Environtropica, April - June 2007, Vol.4, No 1, 000 – 000. ISSSN: 1597-815X

Effects of Organic Amendments on Soil Quality in Ago-Iwoye Farm Settlement, Southwestern, Nigeria.

***Adedeji, O.H and Akanni, C.O.**
*Department of Geography and Regional Planning, Olabisi Onabanjo University, P.M.B. 2002, Ago-Iwoye, Nigeria. *Corresponding Author.*
email : hakeemdare2002@yahoo.com

Accepted on March 3, 2007

Abstract

*The effects of the different treatments of organic amendments (plant residues and animal manures) on the soil pH, soil organic matter (SOM) content and exchangeable bases were determined on experimental plots in Ago-Iwoye Farm Settlement, southwestern Nigeria. Six plots were treated with animal manures (pig slurry, farmyard manure and poultry dung), and plant residues (*Gliricidia sepium, Chromolaena odorata, *and* Azadirachta indica *(neem), and a control were used during the experiments. The amendments significantly ($P < 0.05$) affected the soil organic matter (SOM), total Kjeldahl N; available P, exchangeable Ca, Mg, and K. The plots treated with pig slurry, farmyard manure and poultry dung encouraged the growth of larger number of leaves than those treated with plant residues (227 and 205 leaves respectively for pig slurry and* Gliricidia *spp). The soil organic matter (SOM) content varied with the different weeks of treatment, while the poultry dung treated plots exhibited a high percentage increase in SOM, so also the plots treated with* Gliricidia *spp (3.39% and 2.69% respectively). Organic amendments supplied sizeable percentage of the total need of nitrogen in crop production while also improving the exchangeable cations in the soil. Plant residues and animal manures were therefore relatively important to ensure and promote higher yield and sustainable soil quality.*

KeyWords: Soil Quality, Organic Matter, Litter Cover, *Gliricidia*, *Celosia argentea* TLV8, Soil Management.

Introduction

Agronomists and Soil Scientists have long presumed that traditional practices of intensive cultivation were, for the most part, detrimental to soil quality (Doran *et al*., 1994; Doran, 1996). Despite this knowledge, many regions of the world especially the sub-Saharan Africa (SSA) have little or no quantitative information on the quality and status of the soil resources. This has resulted into many problems associated with the misuse of the soil and inappropriate and unsustainable soil management systems (Pierce and Larson, 1993; Keeney and Cruse, 1997).

Soil quality has been difficult to define and quantify (Doran *et al.*, 1994; Doran and Jones, 1996). Larson and Pierce (1991) defined soil quality as “the capacity of a soil to function within its ecosystem boundaries and interact positively with its environment to that ecosystem”. Soil quality (SQ) is about interactions among soil processes and between soil management processes (Lewandowski and Zumwinkle, 1999). The quality of the soil depends on climate, landform, hydrology and management techniques employed (Andrews *et* *al.*, 2002). Janzen *et al.* (1992) noted that soil quality must be expressed in terms of the soil to sustain plant growth or productivity; and stressed further that productivity is a function of two interactive sets of variables: soil quality (intrinsic soil characteristics) and landscape quality (extrinsic factors such as climate).

A serious limiting factor to the enhancement of agricultural productivity is the steady decline of soil fertility or loss of soil nutrient throughout the sub-Saharan Africa (Asiamah, 1996). In the sub-Saharan Africa, both the organic and the inorganic fertilizers are being used to restore and stabilize soil fertility and thus improve the soil quality. However, for inorganic fertilizer, a number of factors such as the exorbitant prices of such input, poor communication and transport systems, and lack or inadequate credit facilities to purchase the fertilizer contribute to hamper widespread use. Organic technologies such as mulching and incorporation of organic materials show potentials as alternatives to liming, to ameliorate soil pH, and enhance nutrient availability in acidic soils (Christensen, 1996; Pockaee and Sumner, 1997). Various studies have shown that the fertility of soil could be restored through a system of incorporating litter cover and organic matter into the soil for decomposition and mineralization; in which nutrients are released for plant use (e.g. Anoka *et al.*, 1991; Young, 1997; Mugendi, 1999). The prunings of *Gliricida* spp. and *Leucaena leucocephala* were estimated to add varying amount of nutrients (169 to 247 kg/ha of N, 11 to 70 kg/ha of P and 149 to 184 kg/ha of K - for *Gliricida* spp. and *Leucaena leucocephala* respectively) to an Alfisol in western Nigeria (Kang and Wilson, 1987). Prunings from trees and shrubs are a source of mulches and green manure that adds nutrients to the soil.

