FARMERS' PERCEPTION OF THE SOIL FERTILITY STATUS IN TORORO DISTRICT EASTERN UGANDA

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INTRODUCTION

Uganda is basically an agricultural country employing around 90% of the population. Agriculture produces an estimated 49% of the nations GDP. Of this, food crops account for 71%, export crops 5% and livestock, fisheries and forestry account for 17, 4 and 3% respectively. Approximately 56% of agricultural GDP consists of subsistence production (MAAIF, 1996). Most of this agriculture is done in rural areas. However the concept that Uganda is endowed with naturally fertile soils is increasingly being doubted due to ever decreasing crop yields of most crops and yet the population of the country keeps increasing at a rate of 2.5% per annum. The increasing population has a proportionate effect on the soils due to increasing cultivation hence increasing nutrient removal in form of crop harvests, continuous disturbance of the soil physical structure affects the soil structure and its ability to retain soil moisture. Farmers then tend to grow annual crops. The frequent growing of annuals have a profound effect on the soils, because of frequent tillage and nutrient mining caused by leaching and harvesting of crops (Zake, Nkwiine and Miiro, 1998[2]).

All these soil effects culminate into decreased crop productivity, yields and income for a country like Uganda. Several remedies are underway to rectify these soil related problems like agro-forestry promotion, organic farming and use of inorganic fertilizers. Current thinking in agricultural research and development is that the users of technology (farmers) need to be involved at every stage of the technology development process. Participatory research is key in order to let the users appreciate the technologies being disseminated and so enhance adoption.

One of the key tools in participatory work is establishing farmers status in relation to the technology being taken and their own working environment. Farmers perception of their environment has an influence on how they will receive new technologies being promoted. Reasons for non-adoption of innovation in the conventional TOT paradigm have been attributed to characteristics of small scale farmers or an inadequate delivery system but seldom to the characteristics of innovations themselves (Waters-Bayer, 1989). Farmers' informal experimentation has long been under perceived (Rhodes and Bebbington, 1988). Participatory analysis requires and incorporates the community's own interpretations and opinions in research and in its results (Alan, B., Maria, E.C., Vera, G., Miguel, A. M., Claudia R. and Winfred, R., 1995).

Objective: To establish farmers' interpretations and opinions of the fertility status of their fields and compare them with the real field situation through soil analysis.

MATERIALS AND METHODS

The study was conducted in three-sub-counties of Tororo district in eastern Uganda. Research methods employed were a baseline survey and soil analysis for 25 farmers. In the baseline study, an interviews schedule was used which included assessing crops grown, their role in income generation for the farm households and their soil management systems.

The subjects were all client farmers of Africa 2000 Network in Tororo (a Non-Government Organization – NGO) numbering to 256, but a sample of 112 was purposively arrived at. Data obtained was analysed for descriptive statistics using the Statistical Package for Social Scientists (SPSS for Windows Version 6.0 Computer Program).

The overall fertility of the fields as perceived by the farmers in relation to the distance of the field from their homesteads, was computed. This was done by determining the number of farmers (f) with pieces of land in a given distance range (km from homesteads) and multiplying it (f) with the total weighted fertility levels of the fields (FF). Each farmer had given his perception of the fertility of the field on a likert scale of 5 to 1 (very fertile to not at all fertile). The weight of that farmers field was got by multiplying the score on the likert scale with either 5 for "very fertile (5)[1]", or 4 for "Fertile (4)", 3 for "Somewhat fertile (3)", or 2 for "Not fertile (2)", or 1 for " Not at all fertile (1)". The total weighted fertility level (FF) for a given distance range was the sum of all the individual weighted fertility levels (IF) in a given distance range. The Expected Weighted Average fertility (EF) of the fields for the same distance range was also computed by multiplying the number of farmers (f) with fields in that distance range with the factor 9 (f*9). The FF was compared to the EF. If the FF was found to be greater than the EF then the farmers perceived the fields in that distance as fertile. If the FF was less than the EF, then the fields in that distance were perceive as not fertile, and if the FF was equal to the EF then the fields were perceived as somewhat fertile.

