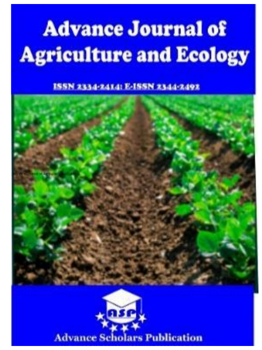
Advance Journal of Agriculture and Ecology
Adv. J. Agric. & Eco.
Volume: 9; Issue: 11
November-2024
ISSN 2334-2414
E-ISSN 2344-2492
Impact Factor: 5.39
Advance Scholars Publication
Published by International Institute of Advance Scholars Development
https://aspjournals.org/Journals/index.php/ajae/index



SOIL FERTILITY STATUS AND MICROBIAL CONTRIBUTIONS TO SOIL FERTILITY IN COMPOUND FARMS IN UNIVERSITY OF NIGERIA, NSUKKA

Asadu, C.L.A and C. E. Mama
Department of Soil Science, University of Nigeria, Nsukka
Corresponding author email: charles.asadu@unn.edu.ng

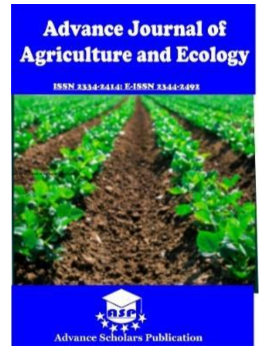
Keywords: *Soil fertility, microbes, compound farms, University*

Abstract: *The study was carried out at the University of Nigeria, Nsukka to assess the soil fertility status and determine microbial contributions to soil fertility in the compound farms. The physicochemical properties of soils, fungi and bacteria species, number and populations were determined after portioning the farms into low slopes (CFLS) and high slope (CFUS) zones. Twenty soil samples from 0-20 cm depth were collected from each zone and bagged in black polythene, air dried and sieved with 2-mm sieve for the analysis of the properties following standard methods. The residents grew similar crops with the same purpose, mainly for family use. The soils of both slope positions were dominated by coarse textures with silt having the least values. The soils of CFUS were slightly acidic and those of CFLS moderately acidic. Also organic matter, total N and available P were low while exchangeable Mg, Ca and K moderate. The CEC values in CFUS were high compared to moderate values obtained from the CFLS soils. The microbial population was higher in the CFUS soils than in the CFLS soils. Generally, the fertility status of the soil was moderate. It was recommended that the farmers should embark on soil nutrient replenishment practices by adding organic and inorganic fertilizers to their soils and avoiding rubbish burning on their compound farms as this practice tend to kill most of the microbes that help in improving soil health and fertility.*

Introduction

Bacteria and fungi are microorganisms that are too small to be seen with the unaided eye. They play crucial roles in various ecosystems, contributing to processes such as organic matter decomposition, nutrient cycling and soil enrichment. In general, micro fauna and flora are known as microorganism that are smaller than 0.1mm (Ellouze *et al.,* 2014; Qiao *et al.,* 2017).The population and species of soil bacteria and fungi differ widely and are influenced by climate, soil conditions and the presence of hazardous substances, thus determining their level of their contributions to organic matter

Advance Journal of Agriculture and Ecology
Adv. J. Agric. & Eco.
Volume: 9; Issue: 11
November-2024
ISSN 2334-2414
E-ISSN 2344-2492
Impact Factor: 5.39
Advance Scholars Publication
Published by International Institute of Advance Scholars Development
https://aspjournals.org/Journals/index.php/ajae/index



build up for soil fertility enhancement, cycling of nutrients in the biosphere, ecosystem sustainability, humus formation, biological conversions and geochemical cycling..

Lands surrounding homes are grown to different crops, using domestic and livestock wastes to fertilize the soils. These lands surrounding homesteads on which crops are grown are generally known as compound farms. Compound farms encompass a system involving the incorporation of trees and shrubs into crop and small livestock farming systems within the compounds of peoples' yards (Okafor and Fernandes, 1987). In this system, garbage, leftover crops and animal waste are used to keep the soil fertile (Onyenweaku et al., 1996). However, soil loss due to crop harvesting result in loss of soil nutrients (Oshunsanya *et al.,* 2018). This is because a lot of soil and soil nutrients are taken from cropped land when root, tuber, bulb, and legume crops like yam, cassava, onion, and groundnut, which are often grown in compound farms, are harvested (Dada *et al.,* 2016). Therefore, to ensure optimum soil productivity and crop performance, nutrients lost through harvesting and other losses must be adequately replaced by fertilizers (Marschner, 1995).Management practices adopted by farmers are crucial to the overall soil fertility and productivity status of compound farms. Proper soil fertility management helps to improve soil fertility status by enhancing organic matter content, increasing the efficiency of nutrients by using closed nutrient cycles, and minimizing nutrient losses (Conway, 1997). For example, farmers have to consider the slope positions of their farmlands as a critical approach to manage the fertility of the soils effectively. This is due to the fact that different slope positions often result in different soil fertility attributes (Awdenegest and Nicholas, 2008). Slope positions shape nutrient and water flux, distribution and concentration across toposequence. As pointed out by Mulugeta *et al.*, (2012), slope increase soil disturbance and erosion, and equally influence soil parameters by altering plant growth, litter formation, and decomposition patterns, which in turn affect carbon and nitrogen contents of soils. At the University of Nigeria, Nsukka compound farms are used to grow a variety of crops to supplement household food needs especially in the face of the biting economic hardship and food insecurity in Nigeria. Thus, the aims of this research were to assess the fertility status the soils of the compound farms and identify bacteria and fungi that could be contributing to the soil fertility and advice the resident staff on the efficient management decisions for increased crop yield and sustainable use of the soils.

