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Full Length Research Paper

The effects of short term fallow on topsoil properties in Mbakyaan District of Buruku local government area, Benue state, Nigeria.

Dr. T. A. Kerenku and Mr. I. Ayoosu

Department of Geography, Faculty of Environmental Sciences, Benue State University, PMB 102019, Makurdi, Nigeria

E-mail: azuatersugh@gmail.com

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A study of the effects of short term fallow on topsoil properties was carried out at Mbakyaan district, Benue State Nigeria to establish the contribution of short term fallow on soil properties as it influence farming in the area. Random sampling technique was used to locate sampling sites in the selected two year fallow areas that were found in the study area. Topsoil soil at a depth of 0-20cm was considered for soil sample collection in the two year fallow areas and areas that were under continuous cultivation. Twenty five soil samples each were collected from the two year fallow areas and areas that were under continuous cultivation. Soil samples were analysed following Adisa (1998). Results indicate that soil in the two year fallow areas have higher and improved properties than those obtained in the areas under continuous cultivation. However, the difference in their mean values between the two year fallow areas and those under continuous cultivation were not significant. The study concluded that soil should be allowed to fallow no matter the time period hence fallowing improves the quality of soil properties. The study recommends that in spite of land shortages the best way of restoring soil fertility is fallowing and it should be encouraged.

Keywords: short term fallow, topsoil properties, continuous cultivation, farming, soil organic matter.

INTRODUCTION

A major factor influencing soil productivity in some parts of sub Saharan Africa is soil fertility (Hartemink, Osborne and Kips, 1995). Soil productivity is the capacity of the soil in its normal condition and environment to produce a specific plant or crop under specified system of management (Herbert, 2010). The farming system may lead to erosion and leaching of soil nutrient which in turn adversely affects the physical and chemical properties of soil. Fallahazade and Hajabbasi (2011) noted that the cultivation of lands in tropical areas have led to negative effects on soil organic matter components. Furthermore, with continuous cultivation, physical properties and productivity of soils decline due to the decrease in organic matter content (Oguike and Mbagwu, 2009) and soil pH. Soils with desirable characteristics are essential for agricultural productivity. Crop production soils are characterized by high organic matter content, active soil organisms, high water retention capacity, moderate air spaces and suitable soil cation exchange and moderately chemical composition. Daune et al., (2004) emphasized that crop rotation and bush fallowing are basic farm practices to be adopted so as to achieve and realize the desirable soil characteristics. Yemefack, Nounamo, Njomgang, Bilong (2002) in their study of the effects of fallow periods on topsoil in Southern Cameroun asserted that humus content increased and consequently increased the organic carbon and this correlated with the results of Kirchlof and Salako (2000) in Southern Nigeria.

The people of Benue State Nigeria tagged 'The Food Basket of the Nation' depend on the traditional bush fallow system of farming for the restoration of soil fertility. Increasing population pressure resulting in land scarcity has resulted in shortened fallow period and a replacement of fallow with continuous cultivation (Nyagba, 1995a; Kerenku, 2012). In the study area, the fallow period use to be at least five years but this, in recent years, has reduced to about two years, where possible, or none at all. Available studies (Yemefack, Nounamo, Njomgang and Bilong, 2002; Kirchlof and Salako, 2000) were in the tropical rainforest region while little or no study of this nature has been carried out in the

savanna region. This study, therefore, assessed the effects of short term fallow on some soil properties compared to soil properties under continuous cultivation in the study area. The study looks at how farmers cope with the present situation where there is no farm input to supplement the changing situation.

MATERIALS AND METHODS

The Study Area

The study area is located between Latitudes 7^0 07'N and 7^0 44'N and Longitudes 8^0 55'E and 9^0 27'E of Benue State, North-central Nigeria. The geology of the area is made of meta sediments principally made of marine sediments, shell stones and silt stones forming the Benue trough (Abaa, 2009). The vegetation could be described as guinea savanna (Nyagba, 1995a). However, increase human activities have reduced natural vegetation to seral re-growth. The climate of the study area is humid tropical wet and dry seasons described by Koppen's classification as 'Aw'. The area annual rainfall ranges between 1000-1500mm and temperature ranges between 23^0C and 28^0C. The soils are the tropical ferruginous soils (Nyagba, 1995a).

The study sites were purposively selected and consist of five kindred of Mbakyaan council ward. Five soil samples from a two year fallow (short term fallow) and five soil samples from non fallow areas adjacent the two year fallows were considered making ten soil samples from each kindred. Together a total of fifty soil samples were collected at a depth of 0-20cm considered topsoil. Using bucket soil auger (Ekande, 1991a) the soil samples were collected and put into polythene bags and transported to the laboratory for air-drying. Each sample was homogenized, sieved using a 2mm sieve and stored for chemical analysis. The soil samples were analysed chemically for the following properties; soil pH, Organic Matter content, total Nitrogen, Ca, Mg, Na, K, P, CEC, base saturation and physical property of Particle size distribution.

Data analysis was done using mean and coefficient of variation to see how the soil properties vary in the study area.