Understanding of soil nutrient status and consequently the soil quality in a region or country would generally facilitate development and improve returns on scarce resources. Majority of the studies conducted on soil fertility in southwestern Nigeria centered around research and experimental farms concentrated in Ibadan and Ile-Ife (e.g. Ojanuga, 1975; Adepetu *et al.*, 1979; Lal, 1984; Lal, 1989a,b; Gbadegesin and Nwagwu, 1990; Hauser, 1990; Ogunkunle and Erinle, 1994). These studies rarely lay emphasis on soil quality or the ability of the soil to perform certain ecological functions as described by Larson and Pierce (1991). This study was aimed at assessing the effects of organic amendments on soil quality in Ago-Iwoye area of Ogun State, Nigeria with the view of contributing to the existing body of knowledge of mineral functioning of the soil and for better understanding of the soil quality status for proper planning to ensure sustainable agriculture.

Materials and Methods

Study Area

The study was carried out on a research farm of the Ogun State Ministry of Agriculture located in the Ago-Iwoye Farm Settlement (Lat.6^0 56' – Lat. 6^0 57' N and Long. 3^0 49' – Long. 3^0 51' E), about 6.5km from Ago-Iwoye (Fig. 1). This area lies within the tropical lowland forest area of Nigeria (Hopkins, 1974). The climate is humid with short dry season and a longer wet season lasting from April to November. It receives about 1300 mm to 1600 mm of rainfall in a year with two peaks in June and September. The mean annual temperature is 27°C with no marked seasonal variation. Relative humidity is high throughout the year with a mean value of about 90%. The area is generally undulating, rarely exceeding 130 a.m.s.l., with a few gentle to steep slopes. The dominant soil types are ferralitic tropical soils (D' Hoore, 1964), classified as Egbeda series and as *Ferric luvisol* (Ojanuga, 1975). The soils are derived from undifferentiated igneous and metamorphic rocks such as granite, biotite gneiss, biotite schist and quartzite (Kehinde-Philips, 1992).