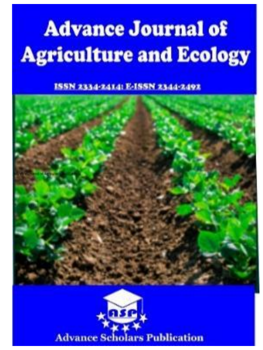
Materials and Methods

Site Description

Location of the Study

The location of this research was at the University of Nigeria, Nsukka campus in Southeastern Nigeria sited by 6°54'N and 7°24'E latitude and longitude respectively, on an elevation of 447.26 meters above mean sea level (Oko-Ibom and Asiegbu, 2006).

Advance Journal of Agriculture and Ecology
Adv. J. Agric. & Eco.
Volume: 9; Issue: 11
November-2024
ISSN 2334-2414
E-ISSN 2344-2492
Impact Factor: 5.39
Advance Scholars Publication
Published by International Institute of Advance Scholars Development
https://aspjournals.org/Journals/index.php/ajae/index



Geology and Soils

The soils of Nsukka are a blend of many soil types, including soils characterized by the reduction or localized segregation of iron, owing to the temporary or permanent water logging of the soil pores which causes lack of oxygen over a long period in the floodplains and ferrallitic soils (also called red earth or acid sands) on the cuesta and plateau slopes (Ezeaku and Iwuanyanwu, 2013). They are predominantly Ultisols, an order of well-drained ferallitic sandy clay loams. Sand deposits of false-bedded sandstone create the dark red to brownish red soil color matrix of the mid and higher slopes (Ezeaku, 2000). Soils on gentler slopes are majorly Alfisols; a reddish brown to brownish black soils based on classification using Soil Survey Staff (1999). However, the soils of this region are inherently low in fertility due to poor nutrient reserves in their parent materials, rapid organic matter decomposition due to high temperatures, and increased nutrient leaching and losses due to rainfall of increased amount and intensity (Asadu *et al.,* 2010).

Climate

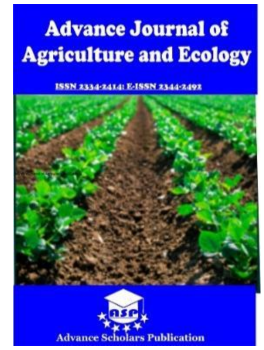
The area has a humid tropical climate with wet (April–October) and dry (November–March) seasons. Precipitation averages 1550 mm per year, with the highest totals occurring in July and September. Average highest temperatures during the daytime reach 31 degrees Celsius, while lowest at night dip to 21 degree Celsius. The relative humidity varies between 70 and 80 percent (Oko-Ibom and Asiegbu, 2006). This range dips below 60% during the Harmattan; a 3-week period of foggy, dry weather that occurs between December and January (Asadu *et al.,* 2001).

Vegetation

The vegetation of Nsukka is secondary, mainly due to anthropogenic activities such as land clearing, bush burning, and land cultivation (Asadu and Akamigbo, 1987), and hence best described as derived savannah (Savanna-mosaic) agroecology (Ezeaku and Iwuanyanwu, 2013). The following species of shrubs and grasses are native to this area: Elephant grass *(Pennisetum purpureum*), Gamba grass (*Andropogon gayanus*), Guinea grass (*Panicum maximum*), Bahia grass (*Paspalum notatum*), Green couch *(*Cynodon dactylo*n*), Para grass (*Brachiaria mutica)*, African star grass (*Cynodon lemfuecens and C. plectostachyus*), etc. (Ezeaku and Eze, 2014). The tree species are oil bean tree (*Penteclethra mycrophylla*), oil palm (*Elais guinensis*), cashew *(Anacadium occidentales*), among others.

Table 1 shows the precise altitudes (elevations above mean sea level, amsl), latitudes and longitudes of the sampled points collected using GPS., Compound farms in upper slope (CFUS) zone had an elevation range from 480 to 424 meters amsl, whereas Compound farms in lower slope (CFLS) zone had an elevation range from 464 to 88 meters amsl. The crops grown by residents range from vegetables, cereals to root and tubers. There was no marked difference in the crops grown due to topographic positions

Advance Journal of Agriculture and Ecology
Adv. J. Agric. & Eco.
Volume: 9; Issue: 11
November-2024
ISSN 2334-2414
E-ISSN 2344-2492
Impact Factor: 5.39
Advance Scholars Publication
Published by International Institute of Advance Scholars Development
https://aspjournals.org/Journals/index.php/ajae/index

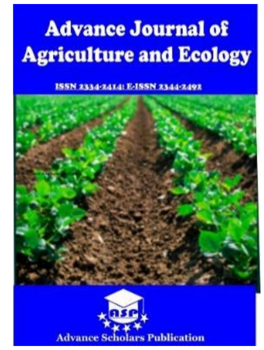


and within the streets. This reflects prevailing similar climatic conditions within UNN and food preferences by the residents.