RESULTS

The soil Particle size distribution as shown in the results of the study indicated that soil from the short term fallow has higher mean values of silt and clay particles (Table 1) than those areas under the continuous cultivated areas. The higher mean values of sand in the areas under continuous cultivation compared to short term fallow areas could be attributed to sheet erosion which remove the fine clay and silt particles away, leaving the coarser sand particles due to land exposure. The soil textural composition affects the organic matter and nutrient status of the soil (Kerenku, 2012). The general textural class of soil in the study area is sandy loam with sand being the dominant inorganic constituents and accounting for at least 70 percent of the soil textural distribution.

The soil pH mean value (pH 6.29) showed that soil under the short term fallow has higher values indicating slight acid soils. While in areas under continuous cultivation, the soil reaction had moderate acid soils with pH mean value of 5.33 (Table 1). The slight acid soils or increase in pH in the area under short term fallow could be ascribed to the effects of ashes from burnt vegetation biomass which acts as lime fertilizer (Awotoye, *et al*. 2011). The organic matter content increased slightly under short term fallow soils with mean values of 1.43 percent while for soils under the continuous cultivation, the mean values of organic matter content is 1.02 percent. Jou *et al* (1995) and Hartemink, (2004) reported that they observed an increase in newly established fallows organic matter content during the first year and this report confirms these findings. The areas under continuous cultivation had low soil nutrient reserve. This could be attributed to either plant utilization and/or the decline in soil organic matter content (Okonkwo, 2010). There is a slight increase in the mean value of nitrogen and phosphorus in the areas under short term fallow as compared to areas under continuous cultivation (Table 1). The improved available phosphorus as seen in the short term fallow was due to the seasonal burning of the vegetal materials observed in the study area. All the exchangeable bases viz: calcium, magnesium and sodium except potassium have mean values higher in areas under short term fallow compared to soils in areas under continuous cultivation. Considering the period of fallow and the value of chemical properties observed in the study, area it is possible to say that the bush fallow has no effect on the chemical properties generally. The reason for slightly higher mean values as observed is the absence of nutrients removal from areas under short term fallow as compared to areas under continuous cultivation. Grubb (1989) noted earlier that hence the fallow vegetation at the stage of two years only is dominated by grasses, and as they tend to be shallower rooted than woody plants, leaching of nutrients may predominate accumulation. This may affect short term fallow to restore soil fertility.

The low mean values of cation exchange capacity as shown in soil under continuous cultivated areas could be the dominance of sand in the areas hence it is chemically inert and does not contribute to exchange of properties of soil (Ogidiolu, 2003). More so, the deteriorated mean values of soil chemical properties in the areas under continuous cultivation is an indication of degradation of soil resulting from pressure on land (Kerenku, 2012). This could also possibly be as a result of poor farming practices of regular burning of litter and crop residue preparatory to new season of farming which

Table 1: Mean Values of Soil Properties under the Short Term Fallow and Continuous Cultivation

Soil Properties	Depth (0-20cm)	Short Term Fallow (n=50)	CV%	Continuous Cultivation (n=50)	CV%
Particle Size Distribution					
Sand (%)		70.84	5.04	79.57	3.00
Silt (%)		13.23	10.73	10.96	7.94
Clay (%)		15.62	10.88	9.68	17.35
Textural Class		Sandy Loam		Sandy Loam	
pH (In water 1:1)		6.29	2.07	5.33	34.33
Organic Matter (%)		1.43	8.39	1.02	16.67
Nitrogen (%)		0.16	6.25	0.07	14.29
Available P (Bray I) (mg kg^{-1})		3.37	17.80	2.51	22.71
Exchangeable Calcium ($mmol_c kg^{-1}$)		4.27	13.11	3.15	21.90
Exchangeable magnesium($mmol_c kg^{-1}$)		2.09	12.44	1.57	17.44
Exchangeable Potassium($mmol_c kg^{-1}$)		0.49	26.53	0.63	12.69
Exchangeable Sodium($mmol_c kg^{-1}$)		0.67	17.91	0.56	19.64
Cation Exchange Capacity		7.23	15.08	5.73	10.57
Base Saturation (%)		97.91	0.89	97.18	1.18

Source: Fieldwork, 2014

decrease the supply of fresh organic material and this means low level of organic matter in the soil which is a storehouse for other nutrients (Van and Nieuwenhuis, 2004). Agbeja, (2011) earlier pointed out that the alarming decline in agricultural produce might be attributed to poor land use practices, illiteracy of the farmers, and lack of agricultural mechanization, as well as poverty and pressure mounted on the soil due to rapid population growth.

From data presented in Table 1 the spatial variation of soil properties in the study area has shown that most of the soil properties have coefficient of variation less than 20 percent. The exchangeable potassium has a coefficient of variation of 26.53 percent and soil pH had a coefficient of variation of 34.33 percent indicating some variability in its performance. Considering the coefficient of variation of 50 percent as was given by Alhassan, et al (2007) the soil of the study area can be described as having relatively low degree of spatial variation.

CONCLUSION

The study from its findings conclude that though there is some improvement in soil properties under short term fallow, the period of fallow under study is not long enough to contribute to enrichment of topsoil properties. The higher mean values of soil properties is an indication of the reserve that have been left in the soil as the areas are not in use for farming for the period under consideration.

For improved soil fertility the study recommends that farm management practices such as crop rotation, mulching with crop/weed residues, use of tillage (where farmers bury down weeds as they cultivate) and the use of organic manure in their farms. Fallowing of land for soil improvement should be encouraged where possible.

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