertilisers, a Logistic regression model identified group membership, age of the HHH and total farm size to significantly influence the levels of knowledge in inorganic fertilisers. In regard to the use of manure + fertilisers, a Logistic regression model identified gender of the HHH, household size, training on manure + fertilisers, group membership and total farm size to significantly influence the levels of knowledge in manure + fertilisers at $P < 0.05$. The implication of these results is that in order to improve knowledge levels, trainings should be enhanced and targeted to the farmers belonging to farmer groups considering their gender, age and total farms size.

Key words: Animal manure, group membership; inorganic fertilisers, socio-economic factors

Résumé

L'appauvrissement des sols en éléments nutritifs est l'une des principales contraintes biophysiques affectant la production agricole en Afrique subsaharienne. En dépit de la recherche passée développant les options de gestion de la fertilité du sol, quelques-unes des recommandations issues de cette recherche ont été mises en application par les utilisateurs finaux ciblés, principalement suite à des faibles niveaux de connaissance et de compréhension de ces technologies. Cette étude a tenté d'identifier les niveaux de connaissances des agriculteurs et des facteurs socio-économiques qui influent sur les niveaux de connaissance pour l'absorption efficace et améliorée, et l'utilisation de ces technologies dans les districts de Meru Sud, Maara et Mbeere Sud dans les hauts plateaux du centre du Kenya, où 300 agriculteurs ont été sélectionnés aléatoirement. Les résultats montrent que 75% des répondants dans la zone d'étude avaient des niveaux élevés de connaissances sur l'utilisation du fumier, 73% des répondants avaient des niveaux élevés de connaissance sur l'utilisation d'engrais, tandis que 43% des répondants avaient des niveaux modérés de connaissance sur l'utilisation des engrais + du fumier. Un modèle de régression logistique a identifié l'âge du chef de famille, ayant la formation sur l'utilisation du fumier animal et l'appartenance au groupe pour influencer de manière significative les niveaux de connaissance des ménages sur l'utilisation du fumier animal. A propos de la connaissance sur l'utilisation des engrais, un modèle de régression logistique a identifié l'appartenance à un groupe, l'âge des chefs de famille et la taille totale des exploitations pour influencer de manière significative les niveaux de connaissance sur les engrais inorganiques. En ce qui concerne l'utilisation du fumier + engrais, un modèle de régression logistique a identifié le sexe des chefs de famille, la taille des ménages, la formation sur les engrais + fumier, l'appartenance à un groupe et la taille totale de l'exploitation pour influencer de manière significative les niveaux de connaissance sur le fumier + engrais à $P < 0,05$. L'implication de ces résultats est que, dans le but d'améliorer les niveaux de connaissance, les formations devraient être renforcées et ciblées sur les agriculteurs appartenant à des groupes d'agriculteurs en considérant leur sexe, l'âge et la taille totale des exploitation.

Mots clés: Fumier animal, appartenance à un groupe, engrais inorganiques, facteurs socio-économiques

Background

Declining soil fertility is a critical challenge affecting agricultural productivity and environmental welfare in Sub-Saharan Africa (SSA). Improved animal manure, mineral fertilisers and combined use of animal manure and mineral fertilisers have been developed, demonstrated and found to immensely improve soil fertility status as well as crop yields. In the central highlands of Kenya, like other livestock-arable farming systems in sub-Saharan Africa, animal manure is one of the most widely used organic inputs being used by approximately 80% of the households and which as the need for increased agricultural production rises; has been found to be limited in quality and quantity (Mugwe *et al.*, 2009). Inorganic fertilisers have been found to be another way of counterbalancing the low soil fertility in the SSA. As many studies have reported, the amounts applied are quite minimal to sufficiently supply the crops with adequate nutrients. The integration of mineral fertilisers with organics encompassing their judicious manipulation in achieving productive and sustainable agricultural systems (ISFM), has been identified to improve the agronomic efficiency of the external inputs used, reduces the risks of acidification and provides a more balanced supply of nutrients (Mugwe *et al.*, 2009).