Table 1: Sampling locations and site characteristics

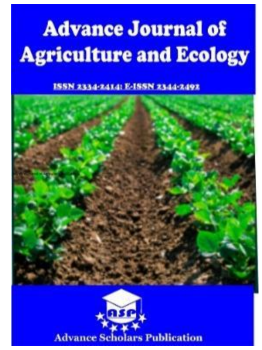
Name	Altitude (m)	Latitude (N)	Longitude (E)	Crops grown	Weeding method	Use of herbicide	Fertilizer application/manure	Purpose of cultivation
Fulton Avenue	427	6°51' 32.33988"	7°24.31.47012	Maize, Mellon, cucumber and cassava	Hand weeding	No	NPK	Commercial and subsistence
Fulton Avenue	424	6°51'24.61032"	7°24'15.68664	Waterleaf, tomatoes and plantain	Hand weeding	No	Poultry manure	Subsistence
Cartwright avenue	440	6°51' 35.96508"	7°24' 28.75788	Okro, tomatoes and garden egg	Hand weeding	No	NPK	Subsistence
Cartwright avenue	461	6°51' 31. 0968"	7°24' 30.67488	Pawpaw, cassava and banana	Hand weeding	No	NPK	Commercial and subsistence
Cartwright avenue	480	6°51' 31.8852"	7°24' 30.94308	Cassava and maize	Hand weeding	No	NPK	Subsistence
227 Ikejiani	462	6°51' 33.24744"	7°24' 22.3181"	Scent leaf, cocoyam and maize	Hand weeding	No	NPK	Subsistence
223 Ikejani	426	6°51' 29.62188"	7°24' 22.518"	Plantain, maize, potatoes and cassava	Hand weeding	No	NPK	Subsistence

Advance Journal of Agriculture and Ecology
Adv. J. Agric. & Eco.
Volume: 9; Issue: 11
November-2024
ISSN 2334-2414
E-ISSN 2344-2492
Impact Factor: 5.39
Advance Scholars Publication
Published by International Institute of Advance Scholars Development
https://aspjournals.org/Journals/index.php/ajae/index



VC53+Q*8	451	6°51' 34.2234"	7°24' 18.43956	Cassava and maize	Hand weeding	No	Poultry manure	Subsistence
220 Ikejiani	429	6°51' 29.9181	7°24' 16.1316"	Cassava, scent leaf, garden egg and water leaf	Hand weeding	No	NPk	Subsistence
441 Elais Avenue	424	6°51' 24.61032"	7°24' 15.68664	Cassava, bitter leaf, ugu and cocoyam	Hand weeding	No	NPK	Subsistence
Eninjoku street	464	6°52'8.82372"	7°24' 45.42984"	Cassava, cocoyam and pawpaw	Hand weeding	No	Poultry manure	Subsistence
Eninjoku street	414	6°52' 10.93692	7°24' 37.55376"	Cocoyam, maize, cassava, ugu and bitter leaf	Hand weeding	No	NPK	Subsistence
Eninjoku street	382	6°52' 12.91368"	7°24' 36.79416	Pawpaw, plantain, cassava and ugu	Hand weeding	No	Poultry manure	Subsistence
Eninjoku	358	6°52'12.91368"	7°24'36.79416	Cassava and maize	Hand weeding	No	NPK	Subsistence
Kingjaja street	309	6°52' 12.07524	7°24' 26.91664"	Maize, cassava and cocoyam	Hand weeding	No	NPK	Subsistence
Chief Imoke Street	88	6°52' 10.28568"	7°24' 36.91476"	Maize, cassava and ugu	Hand weeding	No	NPK	Subsistence
Muritala Moham	308	6°52' 13.40652	7°24' 33.65964	Maize, cassava	Hand weeding	No	Poultry manure	Subsistence

Advance Journal of Agriculture and Ecology
Adv. J. Agric. & Eco.
Volume: 9; Issue: 11
November-2024
ISSN 2334-2414
E-ISSN 2344-2492
Impact Factor: 5.39
Advance Scholars Publication
Published by International Institute of Advance Scholars Development
https://aspjournals.org/Journals/index.php/ajae/index



med street								
Muritala Mohamed	262	6°52' 22.26612"	7°24' 28.87813	Bitter yam, cassava, corn	Hand weeding	No	NPK	Subsistence
654 Junior staff	383	6°52' 19.83"	7°24' 30.59	Maize, cassava and ugu	Hand weeding	No	Poultry	Subsistence
Police post	379	6°52' 16.76388"	7°24' 23.53788	Ugu, maize and cassava	Hand weeding	No	NPK	Subsistence

Note: From Fulton avenue (427) to 441 Elais Avenue (424) indicate compound farms of upper slope (**CFUS**) while from Eninjoku street (464) to former Police post (379) indicate compound farms of lower slope (**CFLS**)

Field sampling

The top soils (0-20 cm dept) were collected using soil auger from twenty different compound farms in University of Nigeria, Nsukka and the latitude, longitude and altitude of the sampling points were taken, including the management practices they adopt, crops grown and the purpose of farming (Table 1). The soil samples were bagged each in a new polythene bag and taken to the Department of Soil Science at the University of Nigeria in Nsukka for analysis.

