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Determination and Restoration of Soil Fertility by Local Farmers: The Case of Techiman Municipality of Ghana

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Abstract: The study was undertaken to find out how crop farmers in the Techiman municipality of Ghana determine and manage the fertility of their soils. Data were obtained through questionnaire and interview of one hundred and ten randomly selected farmers from the municipality between January and February, 2010. Frequency count, percentage and correlation coefficient were used to analyze the data. The farmers have their own set of parameters handed over from one generation to the other which they use to determine the fertility of their soils without consultation with agriculture extension agents or soil research stations. Many of the farmers (70.91%) use crop yield in combination with other parameters as, colour of soil, vegetation cover, soil depth, soil organic matter, activities of soil organisms and looseness of soil to determine soil fertility. Most of the farmers (85%) had no training or education in soil fertility practices. Higher number of the farmers (37.27%) use inorganic fertilizers as a soil fertility restoration method. Other soil fertility methods as crop rotation and fallowing are also practiced by the farmers. The use of crop residues and animal manure to restore soil fertility is not popular among the farmers. The determination and management of soil fertility by the farmers have no significant (at 5% significance level) relationships with sex, age and education of the farmers. Sustainability of soils would be effective if farmers' indigenous knowledge is woven with scientific ones in soil fertility and management practices.

Key words: Soil fertility · Determination · Restoration · Techiman municipality

INTRODUCTION

Low soil fertility is a major constraint to crop production in Sub Saharan Africa due to declining soil fertility and loss of top soil through erosion [1]. Farmers are either entirely abandoning the traditional practices of using natural fallow to restore soil fertility or are unable to leave land fallow long enough for it to gain its fertility [2] as a result of rise in human population which has led to an increase in demand for land use even by other sectors of the economy other than the agricultural sector.

The success of crop production depends largely on a good knowledge of soils which is a unique resource for agricultural production. Thien and Graveel [3] asserted that, soil is a vital natural resource for sustaining life and quality environment on earth. Conservation and appropriate management of soil rely on knowledge of both its form and function. If agriculture, therefore, is to serve as the economic motor that spurs development, then knowledge of the fertility levels of soils in farming practices must be handled comprehensively. Solving the soil fertility problem in Africa is the key to food security and to achieving a number of the Millennium Development Goals [4].

Farmers in order to achieve high yields for their crops use both organic and inorganic fertilizers, which have proven to increase the yields of crops. However, for efficient use of any type of fertilizer to be applied prior knowledge of the nutrient level of the recipient soil is of paramount importance. The African farmer, no matter the educational level is not ignorant of this and therefore has means or knowledge of determining the nutrient status of his land or soil before planting.

Farmers in rural areas to whom development efforts are directed have their own body of knowledge that enables them arrive at decisions, which could help better their lots [5] and therefore, farmers' traditional knowledge in farming should not be ignored because such knowledge may contribute to agricultural development among farming communities.

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Fig. 1: Map of Ghana showing the study area (Techiman municipality)

It is in the light of this that the current research was carried out to find out how local farmers in a selected municipality in Ghana determine the fertility of their soils.

Methodology: The research was carried out in the Techiman municipality of the Brong Ahafo Region of Ghana (Fig. 1). One hundred and ten (110) crop farmers were randomly selected from three (Tuobodom, Tanoso and Manso) communities in the municipality for the study.

The main instrument used for data collection was questionnaire. Background of farmers, methods used by the farmers to determine the fertility of their farmlands, the type of soil fertility management practices farmers adopt as well as some of the constraints they face in the application of their management practices and the training on soil fertility determination farmers have had. The questionnaire was made up of both structured and unstructured questions. Based upon the pretesting of the questionnaire the instrument was reviewed by the authors to enable the objective of the study to be achieved. The administration and collection of questionnaire spread from January 2010 to February 2010. The activities were carried out by the authors with the help of agricultural extension agents.

The data were analyzed using the Statistical Package for Social Sciences (SPSS) version 11. Data were presented in frequencies and percentages. The relationship between respondents' social background and the methods used by the farmers to determine the fertility of their soil and the type of soil fertility management were found using Pearson's correlation coefficient at 5% significance level.

RESULTS AND DISCUSSION

Table 1 shows some social background of the farmers involved in the study, most of them are males (66.36%). Majority of the farmers (76.36%) are below the age of 51years an indication that the farmers are strong enough to carry out effective farming activities.

Only 4.55% of the farmers have had education up to the tertiary level and 23.64% up to the secondary level. Farmers with no formal education and those who have studied up to the primary school level formed the highest proportion (71.81%) of the target population. Farmers with higher level of education are more willing to accept innovations in agriculture [6]; the low level of education among the respondents will therefore not enhance the readiness of the farmers to accept innovations in soil fertility practices.