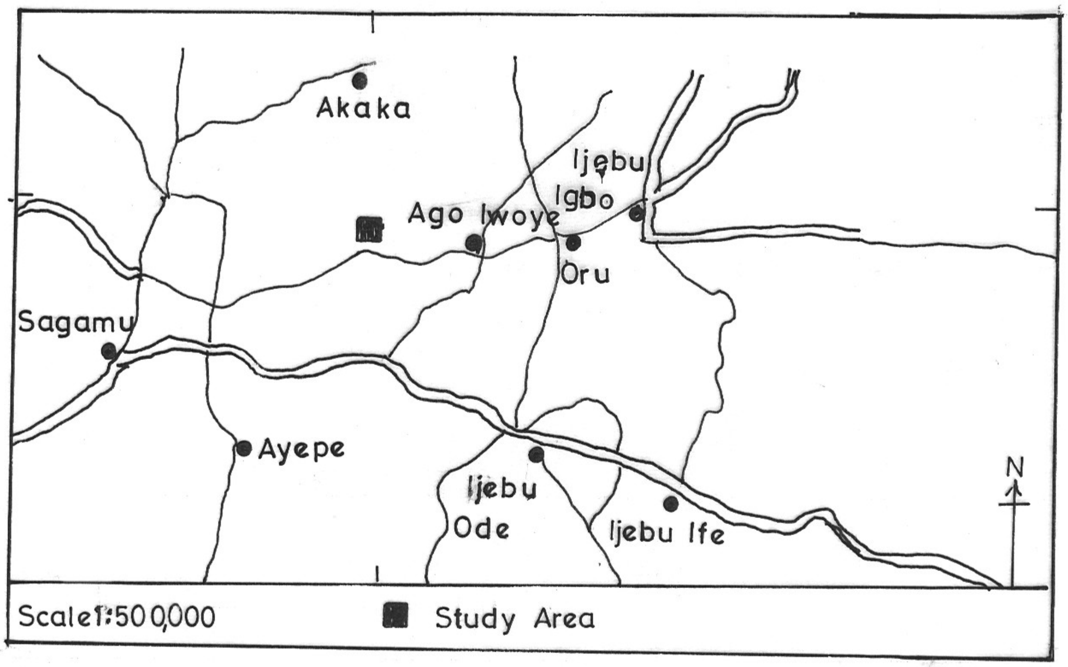

Fig.1. Ago-Iwoye Farm Settlements

The main vegetation type light forest, dense woody scrubs including bamboo forming gallery forest along the rivers and streams. Trees species commonly found include *Isotonia boonei, Anthocleista Vogeli, Cola giganteas, Antiaris africana, Pentaclethra macrophylla,* and *Elaeis guineensis* (Gbadegesin, 1992).

Field and laboratory studies

The experiment was conducted from late June to early October 2004, and repeated the same period in 2005 (rainy periods when decomposition was expected to be rapid). A vegetable variety *Celosia argentea* TLV8 was obtained from the National Institute of Horticulture Research (NIHORT) Ibadan and planted on prepared plots (5 m by 2 m with alleys of 0.5m in between) in the research farm at Ago-Iwoye Farm Settlement. Six treatments of organic manure: poultry dung, pig slurry, farmyard manure (FYM) and prunings from *Gliricidia sepium, Chromolaena odorata, and Azadirachta indica* (neem) were applied to the plots and these were replicated thrice. A seventh plot was also prepared and this served as control. The treatments were applied at the rate of 10 mg ha^{-1} for all the plots in three replicates during the experiments. A weight (10g) of *Celosia argentea* variety TLV8 was mixed with 10 kg of sand and bore into each plot. Records of the plant heights and leaf number were taken at the 4^{th}, 6^{th} and 8^{th} weeks after planting. Precipitation amount was enough during the field study period; hence there was no need for manual watering of the seedlings. Weeding was done when necessary and the thinning of stands of *Celosia argentea* was done after four weeks of planting.

The performances of the vegetable varieties with the different treatments were determined by selecting two plants randomly on each plot. The height and number of leaves of each plant were measured, and the harvested leaves were weighed. The effects of the different treatments on the soil pH, soil organic matter (SOM) content and exchangeable bases were determined through laboratory analysis of soil samples taken from the different plots. Thirty-five soil samples were taken from the different plots including the control. About 20 g of each soil samples were air dried and then passed through 2 mm sieve and the soil pH was determined using the pH meter, organic carbon was determined using the Walkey-Black method (Walkey and Black, 1934) and this was then converted to percentage organic matter by multiplying by a factor of 1.729. The soils were leached with neutral 1M-ammonium acetate solution to obtain extract for determining soil exchangeable cations. Soil exchangeable calcium and potassium were determined by flame spectrophotometry, and magnesium by the atomic absorption spectrophotometer. Soil nitrogen was determined by the Kjeldahl method and available phosphorous was by the method of Bray and Kurtz (1945). Statistical analysis of the data was performed using spreadsheet software, while Parametric (Tukey multiple comparison test) was used to compare the difference of means.

Results and Discussion

Result of the study showed that in the plots treated with poultry dung, pig slurry, and farmyard manure (FYM), germination of the *Celosia argentea* seeds was very high (over 90 %), while on plots treated with *Gliricidia sepium* and *Chromolaena odoratum* germination was fairly average (45-55%) and on the plot treated with *Azadirachta indica* (neem) germination was very poor (< 35%) probably due to toxic substances released by the plant which may inhibit growth (Purginier, 1982). *Azadirachta indica* (neem) was however found to be a good controller of weed as weed growth in the plot treated with it was comparatively reduced compared to other treated plots. Weed growth was very rapid in plots treated with animal manure i.e. poultry dung, pig slurry and farmyard manure (FYM).