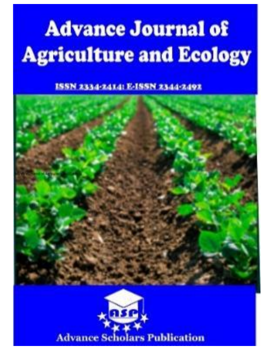
Laboratory analysis

The soil samples were air dried and passed through a 2-mm sieve before analysis in the laboratory. Standard procedures were followed in all the analyses for fertility indices and microbial population determinations. The Bouycous hydrometer technique was used to determine the particle size distribution of the soil (Gee and Orr, 2002). A ratio of 1:2.5 of soil to liquid was used to determine the pH of the soil both in water and 0.1 N KCl. The Walkley and Black wet digestion method was used to determine the organic carbon content of the soil which was converted to soil organic matter (SOM) by multiplying by a factor 1.724 (Nelson and Sommers, 1982). Micro Kjeldahl digestion was used to determine total nitrogen (Bremner and Mulvaney, 1982). The Bray II method was used to determine the available phosphorus (Olsen and Sommers, 1982). Exchangeable acidity and cation exchange capacity (CEC) were determined according Soil Survey Staff (2014). The titration method was used to determine the exchangeable acidity (Mclean, 1982).

Microbial Analysis

A suspension of 1 g of each soil (dry weight equivalent) in 10 ml of sterile water was prepared. One ml of the soil suspension was diluted ten-fold and used in the estimation of aerobic heterotrophic bacterial and fungal populations by standard spread-plate dilution

Advance Journal of Agriculture and Ecology
Adv. J. Agric. & Eco.
Volume: 9; Issue: 11
November-2024
ISSN 2334-2414
E-ISSN 2344-2492
Impact Factor: 5.39
Advance Scholars Publication
Published by International Institute of Advance Scholars Development
https://aspjournals.org/Journals/index.php/ajae/index



method in triplicates. Nutrient agar containing 0.015% (w/v) nystatin (to inhibit fungi growth) was used for bacteria isolation and incubation was at 35°C for five days. Potato dextrose agar to which 0.05% (w/v) chloramphenicol has been added (to inhibit bacteria growth) was used for fungal isolation, and incubation was at ambient temperature for seven days. Pure isolates of representative communities were maintained on agar slant at 4°C. Identification of isolates was based on cultural, microscopic, and biochemical characteristics with reference to Bergey's manual of determinative bacteriology (1989) for bacteria, and Talbot (1978) for fungi.

Data analysis and interpretation

GenStat Discovery Edition 2 was used to conduct a simple factor t-test on the data that were produced from the laboratory analysis. The comparison of the means was carried out using the Fisher's least significant difference (LSD) test at a significant level of $P \leq 0.05$. Enwezor et al. (1989) critical limits of interpreting soil fertility indices and distinguishing between insufficiency and sufficiency concentration levels were used to categorize the soil fertility indices.

Results and Discussion

Soil particle size distributions in the compound farms

The result of particle size distributions (PSD) of all the compound farms sampled at the upper and lower slope is given in Table 2. The particle size distribution results revealed that the trend across the slopes is fine sand > coarse sand > clay > silt. Coarse sand was significantly higher in lower (520 gkg^{-1}) than in upper (260 gkg^{-1}) slope position. The upper slope position recorded significantly higher silt and fine sand than lower slope position (Table 2). However, there was no significant effect of slope position on the clay content. The textural class was sandy clay loam in both the upper and lower slope positions.

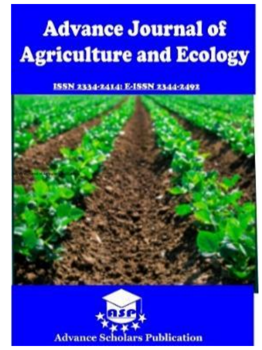
Table2: Particlesizedistributionofcompoundfarmsin UniversityofNigeria, Nsukka

Location	Clay	Silt	Fine Sand	Coarse Sand	Texture
	________(gkg^{-1})________				
Upper	220	170	350	260	sandy clay loam
Lower	240	90	150	520	sandy clay loam
F-LSD	Ns	50	90	60	

Soil chemical properties of the Compound farms

Tables 3 shows the mean values for pH, organic matter content, CEC and other selected fertility parameters in the topsoil of the upper and lower slopes compound farms respectively.

Advance Journal of Agriculture and Ecology
Adv. J. Agric. & Eco.
Volume: 9; Issue: 11
November-2024
ISSN 2334-2414
E-ISSN 2344-2492
Impact Factor: 5.39
Advance Scholars Publication
Published by International Institute of Advance Scholars Development
https://aspjournals.org/Journals/index.php/ajae/index



The soil pH values were significantly different across the compound farms. A mean value of 6.20 was recorded at CFUS compared to 6.0 at CFLS. The exchangeable hydrogen (H^{+}) was significantly higher in the upper slope (1.86 cmolkg^{-1}) than at the lower (1.30 cmolkg^{-1}). Among all the exchangeable bases only exchangeable Ca was significantly influenced by the slope positions being higher (3.54 cmolkg^{-1}) at upper slope than at the lower slope (1.62 cmolkg^{-1}). Again exchangeable Al, CEC and available P were not influenced by the slope position. However, exchangeable Mg and CEC were higher at the upper slopes than at the lower slope while phosphorus and organic carbon were higher at the lower slopes than at the higher slope positions (Table 3).