Soil analysis was done on composite top soil samples (0 – 20 cm) randomly collected from 26 farmers' fields in three sub-counties of Tororo district namely: Osukulu, Kisoko and Rubongi, and analysed using the methods according to Anderson and Ingram (1993). The sufficiency level of fertility of the soils was determined by critical nutrient levels for Uganda soils according to Professor J.Y.K. Zake.

RESULTS

Baseline study

Annual crops grown by the client farmer

The most commonly grown annual crops were sweet potatoes (97%), maize, (93%) and millet (93%), vegetables (91%), groundnuts (86%), cassava (70%), and beans (65%) (Table 1). The main uses of the annual crops were given in three categories: namely home consumption only, home consumption and sale, and sale only.

Perennial crops grown by the farmers

Three perennial crops were grown by the farmers namely bananas pineapples, and coffee, bananas were grown by 63% of the farmers, pineapples by 29%, while coffee was grown by 6% of the farmers.

Table 1: Annual crops grown by the farmers (n=112)

Annual crop	Frequency (f)	Percentage (%)
Sweet potatoes	109	97.3
Maize	104	92.9
Millet	104	92.9
Sorghum	102	91.1
Vegetables	102	91.1
Groundnuts	96	85.7
Cassava	78	69.6
Beans	71	63.4
Soy bean	52	46.4
Rice	37	33.0
Onions	18	16.1
Cotton	16	14.5
Tomatoes	6	5.4
Simsim	4	3.6
Peas	4	3.6
Popcorn	1	0.9

Table 2 : Perennial crops grown by the farmers (n=112)

Crop	Frequency (f)	Percentage (%)
Bananas	70	62.5
Pineapples	21	18.9
Coffee	7	6.3

The crops which farmers observed to be decreasing in yield included cassava (60%), groundnuts and maize (46%), millet and beans (44%), sweet potatoes (43%) and sorghum (42%). Vegetables were indicated to have decreasing yields by 35% of the farmers, soybean by 26%, rice by 21% and onions by 13% of the farmers. Less than 30% of the farmers observed that the yields of their crops were increasing. The proportion of farmers that observed increasing yields for the different crops was: 27% for vegetables, 26% for sweet potatoes, 25% for maize, 24% for sorghum, 19% for groundnuts, 18% for millet, 12% for soybean, 9% for rice, 3% for cassava and 3% of the farmers for onions.

Table 3: Yield trends of the annual crops farmers grew in the previous two years (n=112)

Crop	Frequency (f)	Percentage (%)	Crop	Frequency (f)	Percentage (%)
	Yields decreasing			Yields increasing	
Cassava	67	59.8	Vegetables	30	26.8
Groundnut	52	46.4	Sweet potatoes	29	25.9
Maize	51	45.5	Maize	28	25.0
Millet	49	43.8	Sorghum	27	25.0
Beans	49	43.8	Groundnuts	21	24.1
Sweet					18.8
potatoes	48	42.0	Millet	20	17.9
Sorghum	47	42.0	Soybean	13	11.6
Vegetables	39	34.8	Beans	10	8.9
Soybeans	29	25.9	Rice	5	4.5
Rice	23	20.5	Cassava	3	2.7
Onions	14	12.5	Onions	3	2.7

Farmers indicators for fertile soils and non-fertile soils

The majority (83%) said they could differentiate the two soils while 6% said they could not. The indicators of fertile soils according to farmers (Table 3) were: blackness or darkness of soil (63%), healthy plants (53%), soil does not loose moisture easily (28%), and the soil being a sandy loam (18%). The non fertile soils indicators to the farmers were: soils being stony and sandy (61%), failure of crops to grow well (48%), soils easily loose water (17%) and the colour of infertile soils being red in colour (6%).