Literature Summary

Though a lot of knowledge has been produced through the past research in the SSA, there is dismal adoption of organic resources and little evidence that farmers have benefited from the researchers' efforts in the central highlands of Kenya (Mugwe *et al.*, 2009). Lack of awareness, knowledge and skills is a major constraint, leading to poor adoption of soil technologies in SSA and consequently the central highlands of Kenya (Odera *et al.*, 2006). The low adoption is associated with negative economic externalities, low returns to agricultural investments, decreased food security and general high food prices which consequently threaten food security in the region (Macharia *et al.*, 2010). The absorptive capacity of soil fertility technologies depends heavily upon the level of knowledge obtained through education and training (Mytelka, 2001). This knowledge speeds up the diffusion and adoption of the new technologies in order to make local adaptations and improvements on the existing knowledge and more generally to increase the awareness and ability to take advantage of technological opportunities" (Dahlman and Nelson, 1995). This study therefore, was set out to assess factors influencing smallholder farmers' levels of knowledge in soil fertility management in the central highlands of Kenya.

Study Description

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 lie in the Upper zones-LH1, UM1, UM2, Middle zones-UM3 and Lower zones-LM3, LM4, LM5 (Jaetzold *et al.*, 2006) on the eastern slopes of Mount Kenya at an altitude that ranges from 600 meters in the lower areas to 5200 meters above sea level at the peak of Mt. Kenya. They have an annual mean temperature of 20°C and total annual rainfall ranging from 1200 to 1400 mm. The rainfall pattern is bimodal with long rains (LR) from March to June and short rains (SR) from October to December. The soils are mainly humic Nitisols (Jaetzold *et al.*, 2006) 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 per Km² while Maara district has a population density of 230 persons per Km⁻² (GoK, 2010). Both districts majorly have smallholdings ranging from 0.1 to 2 ha with an average of 1.2 ha per household (GoK, 2010).

Mbeere South District lies in the lower midland 3, 4 and 5 (LM 3, LM 4 and LM 5), Upper midland 1, 2, 3 and 4 (UM 1, UM 2, UM 3 and UM 4), and Inner lowland 5(IL 5) (Jaetzold *et al.*, 2006) at an altitude of approximately 500m-1200m above sea level. It has an annual mean temperature ranging from 21.7 to 22.5°C and average annual rainfall ranging from 700 to 900 mm. It has a population density of 105 persons per Km² with an average farm size less than 5.0 ha per household (GoK, 2010). 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).

Logistic regression analysis was used to predict the influence of socioeconomic variables on the farmer's levels of knowledge in soil fertility technologies. A value of 0 was assigned if the farmer's knowledge level was low and 1 if knowledge level was high giving the regression of non-linear form.

Research Application

The objective of this study was to determine the household socioeconomic factors influencing farmers' level of knowledge in the use of animal manure, inorganic fertiliser and combined use of manure + fertiliser. Results showed age of the household head, training in the use of animal manure and group membership as possible predictor factors likely to influence the household knowledge levels in the use of animal manure (Table 1).

Table 1. 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	.028**	0.013	4.855	0.029	1.028
Gender of household head	.931	0.849	1.203	0.273	0.394
Education level	.699	0.615	1.291	0.256	2.011
Training in animal manure	.509*	0.286	3.157	0.076	0.601
Total farm size	.374	0.236	2.517	0.113	0.688
Years of farming experience	.123	0.696	0.031	0.860	1.130
Number of mature cattle	.001	0.068	0.000	0.993	1.001
Household size	.079	0.076	1.100	0.294	0.924
Group membership	.304**	0.124	6.008	0.014	1.355

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

Table 2. 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 3. 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.

On the other hand, group membership, age of the household heads and total farm size were important variables explaining levels of knowledge in use of inorganic fertilisers (Table 2). For use of a combination of animal manure and inorganic fertilisers (Table 3); household size, gender of the household heads, training on combined use of animal manure and fertilisers, group membership and total farm size were the explanatory variables. These results implies that in order to improve the levels of uptake and utilisation of soil fertility technologies in the central highlands of Kenya, the identified socioeconomic factors should be put into consideration.

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