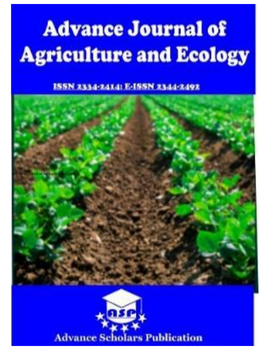
Table 3: Chemical properties of compound farms in University of Nigeria Nsukka

Location (mgkg^{-1})	pH H_2O	pH KCl	SOM (%)	H	Al	Mg cmolkg^{-1}	Ca	K	Na	TN	CEC (%)	Av. P (cmolkg^{-1})
Upper	6.2	5.6	1.61	1.86	0.24	0.80	3.54	0.17	0.08	0.063	16.56	7.74
Lower	6.0	5.0	1.64	1.30	0.20	0.78	1.62	0.16	0.08	0.099	14.76	7.80
F-LSD	0.18	0.2	Ns	0.2	Ns	Ns	1.48	Ns	Ns	0.023	Ns	Ns

Nutrient Dynamics of CFLS and CFUS of the University of Nigeria Nsukka (UNN)

Table 4 presents a general ranking of the examined soil fertility indicators, for CFUS and CFLS. The normal slope effects on soil property distribution along slopes were not expected in this study. This is understandable due to various structures between CFUS and CFLS including buildings and road networks. The soil pH varied from slightly acidity (6.20) at the CFUS to moderately acidic (6.0) at the CFLS and in the range that support nutrient availability in soils of sub-Saharan Africa (Asadu and Nweke, 1999). The CFUS at UNN from time had more grasses than CFLS and Amuyou and Kotingo (2015) found that grasses covering an upper slope segment caused the soil pH to be significantly higher than in other parts of the catena. Both Ogunwale *et al.,* (2002) and Babalola *et al.,* (2007) found a decrease in pH at the bottom of the hill. However, Hendershot *et al.,* (1992) found that downslope areas had somewhat greater pH. Slope, however, did not significantly influenced pH values in this study. The soils CFUS had lower organic matter (1.61g kg^{-1}) than the soils of the CFLS (1.64 g kg^{-1}). These values were rated as "low" based on critical limits by Enwezor *et al.,* (1989) as shown in Table 4. The organic matter in both CFUS and CFLS were low indicating equal influence of the microbes on organic matter at both positions. However, organic matter was found to be more on lower slopes than on upper slopes by Farmanullah *et al.,* (2013). The total nitrogen was also low but the soils of the CFLS had a mean total nitrogen content of 0.099 g kg^{-1}, and those of the CFUS

Advance Journal of Agriculture and Ecology
Adv. J. Agric. & Eco.
Volume: 9; Issue: 11
November-2024
ISSN 2334-2414
E-ISSN 2344-2492
Impact Factor: 5.39
Advance Scholars Publication
Published by International Institute of Advance Scholars Development
https://aspjournals.org/Journals/index.php/ajae/index



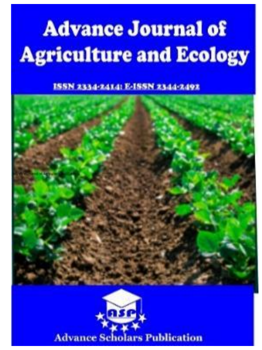
had 0.063g kg^{-1}. In tropical soils, where organic nitrogen makes up most of the total N, Noma *et al.,* (2005) found that total N followed the same trend as organic matter. The difference, however, could be due to low nitrogen fertilization on the upper slopes owing to the dominant grass vegetation. Soil cultivation, as reported by Ezeaku and Iwuanyanwu (2013), leads to low total nitrogen content due to a high rate of decomposition and oxidation of soil organic matter. Available phosphorus was generally low but was lower on the CFUS (7.74 mg kg^{-1}) than on the CFLS (7.80 mg kg^{-1}). Both CFUS and CFLS have a low concentration of available phosphorus, which can be traced back to high mineralization of organic matter content. Farmanullah *et al.,* (2013) also found that phosphorus concentrations were higher at lower slopes than at higher slopes. Phosphorus and other nutrients are slowly but continually lost when the cropping system is intensified, whereas organic matter and nitrogen in the soils are also rapidly depleted (Tanimu *et al.,* 2013). These are often the case in compound farms.

There was no statistically significant difference between the exchangeable magnesium values at both CFUS (0.80 cmol kg^{-1}) and CFLS (0.28 cmol kg^{-1}). The CEC values were higher in CFUS soils than CFLS soils possibly due to the difference in pH values. Soil texture and clay mineral type may also have a role in the moderate CEC levels obtained at the lower slope. Low values of exchangeable acidity and exchangeable Na were considered as an advantage to crop performance in both soils.

Table 4: Rating of Nutrient Dynamics at the slope positions using Enwezor et al. (1989) critical limits

S/N	Fertility parameter	Upper slope (CFUS)	Lower slope(CFLS)
1.	pH	Slightly acidic	Moderately acidic
2	Soil organic matter (SOM)	Low	Low
3	Total nitrogen	Low	Low
4	Available P	Low	Low
5	Exchangeable Mg	Moderate	Moderate
6	Exchangeable Ca	Moderate	Moderate
7	Cation Exchange Capacity (CEC)	High	Moderate
8	Exchangeable Acidity	Low	Low
9	Exchangeable K	Moderate	Moderate
10	Exchangeable Na	Very low	Very low

Advance Journal of Agriculture and Ecology
Adv. J. Agric. & Eco.
Volume: 9; Issue: 11
November-2024
ISSN 2334-2414
E-ISSN 2344-2492
Impact Factor: 5.39
Advance Scholars Publication
Published by International Institute of Advance Scholars Development
https://aspjournals.org/Journals/index.php/ajae/index



Bacteria and Fungi Contributions to Soil Fertility in the Compound Farms

Table 5 shows that bacteria and fungi contributed equally to the soil fertility in compound farms in University of Nigeria, Nsukka as most of the macro nutrients and organic carbon were low with the exception of potassium which was found to be moderate. This could be attributed to the similarity of both bacteria and fungi count in both slopes which was not significantly different across the slopes as well as the species (Tables 5 and 6).