Table 4: Characteristics of fertile and non-fertile soils as perceive by the farmers (n=112)

Characteristic	Frequency (f)	Percentage (%)	Characterustics	FrequeNcy (f)	Percentage (%)
Black/ dark	70	63	Stony and Sandy	68	61
Healthy plants	59	54	Crops don't grow well	54	48
Water is Not lost easily	27.7	19	Looses water easily	19	17

Fertility levels of crop fields as perceived by the farmers in relation to the distance between the fields and farmers' homesteads.

All the fields whether near or far from the farmers' homesteads were perceived to be fertile by the farmers except for a field in a distance of between 2.01 and 2.25 km and fields for 2 farmers which were at a distance of 3 km from the homesteads. Their owners perceived these exceptional fields as somewhat fertile. The majority of the farmers however, regarded their fields as fertile (Table 5).

Table 5: Fertility levels of crop fields as perceived by the farmers in relation to the distance (km) between the fields and farmers' homesteads

Distance in km from the homestead	Frequency	Fertility of field (weighted total) for the distance (FF)	Expected weighted average fertility (EF) of the field (f*9)	Perceived Level of Fertility of the Fields for the distance
				Fertile (F), some what (S), not fertile (N)
0.25	69	882	621	F
0.26-0.50	26	294	234	F
1.26-1.50	19	177	171	F
0.76-1.00	12	134	108	F
0.51-0.75	10	95	90	F
1.51-2.00	4	38	36	F
1.01-1.25	3	34	27	F
2.26-2.50	1	25	9	F
3.0	2	18	18	S
2.01-2.25	1	9	9	S
4.5	1	16	9	F
6.0	1	16	9	F

Table 6: Soil analysis results of 25 farmers' fields

Farmer No.	pH	Av.P. ppm	% N	% OM	Na	Me/100g	Ca	Mg	% sand	% clay	% Silt
1	5.4	3.1	0.07	0.92	0.087	0.2	2.4	0.72	78	8	14
2	5.6	7.8	0.75	0.66	0.28	0.3	1.8	0.4	96	6	8
3	5.7	9.3	0.05	0.66	-	0.15	1.6	0.4	88	6	6
4	6.1	28	0.1	1.33	-	0.3	4.6	0.88	76	14	10
5	5.6	18.7	0.07	0.83	-	0.15	2.2	0.56	88	6	6
6	6.3	84.7	0.13	2.07	-	0.85	5.8	1.44	74	14	12
7	5.1	3.1	0.05	0.5	-	0.1	1.0	0.32	86	5	9
8	5.6	5.4	0.08	0.5	0.26	0.15	1.2	0..4	86	5	9
9	6.3	48.3	0.08	1.0	-	0.4	3.2	0.72	82	8	10
10	5.1	18.7	0.07	0.74	0.087	0.1	1.2	0.4	88	6	6
11	5.8	3.9	0.05	1.33	-	0.35	2.8	0.72	76	10	14
12	6.5	10.9	0.07	1.33	-	0.3	4.0	0.64	80	10	12
13	5.6	11.7	0.1	1.33	-	0.35	2.8	0.96	82	8	10
14.	5.6	3.1	0.07	1.0	-	0.15	2.0	0.64	82	8	10
15	5.7	21.8	0.1	1.57	-	0.7	3.2	1.28	78	10	12
16	5.6	29.6	0.15	1.33	-	0.35	2.4	0.80	78	10	12
17	5.1	4.7	0.10	1.16	0.087	0.3	1.1	0.64	82	8	10
18.	5.7	10.9	0.07	1.16	-	0.4	2.8	0.88	82	10	8
19	7.2	49.0	0.07	1.42	0.087	0.45	4.6	1.12	80	8	12
20	5.1	2.33	0.13	1.66	0.17	0.3	3.2	0.8	64	16	20
21	6.3	1.6	0.11	1.5	0.26	0.2	5.2	0.96	66	14	20
22	5.5	35.8	0.10	2.4	-	0.6	4.0	1.76	68	22	10
23	5.3	10.1	0.07	0.92	-	0.3	2.6	0.8	80	12	8
24	6.7	9.3	0.10	1.09	-	0.2	4.2	0.72	80	8	12
25	5.7	2.3	0.11	1.33	0.17	0.5	3.2	0.96	72	16	12
26	5.8	8.65	0.07	0.82	-	0.25	2.4	0.56	80	6	14

