Education level Influenced Soil Degradation Perception in a semi-arid environment of Makueni County

Kimiti Jacinta M.
South Eastern Kenya University
School of Environment and Natural Resources Management
P.O Box 170-90200, Kitui, Kenya
Email: jkimiti@seku.ac.ke; Cell: (+254)721473341

Dr. Jacinta M. Kimiti is currently a lecturer at South Eastern Kenya University (SEKU). Jacinta holds a BSc. MSc. and PhD.in Soil Biology and fertility. She has spend 22 years on research and university teaching. Currently Jacinta is a Dean in the School of Environment and Natural Resources Management

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Abstract

Small-holder farmers have indigenous knowledge on farm soil fertility status. However, the knowledge vary from one place to another and in most cases the information is scantly documented. To address this problem we documented farmer knowledge on current status of soil fertility, types of inputs used, existing soil erosion control measures, household head education levels and farmer perception on causes of soil fertility decline in four selected site of Makueni County. A questionnaires were used to collect data from randomly from household heads.. Results from farmers revealed that only 8% of the soils were fertile, 14% were poor and 78% were in the borderline. Further, about 90% of the farmers used farmyard manure erratically and without measure while only 2% used inorganic fertilizers. Between 60% and 67% of household heads had only primary school education and 85% of farmers terraced their farms. However, 64% of the farmers perceived that the main course of low soil fertility was soil erosion. In contrast to farmers' perception and based on results of this study we concluded that the most probable cause of soil fertility decline was soil nutrient mining by crops.

Keywords: Education level, fertilizer, households, indigenous knowledge, farmyard manure, semi-arid, soil erosion, soil fertility.

1. Introduction

Soil nutrient depletion of arable lands is a major constraint to crop production in most parts of Africa. It results from continuous cropping with little or no inputs to replenish soil fertility, removal of crop residues to feed animals, overgrazing between the cropping seasons and soil erosion (Sanchez *et al*., 1997; Smaling *et al*., 1997; Stoorvogel *et al*., 1993). Soil nutrient depletion lowers the returns to agricultural investment, reduces food security through low crop yields, increases food prices and reduces government revenue through reduced taxes collected on agricultural goods (Sanchez *et al*., 1997; Henao and Baanante, 2006)

Over the history of farming, farmers have used inputs to replenish soil fertility and farmyard manure have been used over a long period of time in tropical Africa to replenish soil fertility and enhance crop production (Dennison, 1961; Giller *et al*., 1997; Hartley, 1937; McCown *et al*., 1992). For example, in the arid and semi-arid lands (ASALs) of eastern Kenya, smallholder farmers have used farmyard manure over their history of farming to replenish soil fertility (Kimiti, *et al*., 2009; Mathuva *et al*., 1998; Probert *et al*., 1995). However, farmyard manure, especially cattle manure, which is commonly used by farmers, is of low nutrient content and the amounts available are not usually adequate (Giller *et al*., 1997; Kimani and Lekasi, 2004; Probert *et al*., 1995). In addition, chemical composition of manure is highly varied depending on the diet fed to the livestock, collection and storage methods (Giller *et al*., 1997; Powell, 1986). For example in Kenya nitrogen (N) content of cattle manure ranges from 0.2%-2.2%, while phosphorus (P) content ranges from 0.08% to 0.95% (Kimani and Lekasi, 2004).

Inorganic fertilizers can supplement low nutrient animal manures but their prices especially to smallholder farmers on staple food crop production is uneconomical (Jama *et al*., 1997). For

example in the arid and semi arid lands (ASALs) of eastern Kenya, adoption of inorganic fertilizers is constrained by high costs, low farm returns, and lack of right fertilizers to the resource poor farmers (Ikombo, 1984). Therefore the main objective of this study was to find out what farmers thought was the main cause of soil fertility decline and how farmers managed their farms to enhance and conserve soil fertility in their farms. .

2. Methodology

The study was carried out in four locations, distributed in two divisions of Makueni County in south eastern drylands of Kenya. Through random household visits, a total of 119 househlds, representing about 10% of total households in each sub-location (Mugenda and Mugenda, 2003) were interviewed. Data collected included information on soil fertility status, types of inputs used, soil erosion control measures, incidence of soil erosion, household head education level and farmer perception on the causes of soil fertility decline. The data was cleaned and analysed using SPSS to show farmer responses in the selected sites.

3. Results

Results from three categories of soil fertility levels (fertile, poor and borderline) revealed that poor soils were relatively higher (14%) than fertile soils (9%) and that most of the soils were on the borderline (78%), between fertile and poor soils (table 1). In addition, most poor soils were reported at Kavuthu (24%) and Matiku (23%) sub-locations. Further, Poor soils ranged from 0 at to 24%, while fertile soils reported in the sites ranged from 0 to 22%. Most fertile soils were reported at Ndunguni while no fertile soils were reported at Yikivumbu (Table 1).