The low population of bacteria and fungi obtained could be as a result of rubbish burning regularly practiced by residents. The heat generated kills or reduces their population leading to slow decomposition of available organic matter and recycling of nutrients in the soil.

Table 5: Bacteria count and isolate from the Soil of the upper and lower slope

Location	Bacteria Count (CFU/g)	Bacteria isolated
Upper	3.4 X 10^5	*Penicillium* spp, *Aspergillus* spp, *Geotrichum* spp, *Saccharomyces* spp,
Upper	3.8 X 10^5	*Penicillium* spp, *Aspergillus* spp, , *Geotrichum* spp, *Candida* spp
Upper	4.4 X 10^5	*Saccharomyces* spp, *Candida* spp, *Penicillium* spp, *Aspergillus* spp,
Lower	3.9 X 10^5	*Trichoderma* spp, *Penicillium* spp, *Aspergillus* spp, *Pichia* spp, *Saccharomyces* spp, *Candida* spp
Lower	3.4 X 10^5	*Penicillium* spp, *Aspergillus* spp, *Candida* spp
Lower	3.2 X 10^5	*Geotrichum* spp, *Trichoderma* spp, *Penicillium* spp, *Aspergillus* spp, *Saccharomyces* spp, *Candida* spp

Table 6: Fungi count and isolates from soil of the study area

Location	Fungi Count (CFU/g)	Fungi isolated
Upper	2.1 X 10^5	E. coli, *Pseudomonas* spp, , *Bacillus* spp, *Azotobacter* spp, , *Klebsiella* spp, *Aeromonas* spp,
Upper	4.0 X 10^5	*Azospirillum* spp , *Bacillus* spp, E. coli , *Azotobacter* spp, *Aeromonas* spp, *Streptococci* spp,
Upper	5.8 X 10^5	*Micrococcus* sp, *Pseudomonas* spp, *Enterococcus* spp, *Bacillus* spp, *Azotobacter* spp, *Corynebacteria* spp, *Azospirillum* spp, *E. coli*
Lower	4.8 X 10^5	*Klebsiella* spp, *Aeromonas* spp, *Streptococci* spp, *E. coli* , *Enterococcus* spp, *Bacillus* spp, *Azospirillum* spp,
Lower	2.7 X 10^5	*Bacillus* spp, *Aeromonas* spp, *Streptococci* spp, *E. coli*, *Azospirillum* spp, *Klebsiella* spp
Lower	2.6 X 10^5	*Bacillus* spp, *Azotobacter* spp, , *Klebsiella* spp, *Aeromonas* spp, *Streptococci* spp, *E. coli*, *Azospirillum* spp,

Advance Journal of Agriculture and Ecology
Adv. J. Agric. & Eco.
Volume: 9; Issue: 11
November-2024
ISSN 2334-2414
E-ISSN 2344-2492
Impact Factor: 5.39
Advance Scholars Publication
Published by International Institute of Advance Scholars Development
https://aspjournals.org/Journals/index.php/ajae/index

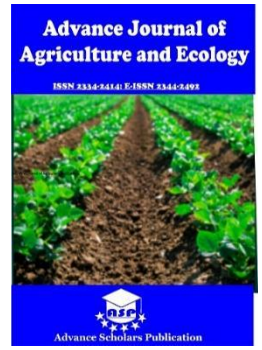


Table 6: Fungi count and isolates from soil of the study area

Location	Fungi Count (CFU/g)	Fungi isolated
Upper	2.1×10^5	E. coli, *Pseudomonas* spp, , *Bacillus* spp, *Azotobacter* spp, , *Klebsiella* spp, *Aeromonas* spp,
Upper	4.0×10^5	*Azospirillum* spp , *Bacillus* spp, E. coli , *Azotobacter* spp, *Aeromonas* spp, *Streptococci* spp,
Upper	5.8×10^5	*Micrococcus* sp, *Pseudomonas* spp, *Enterococcus* spp, *Bacillus* spp, *Azotobacter* spp, *Corynebacteria* spp, *Azospirillum* spp, *E. coli*
Lower	4.8×10^5	*Klebsiella* spp, *Aeromonas* spp, *Streptococci* spp, *E. coli* , *Enterococcus* spp, *Bacillus* spp, *Azospirillum* spp,
Lower	2.7×10^5	*Bacillus* spp, *Aeromonas* spp, *Streptococci* spp, *E. coli*, *Azospirillum* spp, *Klebsiella* spp
Lower	2.6×10^5	*Bacillus* spp, *Azotobacter* spp, , *Klebsiella* spp, *Aeromonas* spp, *Streptococci* spp, *E.coli* , *Azospirillum* spp,

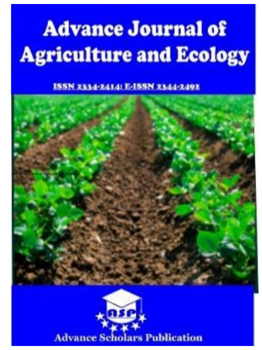
Analysis of fungi and bacteria count and species in the compound farms

The microbial analysis of bacteria and fungi in Table 7 shows no significant difference in both bacteria and fungi count even though higher population of bacteria and fungi were obtained in the CFUS (3.9×10^5,4.0×10^5.) than in the CFLS (3.5×10^5,3.4×10^5.). The pH of the soils possibly influenced their population as CFUS with slightly acidic pH (6.20) had higher population of both bacteria and fungi than the CFLS with moderately acidic pH (6.0). Again the species and number of bacteria and fungi isolated appeared not to be quite different across the slopes (Table 7). The non-significant difference in the microbial population, species and number seem to support the low and non-significant difference in the organic matter content of the soils across the slope positions as well as the moderate fertility status of both soils.