Effects of treatments on plant height

The effect of the treatments on the plant height was observed to vary significantly ($P < 0.05$) in all treated plots except the control plot due to the release of additional nutrient by the decomposing of the amendment materials. The plant heights for the plots treated with animal manures (e.g. FYM and pig slurry) were quite higher (133.22 mm and 136.56 mm respectively) than those treated with plant materials (*Gliricidia sepium, Chromolaena odoratum, and Azadirachta indica*) which were 120.33, 122.79, and 105.35 mm respectively. Although plants treated with poultry dung had lower heights than other animal manures (Table 1), the height (with mean = 116.05 ± 52.5 mm) was greater than that of *Azadirachta indica* (mean = 105.35 ± 39.3 mm) and control plot (mean = 55.09 ± 22.1 mm). The vegetable variety, *Celosia argentea* seeds therefore grew more rapidly in plots treated with animal waste (Table. 1). The treatments, especially the pig slurry and farmyard manure (FYM) encouraged rapid growth of the *Celosia argentea* TLV8 more than all other amendment materials.

Effects of treatments on number of leaves

The total number of leaves per plot of the vegetable varied with the different types of treatments. The plots treated with pig slurry, farmyard manure and poultry dung encouraged the growth of larger number of leaves than those treated with plant residues. Plots treated with *Chromolaena odoratum* (205 leaves), performed better in terms of leaf number than those treated with *Azadirachta indica* and *Gliricidia sepium*. The total numbers of leaves counted for treatments with animal manures were 193, 216, and 227 for poultry dung, FYM, and pig slurry respectively (Table 2). The pig slurry had a 3.67 % and 11.37 % increase over the poultry dung and FYM treatments respectively ($P < 0.05$). The control plot with 128 leaves had significantly fewer numbers of leaves per plot ($P < 0.05$) than the entire treated plot. It can therefore be concluded that the animal manure enhanced the growth of more leaves than the plant residues, however, *Chromolaena odoratum* supported more leaves than the poultry dung.

Effects of treatment on yield

All the yields for the treatments were significantly different ($P < 0.05$) from that of the control plot, however, the animal manure treated plots especially the pig slurry and farmyard manure (FYM) plots showed significant increase ($P < 0.01$) in yield compared to those treated with plant materials probably due to the faster rate of decomposition of animal manure and subsequent release of plant nutrients. Pig slurry and farmyard manure appeared to perform best in improving yield. Pig slurry produced yield of over 36.96 t/ha for the *Celosia argentea* variety, while the farmyard manure produced about 31.25 t/ha (Table 3). The yield in the plot treated with *Azadirachta indica* (neem) was very poor (about 7.5 t/ha) compared to other plots and this could be as a result of the alleopathic property of neem (Purginier, 1982).

Effects of treatments on organic matter content in soil (SOM)

Assessment of the state of soil organic matter is a valuable step towards identifying the overall quality of a soil because organic matter is the primary source of, and a temporary sink for, plant nutrients (Gregorich *et al*., 1994; Larson and Pierce, 1994; Morris *et al*., 1997). The soil organic matter (SOM) content generally changed as the growth of the plants increased, achieving the highest levels in the eight week. A slight decline in the levels of SOM especially after the 6th week of treatment in plots treated with FYM, *Chromolaena odoratum, Azadirachta indica* (neem), and the control was observed ($P < 0.01$). There was a 27%, 35.6%, 16.26%, and 21.27% decrease in SOM content for the FYM, *Chromolaena odoratum, Azadirachta indica* (neem), and the control respectively at the 6th week before increasing again in the 8th week except for the control plot, which further declined by 10.34 % from the amount in the 6th week. Experimental plots treated with pig slurry, poultry dung, and *Gliricidia* spp. did not experience any significant decline in SOM in the 6th week ($P > 0.05$). Organic matter declined in the control plot due to the fact that no treatment was added and hence, no additional nutrients apart from the initial amount present in the soil. There was a general increase in the 8th week for all the treated plots except the control. Organic matter content ranged between 1.50 % in *Chromolaena odoratum* to 3.32 % in pig slurry in the 6th week. *Gliricidia* spp. and pig slurry performed better in improving the organic matter content of the soils.