Results on types of farm inputs indicated that use of farmyard manure for soil fertility improvement ranged from 84% to 97% in the study sites (Table 2). In addition to farmyard manure, farmers in the study sites used crop residues, compost and rarely fertilizers to enhance soil fertility. Crop residues were the second commonly used soil amendment after farmyard manure (Table 2) while fertilizers were the least used (2%). Among the study sites, Ndunguni had the highest incidences of use of crop residues (39%), compost (70%) and inorganic fertilizers (8%) (Table 2). However, most farmers (85%) in all study sites indicated that the farmyard manure was inadequate, was used without measure and the application process was erratic (Table 3). Majority of the farmers (98%) at Yikivumbu sub-location reported that farmyard manure was inadequate. Results further indicated that in addition to the use of farm inputs to enhance soil fertility, farmers used soil erosion control structures to check soil erosion and hence conserve soil fertility. Most farmers (85%) in the study sites terraced their farms (Table 4). Highest incidences of terracing were reported at Yikivumbu (100%) and least at Kavuthu sub-location (68%). Most terraces (61%) had grass while others had trees (8%) or trees and grass (8%) (Table 4).

Analysis of famer perception on the main cause of low soil fertility in the study sites revealed that most farmers (75%) believed that soil erosion was the main cause of soil fertility decline (Table 5). The highest number (81%) was from Yikivumbu where 100% of the farmers interviewed terraced their farms and 98% reported that farmyard manure was not adequate. The least (68%) was Kavuthu who had highest manure availability (23%) and highest incidence of poor soils. Further, analysis of household head education level indicted that about 13% of the

farmers had no formal education while about 60% of had only primary school education (Table 6). In addition, about 28% had secondary school education while only about 1% had tertiary education.

4. Discussion

Most farms in the study sites had moderate soil fertility status followed by poor soils and finally fertile soils with overall means of 88%, 14% and 9%, respectively. This implied that fertile soils covered less than 10% of the cultivated farms in the selected sites. These results agreed with the findings from farmer participatory meetings in the same study sites (Kimiti, 2008), which revealed that, fertile soils covered less than 10% of cultivated farms, implying that farmers are conversant with their farm soil fertility status. However, higher proportions of poor soils at Kavuthu (24%) and Matiku (23%) (Table 1) were most probably due to continuous cropping without adequate farm inputs and removal of soil nutrients by harvested crops (Sanchez *et al.*, 1997; Smaling *et al*., 1997) coupled with high population densities and small farm units of the two study sites. This is because data not included here revealed that the two sites were densely populated and had the smallest farm units among the selected study sites. This would imply that continues cropping without adequate nutrient replenishment would have been inevitable thus contributing to the high incidences of poor soils reported in the sites. The high incidences of fertile soils reported at Ndunguni were most probably due to the use of crop residues (39%), compost (70%) and fertilizers (8%), of which their nutrients were most likely higher than that of farmyard manure alone, which was commonly used in other study sites (Table 2).

Use of farmyard manure as the main farm input was most probably due to its availability because most farmers kept livestock in the selected sites (Kimiti *et al.*, 2009) and thus farm yard manure was readily available to most farmers. However, most farmers (85%) indicated that farmyard manure application was constrained by its seasonal inadequacy in the study sites (Table 3). Other authors (Giller *et al*., 1997; Kimani and Lekasi, 2004; Probert *et al*., 1995) have reported that farmyard manure is usually inadequate as a farm input and this limits its appropriateness as a sole input to enhance soil fertility. Further, use of farmyard manure has its disadvantages as an input to enhance soil fertility in that some manures such as cattle manures, which makes bulk of farmyard manure in eastern Kenya drylands, are known to have low nutrient content and its chemical composition is highly varied depending on the diet fed to the livestock, and collection and storage methods (Giller *et al*., 1997; Powell, 1986; Kimani and Lekasi, 2004).

In addition to farmyard manure, farmers used crop residues, which they said consisted of the remains from legume threshing especially common bean (*Phaseolus vulgaris* L.), cowpea (*Vigna unguiculata* (L.) Walp), pigeon pea (*Cajanus cajan* (L.) Millsp), green grams (*Vigna radiata* (L.) R. Wilcz) and dolichos (*Lablab purpures* L.). Only a few cereals that were rarely grown or grown in small quantities such as pearl millet (*Pennisetum glaucum* (L.) R.Br.), sorghum (*Sorghum bicolor* (L.) Moench) and finger millet (*Eleusine corcana* (L.) Gaertn) were used as residues, According to the farmers most maize (*Zea mays* L.), residues, which were usually common and in large quantizes (data not included) were fed to livestock. Farmers further indicated that usually the crop residues used for soil fertility improvement were leftovers from livestock feeding, implying that most of the crop residues were fed to livestock.