Table 7: Microbial analysis (bacteria and fungi) in the compound farms

Location	Bacteria count (CFU/g)	Bacteria isolated	Fungi count (CFU/g)	Fungi isolated
Upper	**3.9×10^5**	**4**	**4.0×10^5.**	**6**
Lower	**3.5×10^5**	**5**	**3.4×10^5.**	**7**
F- LSD	**Ns**	**Ns**	**Ns**	**Ns**

Advance Journal of Agriculture and Ecology
Adv. J. Agric. & Eco.
Volume: 9; Issue: 11
November-2024
ISSN 2334-2414
E-ISSN 2344-2492
Impact Factor: 5.39
Advance Scholars Publication
Published by International Institute of Advance Scholars Development
https://aspjournals.org/Journals/index.php/ajae/index



Conclusion

The status of soil fertility and the contributions of fungi and bacteria in the upper and lower slope compound farms at University of Nigeria, Nsukka were assessed in this study in order to advice the residents on appropriate practices for sustainable crop production. The compound farms were partitioned into low slopes (CFLS) zones and high slope (CFUS) zones. The residents were found to grow almost similar crops including vegetables, maize, and cassava. The soils of both slope positions were of moderate fertility status as most of the macronutrients values were moderate and the pH values were in the range that supports most arable crops. However, the CEC values of the CFUS soils were higher than those of CFLS. Again, the organic matter, total N and available P were low. The soils contained almost similar microbial population, species and number which suggested equal contributions to soil fertility. It was recommended that residents should practice integrated application of organic and inorganic fertilizers and avoid rubbish burning in their farms to help build up microbial population which would aid organic matter decomposing and mineralization.

References

Asadu, C. L. A., & Akamigbo, F. O. R. (1987). The use of abrupt changes in selected soil properties to assess lithological discontinuities in soils of Eastern Nigeria. *Pedologie*, 37(1), 42–56.

Asadu, C. L. A., & Nweke, F. I. (1999). The soils of cassava-growing areas in sub-Saharan Africa. *COSCA Working Paper No 18*. Collaborative Study of Cassava in Africa, RCMD, International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria.

Asadu, C. L. A., Ekwo, A. U., & Udigwe, T. K. (2001). Soil characteristics around Lake Opi in eastern Nigeria and land use recommendations. *Agro Science Journal*, 2(1), 76–90.

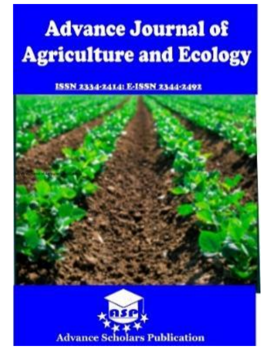
Awdenegest, M., & Nicholas, M. H. (2008). Soil fertility in relation to slope position and agricultural land use: A case study of Umbulo catchment in Southern Ethiopia. *Environmental Management*. https://doi.org/10.1007/s00267-008-9157-8

Babalola, T. S., Fasina, A. S., & Peter, T. (2007). Relationship between soil properties and slope position in a humid forest of Southwest Nigeria. *Agricultural Journal*, 2, 370–374.

Bremner, J. M., & Mulvaney, C. S. (1982). Total nitrogen. In C. A. Black (Ed.), *Methods of Soil Analysis*, part 2, Agronomy 9 (pp. 1149–1178). American Society of Agronomy.

Conway, C. (1997). Results of the test run in the 96/97 rainy season in the North Central

Advance Journal of Agriculture and Ecology
Adv. J. Agric. & Eco.
Volume: 9; Issue: 11
November-2024
ISSN 2334-2414
E-ISSN 2344-2492
Impact Factor: 5.39
Advance Scholars Publication
Published by International Institute of Advance Scholars Development
https://aspjournals.org/Journals/index.php/ajae/index



Division. *Ministry of Agriculture, Water and Rural Development*, Namibia.

Dada, P. O. O., Adeyanju, O. R., Adeosun, O. J., & Adewumi, J. K. (2016). Effects of soil physical properties on soil loss due to manual yam harvesting under a sandy loam environment. *International Soil and Water Conservation Research*, 4, 121–125.

Enwenzor, W. O., Udo, E. J., Usoroh, N. J., Ayotade, K. A., Adepetu, J. A., Chude, V. A., & Udegbe, C. I. (1989). Fertilizer use and management for crops in Nigeria. *FPDD*, Federal Ministry of Agriculture, Water Resources and Rural Development, Lagos, Nigeria.

Ezeaku, P. I. (2000). Applicability of two concepts of land evaluation to the soils of southeastern Nigeria (Ph.D. thesis). University of Nigeria, Nsukka.

Ezeaku, P. I., & Iwuanyanwu, F. C. (2013). Degradation rates of soil chemical fertility as influenced by topography in Southeastern Nigeria. *IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)*, 6, 39–49.

Ezeaku, P. I., & Eze, F. U. (2014). Effect of land use in relation to slope position on soil properties in a semi-humid Nsukka area, Southeastern Nigeria. *Journal of Agricultural Research*, 3, 52.