Soil analysis of the farmers' fields

Results as shown in Table 6.0 showed that the soils were predominantly sandy, only 7 out of the 25 soils had clay content 10% (Table ...) organic matter content was also low since all the samples were below the critical level of 3% OM all samples had their nitrogen contents below the critical level of 0.2% N. Forty eight percent (48%) of the samples had their P below the critical level of 10 PPM, and where the P level was good, the pH of the soil was relatively high.

DISCUSSION

The farmers were mainly growing annual crops more than perennial crops (Tables 1 and 2). Cultivation of annual crops entails frequent soil tillage, adversely affecting both the soil physical and chemical properties leading to reduced crop yields, food security and income (Young 1989). Zake, Nkwiine and Miiro R. (1998[1]) argue that unless annual crops are reinforced by soil inputs, the soils will eventually deteriorate in a short time. Farmers them selves in Tale 3 perceive the yields of their annual crops to be decreasing than increasing. They could very well articulate the differentiating characteristics of fertile and non-fertile soils in a scientifically acceptable way. A moderate proportion of them actually used soil inputs to strengthen the remedial process. The prevalent annual cropping system and low soil input use is further justified by the low nutrient level particularly N and P as given by the results of the soil analyses of 26 farmers' fields.

The soils were found to be sandy and with low nutrient levels. Sandy soils are easily leached, and have very little capacity to retain organic matter and water. Such a soil dries very quickly during dry seasons. Yet dry seasons are now very common in Tororo district. This makes the soil only suitable for annual crops. Both the clay content and organic matter were low implying low nitrogen levels in the soils. Low organic matter in the soil usually leads to low available P. It also means cations of Cs, Mg, K and Na would be limited on the exchange surface which lowers the soil pH providing relatively acidic soil.

Farmers' perceived their fields as fertile which contradicted with the scientific findings but however justifies the importance of collective farmers opinions of farm issues as a form of feedback. According to Alan *et al.* (1995) feedback is fundamental component of participatory analysis, the community does more than provide information it actively criticises, opposes and improves on the researchers' understanding of the situation. Robert and Rajaasekaran (1994) note that when farmers' indigenous knowledge is well understood and incorporated into agricultural and extension education program s, it helps in understanding the 'emic' perspectives of local people among others, while Scoones (1989) shares that understanding the farmers knowledge systems gives a framework of reference for increasing the effectiveness of agricultural and extension programs.

CONCLUSION

The farmers in the study were mainly growing annual crops and very few perennial crops which has an adverse effect on the physical and chemical properties of the soils. Farmers observed decreasing yields of he annual crops they grew and could differentiate fertile from non-fertile soils. There was more continuous cultivation of nearer fields among the farmers than fallowing. The farmers employ crop rotation as major soil fertility remedial system that is common to them. There is moderate use of soil inputs. All these ideally show that the soils in the area are exhausted and infertile. The soil analyses proved this showing that the soils are sandy, had low clay and organic matter content, had low nitrogen levels, and relatively low available P. The soils too had low amounts of the exchangeable bases and hence were acidic.

Farmers mainly perceived their soils as fertile which contrasted the mainly annual crop farming system, the yield trends, and the soil analyses. The reason for this was not immediately addressed by the study.

RECOMMENDATIONS

The Non Government Organisation should share these results and discrepancies with the farmers and collect their reactions. A consensus should be reached with the farmers about the status of their actual farming practices, views on crop yields, the laboratory soil analyses and their perception of the soil fertility status of their soils. A participatory characterisation of the fertility of the farmers' soils should be done and participatory approach to the soil fertility problem be developed should be used to encourage farmers use remedial practices and technologies like the Phosphate Rock (locally available and supplied by the NGO), rhizobia for the leguminous plants and trees, inorganic fertilizers as well as organic fertilizers.

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