Effects of treatments on the exchangeable Ca, Mg, and K.

It was observed that exchangeable Ca, Mg, and K tended to increase as the days after planting increased into the 6th week. In plots treated with FYM, *Azadirachta*, and poultry dung. The poultry dung treated plot increased most significantly ($P < 0.05$) from 3.86cmol kg^{-1}in the 4th week and 7.60cmol kg^{-1} soil in the 6th week, but declined to 6.70cmol kg^{-1} soil in the 8th week. Magnesium also increased from 1.54cmol kg^{-1} soil in the 4th week to 4.56cmol kg^{-1} in soil the 6th week for plots treated with poultry dung, but decreased to 2.69cmol kg^{-1} soil in the 8th week. This was also true of plots treated with *Chromolaena odoratum*, while other plots continued to increase throughout except the control that continued to decline. The potassium content exhibited the same trend like the magnesium (Table 5). The trends observed could be as a result of the fact that calcium and magnesium are normally found to be substantial in the topsoil, which is associated with more organic matter in moist tropical lowlands (Greenland and Kowal, 1960), while K is rapidly and tightly recycled in the soil.

Effects of treatments on the soil N and available P

The poultry dung treated plots exhibited a high percentage increase in soil nitrogen, so also the plots treated with *Gliricidia* spp., (a nitrogen-fixer). These two plots had higher nitrogen contents than all other plots including the control. Available P is also more pronounced in the plots treated with poultry dung and *Gliricidia* spp. Both soil nitrogen and available P declined rapidly in the control plots because there was no addition of organic manure.

Conclusion

The on-farm comparison, of the effects of organic amendments on the growth of the *Celosia argentea* provided an indication of the short-term impacts of SOM management practices for the region. The result of the study showed that in the plots treated with animal manures (poultry dung, pig slurry, and FYM) more yield (in terms of number of leaves), resulted in higher SOM, and exchangeable Ca, Mg, and K than those treated with plant residues and the control plots. The plot treated with *Azadirachta indica* (neem) had very poor growth probably due to toxic substances released by the plant, which inhibited growth (Purgineer, 1982). Of all the amendments applied, pig slurry followed by poultry dung exhibited the highest potential of improving the SOM conditions. *Gliricidia* spp. was the most productive of the plant residues because there was constant increase in leaf number, exchangeable Ca, Mg, and K, and SOM throughout the period of the field experiment.

The addition of both animals' manures (poultry dung, pig slurry, and FYM) and plant residues (especially *Gliricidia spp*. and *Chromolaena spp*.) were found to contribute significantly to the growth of *Celosia argentea* and improved soil quality as indicated by the higher SOM content and the exchangeable Ca, Mg, and K; available P and nitrogen present in the soil. Amendments such as *Azadirachta indica* (neem) have also shown its alleopathic property, which could help reduce the growth of weeds.

The study has also demonstrated that organic amendments were vital to improving the soil quality status in soils that have low nutrient holding capacities like those of the present study area.

References

Adepetu, J. A., A. A. Adebayo., E. A. Aduayi, and C. O. Alofe (1979). A Preliminary Survey of the Fertility Status of Soils in Ondo State under Traditional Cultivation. *Ife J. Agric*. 1 (2): 134 - 149.

Andrews, S. S., Mitchell, J.P., Mancinelli, R., Karlen, D. L., Hartz, T.K., Howarth, W.R., Pettygrove, G.S., Scow, K.M. and Munk, D.S. (2002). On-farm assessment of soil quality in California's Valley. *Agronomy Journal*. 94 (1): 12-23.