Farmanullah, K., Zubair, H., Waqar, A., Muhammad, R., Zahir, S., Muhammad, S., Ishaq, A. M., & Muhammad, H. (2013). Effect of slope position on physico-chemical properties of eroded soil. *Soil & Environment*, 32(1), 22–28.

Gee, G. W., & Orr, D. (2002). Particle size analysis. In D. J. Dan & G. C. Topps (Eds.), *Methods of Soil Analysis*, part 4, physical methods (pp. 201–228). Soil Science Society of America.

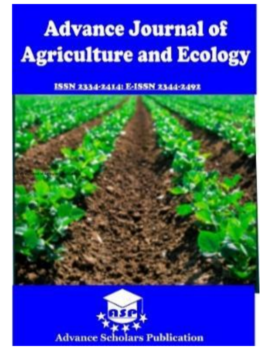
Hendershot, W. H., Courchesne, F., & Schemenauer, R. S. (1992). Soil acidification along a topographic gradient on Roundtop Mountain, Quebec, Canada. *Water, Air, and Soil Pollution*, 61(3–4), 235–242.

Marschner, H. (1995). *Mineral nutrition of higher plants*. Academic Press.

Mclean, E. O. (1982). Soil pH and lime requirement. In A. L. Page (Ed.), *Methods of Soil Analysis*, part 2. Chemical and microbiological properties (pp. 199–224). American Society of Agronomy, Soil Science Society of America.

Mulugeta, D., Sheleme, B., & Mulugeta, L. (2012). Impact of slope position on soil carbon and total nitrogen stocks along a

Advance Journal of Agriculture and Ecology
Adv. J. Agric. & Eco.
Volume: 9; Issue: 11
November-2024
ISSN 2334-2414
E-ISSN 2344-2492
Impact Factor: 5.39
Advance Scholars Publication
Published by International Institute of Advance Scholars Development
https://aspjournals.org/Journals/index.php/ajae/index



catena in KindoKoye watershed, Southern Ethiopia. *Ethiopian Journal of Natural Resources*, 12(2), 185–195.

Nelson, D. W., & Sommers, L. E. (1982). Total carbon, organic carbon, and matter. In A. L. Page, R. H. Miller, & D. R. Kenney (Eds.), *Methods of Soil Analysis*, chemical and microbiological properties, part 2 (pp. 9). Agronomy Monograph.

Noma, S. S., Ojanuga, A. G., Ibrahim, S. A., & Iliya, M. A. (2005). Detailed soil survey of Sokoto–Rima floodplain at Sokoto. In *Managing soil resources for food security and sustainable environment*. Proceedings of the 29th Annual Conference of Soil Science Society of Nigeria.

Ogunwale, J. A., Olaniyan, J. O., & Aduloju, M. O. (2002). Morphological, physico-chemical, and clay mineralogical properties of soil overlying basement complex rocks in Ilorin East, Nigeria. *Moor Journal of Agricultural Research*, 3(21), 147–164.

Okafor, J. C., & Fernandes, E. C. M. (1987). Compound farms of Southeastern Nigeria: A predominant agroforestry home garden system with crops and small livestock. *Agroforestry Systems*, 5, 153–168.

Oko-Ibom, G. O., & Asiegbu, J. E. (2006). Growth and yield responses of rainy season field tomatoes to fertilizer application timing and splitting. *Journal of Agriculture, Food, Environment and Extension*, 5(1), 17–25.

Olsen, S. R., & Sommers, L. E. (1982). Phosphorus. In A. L. Page, R. H. Miller, & D. R. Keeney (Eds.), *Methods of Soil Analysis*, part 2, chemical and microbiological properties (pp. 403–430). American Society of Agronomy.

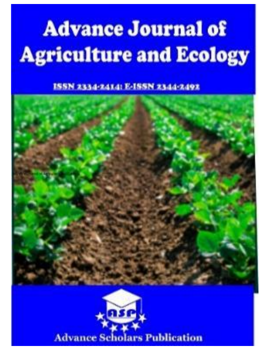
Onyenweaku, C. E., Obasi, P. C., & Anyanwu, S. O. (1996). Production relationships among compound and non-compound farms in Imo State, Nigeria. *Journal of Applied Science in Southern Africa*, 2(1).

Oshunsanya, S. O., Yu, H., & Li, Y. (2018). Soil loss due to root crop harvesting increases with tillage operations. *Soil and Tillage Research*, 181, 93–101.

Soil Survey Staff. (1999). *Soil Taxonomy: A basic system of classification for making and interpreting soil surveys*. NRCS USDA.

Soil Survey Staff. (2014). *Kellogg soil survey laboratory methods manual* (Soil Survey Investigations Report No. 42, Version 5.0). U.S. Department of Agriculture, Natural Resources Conservation Service.

Advance Journal of Agriculture and Ecology
Adv. J. Agric. & Eco.
Volume: 9; Issue: 11
November-2024
ISSN 2334-2414
E-ISSN 2344-2492
Impact Factor: 5.39
Advance Scholars Publication
Published by International Institute of Advance Scholars Development
https://aspjournals.org/Journals/index.php/ajae/index



Tanimu, J., Uyovbisere, E. O., Lyocks, S. W. J., & Tanimu, Y. (2013). Effects of cow dung on the growth and development of maize crop. *Greener Journal of Agricultural Sciences*, 3(5), 371–383.