It is indicative from Table 2 that most of the farmers (70.91%) use more than one parameter to determine soil fertility. The farmers use crop yield and other parameters as, colour of soil, vegetation cover, soil depth, soil organic matter, activities of soil organisms and looseness of soil to determine soil fertility. Apart from the few respondents who use crop yield (18.18%), vegetation cover (7.27%) and soil colour (3.64%) as sole soil fertility determinants none of the other parameters are considered as a sole indicator for a fertile soil. Signs used as indicators of a fertile soil in connection with the parameters by the farmers are: Colour - dark soil; vegetation – luxuriant green vegetation, type of plant species, high rate of weed re-growth and dense vegetation; soil depth - whole blade of a cutlass penetrates the soil with ease; soil organic matter – abundance of dead living materials; activities of soil organisms – presence of soil casts and visible movements

Table 1: Social background of respondents

Response	Frequency	Percentage
Sex		
Male	73	66.36
Female	37	33.64
Total	110	100
Age (years)		
= 20	8	7.27
21-30	16	14.54
31-40	26	23.64
41-50	34	30.91
51-60	15	13.64
= 60	11	10.00
Total	110	100
Level of education		
No formal education	40	36.36
Primary	39	35.45
Secondary	26	23.64
Tertiary	5	4.55
Total	110	100

Table 2: Determination of soil fertility by farmers

Soil fertility determination method	Frequency	Percentage	Summary of signs/indicators of a fertile soil
Colour of soil only	4	3.64	• Dark soil
Vegetation only	8	7.27	• Luxuriant green vegetation
			• High rate of weed re-growth
			• Type of plant species
			• Dense vegetation
Depth of soil only	0	0	• High depth of soil layer-Whole blade of a cutlass penetrates the soil with ease
Soil organic matter only	0	0	• Abundance of dead living materials
Activities of soil organisms only	0	0	• Presence of soil casts
			• Visible movements of insects, worms and arthropods
Looseness of soil only	0	0	• Ease to pick and walk on the soil when dry
Yield of crops only	20	18.18	• Large sizes of fruits, roots and tubers
Yield and other parameters above	78	70.91	-
Send soil samples to research stations	0	0	-
Consult agriculture extension agents	0	0	-
Total	110	100	-

of insects, worms and arthropods; looseness of soil – ease to pick and walk on the soil when dry; crop yield - large sizes of fruits, roots and tubers.

The farmers have set of local wisdom of soil fertility determination handed over from ancestors through experience and most of them do not use only one indicator to assess soil fertility but use yield in combination with others. One single factor is not enough to assess soil fertility. The farmers see soil fertility as a multifaceted concept as recognized by Talwar and Rhoades [7]. The farmers know indigenous soil science and their assessment of soil fertility can be scientifically proven as correct as observed by Bellon and Taylor [8] in a similar study on soil quality rankings.

Farmers neither consult agriculture extension agents nor send soil samples to research stations to determine the fertility of their soils. Farmers in the study area probably do not know or see the need to contact agriculture extension agents or soil research stations to help them assess the fertility of their soils. This may stem from the fact that most of the farmers (85%) have had no training or education in soil fertility practices and therefore may not know the necessity to determine the fertility of their soil outside their indigenous methods.

Fallowing, crop rotation, applications of inorganic fertilizers, crop residues and animal manures are some of the soil fertility restoration practices indentified among the farmers (Table 3). Higher number of respondents

Table 3: Soil fertility restoration practices

Type of soil fertility restoration practice	Frequency	Percentage	Constraints
Fallowing	24	21.82	• Difficulty in acquiring new land for farming
Crop rotation	29	26.36	• Difficulty in acquiring extra land for the rotation
Application of inorganic fertilizers	41	37.27	• High cost of fertilizer
			• Application becomes ineffective with time
Application of crop residues	5	4.55	• Very difficult in acquiring large quantities for large farms
Application of animal manures	2	1.82	• Very difficult in acquiring large quantities for large farms
Crop rotation and application of inorganic fertilizers	9	8.18	-
Total	110	100	

Table 4: Relationship between the social background of respondents and type of soil fertility determination method and restoration practice

	Coefficient of correlation	
Social background	Soil fertility determination method	Type of soil fertility restoration practice
Sex	0.032ns	0.085ns
Age	0.203ns	0.059ns
Level of education	0.064ns	0.183ns

ns= Not significant (at 5% significance level)

(37.27%) use inorganic fertilizers as soil fertility restoration method, 26.36% use crop rotation and 21.82% use fallowing as means of restoring soil fertility. The application of crop residues and animal manure as soil fertility restoration practices have very low responses of 4.55% and 1.82% respectively from the farmers. Some (8.18%) also practice both crop rotation and the application of inorganic fertilizer.