Anoka, U.A., Akobundu, I.O. and Okonkwo, S.N.C. (1991). Effects of *Gliricidia sepium* and *Leucaena leucocephala* on growth and development of *Imperata cylindrica*. *Agroforestry Systems*, 16: 1-12.

Asiamah, R.D. (1996). Nutrient Depletion and Soil Mining in sub-Saharan Africa Agriculture. In: Batjes, R.H. et al (eds.) ISRIC, 1996. *National Soil Reference Collection and Databases. . NASREC.* Vol. 2:18-23.

Aweto, A.O. (1987). Physical and Nutrient Status of Soils under Robber (Hevea Brasilensis) of Different ages in South-Western, Nigeria. *Agricultural Systems* 23: 63-72.

Bray, R.H. and Kurtz, L.T. (1945). Determination of total, organic and available forms of phosphorous in soils. *Soil Science*.59: 39-46.

Christensen, B.T. (1996). Matching measurable soil organic matter fractions with conceptual pools in simulation models of carbon turn-over: Revision of model structure.. In: D.S. Powlson *et al.*(ed). *Evaluation of organic matter models*. NATO. ASI Ser. Vol. 138: 143-159 Springer-Verlag, Berlin.

D'Hoore, J. L. (1964). *Soil Map of Africa. Explanatory Monograph*. Lagos, Nigeria: CCTA.

Doran, J.W. (1996). *On-Farm Measurement of Soil Quality Indexes.* USDA-ARS, 116 Keim Hall, University of Nebraska, Lincoln NE 68583.

Doran, J.W., and A.J Jones (eds.) (1996). Methods for Assessing Soil Quality. *Special Publication No 49. Soil Science Society of America*, America Society of Agronomy, Inc Madison, WI 410 YP.

Doran, J.W., Sarrantonio, M. and Janke, R (1994). Strategies to promote soil quality and health. In: Pankhurst, CE, Doube, BM, Gupta, VVSR, Grace, PR. (eds) *Soil Biota: management in sustainable farming systems*. CSIRO: Australia. 230-237.

Gbadegesin, A.S. (1992). Soils. In: Onakomaiya, S.O., Oyesiku, O.O., and Jegede, F.J. (eds.) *Ogun State in Maps.* Rex Charles Publications. Nigeria. 34-38.

Gbadegesin, A., and Nwagwu, U. (1990). On the suitability assessment of the forest and savanna ecological zones of southwestern Nigeria for maize production. *Agriculture, Ecosystems, and Environment.* 31:99-113.

Greenland, D.J. and Kowal, J.M. (1960). Nutrient content of the moist forest of Ghana. *Plant and Soil.* 12: 154-173.

Gregorich E.G., Carter, M.R., Angers, D.A., Monreal, C.M. and Ellert, B.H. (1994). Towards a minimum data set to assess soil organic matter quality in agricultural soils. *Can. J. Soil Science*, 74:367-385.

Hauser, S. (1990) Water and nutrient dynamics under alley cropping versus monocropping in the humid-subhumid transition zone. *Transactions 14th International Soil Science Society Congress,* Kyoto, Japan, Vol. VI, 204-209.

Hopkins, B. (1974). *Forest and Savanna*. London: Heinemann.

Janzen, H. H., Larney, F. J. and B. M. Olson. (1992). Soil Quality Factors of Problem Soils in Alberta. *Proceedings of 29th Annual Alberta Soil Science Workshop*. Feb 18-20, 1992. 17-28. Lethbridge, Alberta. Department of Soil Science, University of Alberta, Edmonton, Alberta T6G 2E3.

Janzen, H.H., Campbell, C.A., Gregorich, E.G. and Ellert, B.H. (1998). Soil carbon dynamics in Canadian agroecosystems. In: Lal *et al.* (eds.*) Soil processes and the carbon cycle*. CRC Press, Boca Raton, FL. 57–80.

Kang, B.T., Wilson, G.F. (1987) The development of alley cropping as a promising agroforestry technology. In: Steppler, H.A., Nair, P.K.R. (eds), *Agroforestry a Decade of Development.* ICRAF, Nairobi, Kenya, 227-243.