High incidences in the use of crop residues at Ndunguni was partly because most farmers at the site practiced irrigation along a seasonal river called Muoni and the inhabitants planted vegetables which needed nutrient inputs, So, to enhance vegetable production they applied manure, crop residues, compost and even fertilizers. It is only at this site where an average of 8% fertilizer use was reported. The fertilizer was strictly used to enhance production of the irrigated crops. Further, use of inputs at the site enhanced soil fertility and biomass production part of which was used directly as crop residues or composted to apply to the fields. In addition, due to irrigation, farmers indicated that grass available along the irrigation canals was used to feed livestock hence reducing dependence of livestock on crop residues, which were then used for composting and for direct application to fields.

Low incidence on the use of inorganic fertilizers in the study sites was most likely due to lack of awareness on the importance of fertilizers most probably contributed by low education level. This was partly because, data not included revealed that farmers in the study sites believed that use of inorganic fertilizers hardened their farms resulting to reduction in crop yields. This observation indicated that there is need to sensitize farmers in the study sites on the importance of inorganic fertilizers so as to improve soil fertility and overall crop production.

Observations made on the use of farm inputs, especially low incidences in the use of fertilizers, could have been contributed by education level of the household heads. This is because results obtained, showed that between 60% and 81% of household heads believed that soil erosion was the main course of soil fertility decline in the study sites (Table 5). However, farmers' claims were in contrast to what was happening on their farms because an average of 85% the farmers

reported that they used soil conservation terraces and 61% of the terraces had grass indicating that the terraces were old and firm to check soil erosion (Table 4). Farmers' perception on the cause of soil fertility decline indicated that they were not aware that continuous cropping without adequate soil replenishment can lead to soil nutrient depletion due to nutrient mining by crops (Sanchez et al., 1997; Smaling et al., 1997; Stoorvoget et al., 1993). Therefore, nutrient mining could have been very common under low nutrient inputs in the study sites.

Level of formal education in the study site was low because about 59% of the household heads had only primary school education, while lack of formal education among household heads stood at about 13%. This implied that about 70% of the household heads lacked secondary education, which is important in technology adoption. For example (Nyangito, 1996) found out that level of education affected adoption of potato post harvesting practices and storage technologies at Kinangop in Kenya. There is therefore need to sensitize farmers in the study sites on the use of appropriate inputs to replenish soil fertility.

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Table 1: Soil fertility status of farms in the selected sites of Makueni District

	Soil Fertility Status (%)		
Sub-location	Fertile	Moderate	Poor
Yikivumbu	0	100	0
Ndunguni	22	70	9
Kavuthu	5	71	24
Matiku	7	70	23
Means	9	78	14

Table 2: Types of inputs used by farmers to enhance soil fertility in selected study sites

Site	Farmyard manure	Crop residues	Compost	Fertilizers	No inputs
Yikivumbu	97	6	3	N/A	N/A
Ndunguni	87	39	70	8	13
Kavuthu	91	10	N/A	N/A	10
Matiku	84	14.	16	N/A	9
Means	90	17	22	2	8

N/A Means the input was not used in the site

Table 3: Farmyard manure (%) seasonal adequacy status for farm application

Farmyard manure adequecy	Yikivumbu	Ndunguni	Kavuthu	Matiku	Means
Yes	2	8	23	14	15
No	98	92	67	86	85

Table 4: Terracing (%) used for soil erosion control in the selected study sites

Site	Terraces are present	Bare terraces	Terraces with grass	Terraces with trees	Terraces with trees and grass
Yikivumbu	100	16	72	0	7
Ndunguni	87	53	74	5	5
Kavuthu	68	29	29	15	5
Matiku	86	24	68	10	5
Means	85	31	61	8	8

Table 5: Farmer responses (%) on soil erosion as a major course of soil fertility decline on farms

Response	Yikivumbu	Ndunguni	Kavuthu	Matiku	Means
Yes	81	78	68	72	75.
No	19	22	33	30	25

Table 6: Level of formal education of household heads (%) in selected study sites

Education level	Yikivumbu	Ndunguni	Kavuthu	Matiku	Means
None	16	4	19	12	13
Primary	66	70	43	58	59
Secondary	16	26	38	30	28
Tertiary	3	N/A	N/A	N/A	1

(Kimiti et al., 2009)