Application of inorganic fertilizers have been found to give quick response to changes in crop yield and also farmers find it easy to apply the fertilizer [9] and no wonder, greater percentage of the farmers respond to using this method of soil fertility restoration. High cost of fertilizer and the ineffectiveness of continuous application of inorganic fertilizers are the major constraints to this method of soil fertility restoration observed by the farmers. Continuous application of inorganic fertilizers especially the ammonium based fertilizers lead to soil acidity [9].

Crop rotation an effective and well known soil fertility restoration method is also practiced by the farmers without much emphasis on the scientific bases of it. Crops follow each other in the rotation based on household demands and the traditional crops of the area. The farmers who practice this method find it difficult to acquire extra land for rotation of crops, families are increasing in numbers and the demand for land is also on the rise. Following which is the traditional method for soil fertility restoration is losing its significance among the farmers with the similar reason cited above, that is, there is pressure on the land for farming as a result of rise in family numbers.

Farmers know the importance of crop residues in the restoration of soil fertility but there is no conscious application of residues to fields by the farmers. Few farmers who practice this method cite the difficulty in getting large quantities enough for a large field of land. Domestic animals also compete for the crop residues as discussed by Sandford [10] that in sub-Saharan Africa crop residues are most of the time used to feed ruminants.

Food crop farmers in this sector of the country are not used to the application of animal manure as fertilizers and hence the very low percentage of respondents recorded for those using animal manure as soil fertility management. Farmers also cited the same constraint faced by those farmers who use crop residues in their soil management activities.

Sex, age and education of the farmers have no significant relationship with how the farmers determine and restore soil fertility (Table 4).

CONCLUSIONS AND RECOMMENDATION

Farmers have their own set of parameters to determine soil fertility without consulting agriculture extension agents or soil research stations for help. Majority of the farmers use crop yield in combination with other parameters as, colour of soil, vegetation cover, soil depth, soil organic matter, activities of soil organisms and looseness of soil to determine soil fertility.

Use of inorganic fertilizer to restore soil fertility is the method practiced by many of the farmers. Farmers cited high cost of fertilizer and the ineffectiveness of continuous application of inorganic fertilizers as major constraints to this method of soil restoration.

The way the farmers determine and maintain fertility of their soils has no significant relationship with their sex, age and their educational background.

Efforts should be made by ministries of agriculture to combine farmers' indigenous knowledge and scientific knowledge in the determination and management soil fertility to make sustainability of soils effective.

REFERENCES

1. Shapiro, B.I. and J.H. Sanders, 1998. Fertilizer use in semi-arid West-Africa: profitability and supporting policy. Agric. Syst., 56: 467-482.
2. Corbeels, M., A. Shiferaw and M. Haile, 2000. Farmers Knowledge of Soil Fertility and Local Management Strategies in Tigray, Ethiopia. Managing Africa's Soils: No.10. http://www.iied.org/downloadable.
3. Thien, S.J. and J.G. Graveel, 1997. Laboratory Manual for Soil Science: Agricultural and Environmental Principles. 7th Ed. Wm. C. Brown Publ. Dubuque, IA., pp: 85.
4. Verchot, L.V., F. Place, K.D. Shepherd and B. Jama, 2007. Science and Technological Innovations for Improving Soil Fertility and Management in Africa. A report for the NEPAD Science and Technology Forum.
5. Kolawole, O.D., 2002. Factors Associated with the Utilization of Indigenous Knowledge Systems of Soil Fertility Conservation by Farmers in Ekiti State, Nigeria. Ph.D Thesis. Department of Agricultural Extension and Rural Sociology, Obafemi Awolowo University, Ile-Ife.
6. Yamota, J.R.G. and A. Tan-Cruz, 2007. Farmers' Adoption of Organic Rice Farming in Magsaysay, Davao Del Sur: Factors and Practices. 10th National Convention on Statistics (NCS), EDSA Shangri-La Hotel, Bo. Obrero, Davao City, Philippines October 1-2, 2007.
7. Talwar, S. and R.E. Rhoades, 1998. Scientific and local classification and management of soils. Agriculture and Human Values, 15(2): 3-14.
8. Bellon, M.R. and J.E. Taylor, 1993. "Folk" soil taxonomy and the partial adoption of new seed varieties. Economic Development and Cultural Change, 41(4): 762-786.
9. Muir, P.S., 2002. Consequences for organic matter in soil. Oregon State University: B1301 Human Impacts on Ecosystems.
10. Sandford, S.G., 1989. Crop residue/livestock relationships. In: Soil, Crop and Water Management in the Sudano-Sahelian Zone." Proceedings of an international workshop, January 11-16, 1987. ICRISAT Sahelian Center, Niamey, Niger. ICRISAT, Patancheru, pp: 169-182.