Karlen, D.L, Mausbach, M. J., Doran, J.W., Cline, R.G., Harris, R.F. and Schuman, G.E. (1997). Soil quality: A concept, definition, and framework for evaluation. *Soil Science Society of America Journal*. 61:4-10.

Keeney, D.R. and Cruse, R. (1997). Soil quality: the bridge to a sustainable agriculture. *International Symposium on Soil, Human and Environmental Interactions*. Institute of Soil Science, Academica Sinica, Nanjing, China. May 1997. 99-103.

Kehinde-Phillips, O. (1992). Geology. In: Onakomaiya, S.O *et al*. (eds.), *Ogun State in Maps.* Rex Charles Publishers, Ibadan, Nigeria. 12-13.

Lal, R. (1984). Management of soils for continuous production: controlling erosion and maintaining physical condition. In: D. J. Greenland (ed.). *Characterization of soils: examples from some areas of humid tropics.* 188-201.Claredon Press; Oxford. U.K.

Lal, R. (1989a). Agroforestry systems and soil surface management of a tropical alfisol: 2. Water runoff soil erosion and nutrient cropping as a promising agroforestry technology. In: Steppler, H.A. and Nair, P.K.R. (eds), *Agroforestry a Decade of Development loss*. *Agroforestry Systems*. 8: 97-111.

Lal, R. (1989b). Agroforestry systems and soil surface management of a tropical alfisol: 3. Changes in soil chemical properties. *Agroforestry Systems* 8: 113-132.

Larson, W.E., Pierce F.J. (1994). The dynamics of soil quality as a measure of sustainable management. In: Doran J.W., *et al.*, (ed). *Soil quality for a sustainable environment*. Madison, WI: SSSA. Pp.37-51 SSSA Spec. Publ. 35.

Larson, W.E. and F.J. Pierce (1991). Conservation and Enhancement of Soil Quality. In: *Evaluation for Sustainable Land Management in the Developing World*. pp.175-203, Int. Board for Soil Res. and Management. (IBSRAM Proceedings). No 12(2).

Lewandoski, A. and Zumwinkle, M. (1999). *Assessing the soil system. A review of soil quality literature*. Minnesota Department of Agriculture. Energy and Sustainable Agriculture Program. 24-45.

Meyer, I. D., Dabney, S.M., and Harmon, W.C. (1995). Sediment-trapping effectiveness of stiff-grass hedges. *Trans. ASAE*. 38: 809-815.

Morris, D.M., Kimmins, J.P. and Duckert D.R. (1997). The use of the soil organic matter as a criterion of the relative sustainability of forest management alternatives: a modelling approach using FORECAST. *For. Ecol. Manage*. 94:61-78.

Mugendi, D. (1999). Alley cropping of maize with Calliandra and Leucaena in the sub-humid highlands of Kenya. Part I. Soil fertility changes and maize yield. *Agroforestry Systems*. 46: 39-50.

Ogunkunle, A. O. and Erinle, W. O. (1994). Influence of Tillage or the Variability of Some Soils of an Alfisol in Southwestern Nigeria. *Journal of Science Research*. Vol. 1 (1): 51-57

Ojanuga, A. G. (1975). Morphological, physical and chemical characteristics of soils of Ife and Ondo areas. *Nigeria J. of Science*. 9. 225 - 265.

Pierce, F.J. and Larson, W.E. (1993). Developing criteria to evaluate sustainable land management. In: J.M. Kimble (ed.) *Proceedings of the Eighth International Soil Management Workshop: Utilization of Soil Survey Information for Sustainable Land Use*. May 1993. USDA, Soil Conservation Service, National Soil Survey Center. p. 7-14.

Pockaee, T. and Summer, P. (1997). Cation and nitrogen contents of organic matter determines its soil liming potentials. Soil Sci. Soc.Am.J. 61: 86-92.

Purgineer, O. (1982). Neem as multipurpose tree: *Agroforestry Today*. 18:20-23.

Walkey, A., Black, I.A. (1934). An estimation of the Detjareff method for determining soil organic matter and a proposed modification to the chromic acid titration method. *Soil Sci*. 37:29-38.

Young, A. (1997). *Agroforestry for soil management*. CAB International, Wallington, UK.

Table 1:Efffects of different treatments on plant heights

Treatments	Plant Heights (mm)				
	4th week	6th Week	8th Week	Total	Mean ± SD
Poultry Dung	55.25	109.50	183.4	348.15	116.05 ± 55.5
FYM	75.47	132.80	194.0	402.27	133.22 ± 48.4
Pig Slurry	78.32	133.34	198.02	409.68	136.56 ± 48.9
Gliricidia sp.	75.40	121.90	163.7	361.00	120.33 ± 36.1
Chromolaena sp	59.21	132.20	175.95	367.16	122.79 ± 48.2
Azadirachta (neem)	55.75	108.50	151.80	315.05	105.35 ± 39.3
Control	24.73	63.85	76.7	165.28	55.09 ± 22.1
TOTAL	343.21	668.75	946.55	2373.62	

Source: On farm Study 2005, LSD (0.05)= 3.14

Table 2: Effects of different treatments on number of leaves

Treatments	Leaf number				
	4th week	6th Week	8th Week	Total	Mean (x)
Poultry Dung	40	63	90	193	64.3
FYM	52	66	98	216	72.0
Pig Slurry	56	68	103	227	75.67
Gliricidia sp.	49	61	86	196	65.33
Chromolaena sp	44	69	92	205	68.33
Azadirachta (neem)	31	59	68	158	52.67
Control	23	43	61	127	42.33
TOTAL	295	429	598	1222	

Source: On farm Study 2005,LSD (0.05) =4.9

Table 3: Effects of different treatments on Yield

Treatments	Yield (ton/ha)				
	4th week	6th Week	8th Week	Total	Mean (X)
Poultry Dung	9050	10050	11200	30300	10100
FYM	10100	10450	10700	31250	10416
Pig Slurry	11365	12600	13000	36965	12321
Gliricidia sp.	3550	3850	4120	11520	3840
Chromolaena sp	5200	6000	6300	17500	5833
Azadirachta (neem)	1025	3000	3520	7545	2515
Control	1230	1850	1900	4980	1660
TOTAL	41520	47800	50740	140060	

Source: On farm Study 2005, LSD (0.05) = 43.75

Table 4: Effects of different treatments on Organic Matter Content

Treatments	Soil Organic Matter (%)		
	4th week	6th Week	8th Week
Poultry Dung	2.62	3.16	3.39
FYM	2.44	1.78	2.65
Pig Slurry	2.57	3.32	3.62
Gliricidia sp.	2.35	2.56	2.69
Chromolaena sp	2.33	1.50	1.99
Azadirachta (neem)	2.09	1.75	1.92
Control	2.21	1.74	1.56

Source: On farm Study 2005.

Table 5: Effects of different treatments on Exchangeable Bases

Treatments	Exchangeable Bases (cmol kg^{-1})								
	Ca			Mg			K		
	4th Week	6th Week	8th Week	4th Week	6th Week	8th Week	4th Week	6th Week	8th Week
Poultry Dung	3.88	7.60	6.70	1.54	4.56	2.69	1.44	3.25	2.56
FYM	5.46	6.45	6.88	1.70	1.81	2.06	1.66	3.09	2.45
Pig Slurry	5.78	7.55	7.89	1.43	4.45	2.64	1.42	3.32	2.78
Gliricidia sp.	4.22	3.89	4.68	1.33	1.09	1.37	1.35	1.13	1.37
Chromolaena sp	4.45	3.51	4.30	1.53	0.98	1.36	1.56	0.99	1.35
Azadirachta (neem)	3.67	4.01	4.13	1.29	1.42	1.62	1.31	1.41	1.63
Control	4.11	3.90	3.76	1.48	1.32	1.09	1.50	1.46	1.08

Source: On farm Study, 2005