



ASSESSMENT OF FLOOD RECESSION ON SELECTED MACRO NUTRIENTS AND CHEMICAL PROPERTIES OF SOILS IN SOUTHERN IJAW, BAYELSA

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ABSTRACT

The study was carried out in Southern Ijaw Local Government Area of Bayelsa State, Nigeria with the sole aim to assess the effect of flood recession on soil chemical properties and selected micro nutrients using the Semi detailed soil survey approach. One soil profile pit each was dug in each of the identifiable mapping unit and described in situ. Results obtained revealed that when compared to interpretation guide for evaluating analytical data for management of degraded soils shows that at flood recession, pH (4.9 – 5.48) was strongly acidic, organic carbon (6.1 – 7.6 g/kg) were moderate, TN and P (0.7 – 0.9 g/kg) and (16.2 and 43.2 mg/kg) were very high respectively, Ca and K were also very high in the soil (7.51 – 25.48cmol/kg) and (2470.05 – 3293.79 cmol/kg) respectively, CEC (34.34 – 38.75 cmol/kg) was also very high. The same trend was observed in the level of selected micro nutrients in the soils due to flood recession when compared to available interpretation standard for crop production. Flooding and flood recession actually impacted on soils of the study area by increasing the level of some of the chemical properties and selected micro nutrients of the soils due to influx of materials in the environment by flood water, which the aim of this research is to evaluate impact of flood on Chemical Properties and Selected Micro Nutrients in Soils Southern Ijaw, Bayelsa State.

Keywords: Sustainable, Ecosystem, Development, Climate, Flooding

INTRODUCTION

Natural hazard of flood is not new to the people of Niger Delta in general and Bayelsans in particular. It is well known that the agricultural production system as well as the livelihood of people is intimately related with flooding in some parts of the world. Flood is not bad to some extent and it has some beneficial impacts on the agricultural production. Flooding results in shortage of food crops due to loss of entire harvest and the destruction of soil quality and when a soil is flooded (anaerobic conditions), microorganisms use the available soil O₂ to survive (Ozi *et al*, 2024). Free O₂ in the soil is usually depleted within a couple of days after flooding (Akpoveta *et al*, 2014). Again, Akpoveta, *et al* (2014) also opined that, despite the significant consequences of flooding on the environment, flood plays an important role in maintaining key eco-system function and biodiversity in many natural systems. Flood deposits organic materials, minerals, and essential nutrients from rivers and oceans into land which makes the soil richer, fertile and productive (Ozi *et al*, 2024). Soil in Bayelsa State have the potential for rain-fed agriculture and since the soils are broadly called wetland soils whose development and properties are strongly influenced by temporary and permanent saturation in the upper pedon (Peter and Umweni 2022). There is paucity of information on the soil qualities and conditions in the study area regarding selected trace elements and soil chemical properties as well as soil fertility status which is sine qua non for effective agricultural crop production. Thus, the main objective of this study was to assess the effect flood of recession on selected micro nutrients (Trace elements) and chemical properties of Soils Southern Ijaw, Bayelsa

MATERIALS AND METHODS

Description of the Study Area

This study was carried out in Bayelsa State in the Niger Delta region of Southern Nigeria. It lies between latitude 4.78991667 and 4.98841667 and longitude 6.29108333 and 6.29797222. The state is bounded by Delta State in the north, Rivers State in the east and the Atlantic Ocean in the western and southern parts. The study was conducted in three Local Government Areas: Ogbia, Yenegoa and Amassoma. Generally, Bayelsa State is a lowland state characterized by tidal flats and coastal beaches, beach ridge barriers and flood plains. The net features such as cliffs and lagoons are the dominant relief features of the state. The fact that the state lies between the upper and lower Delta plain of the Niger Delta suggests a low-lying relief. The broad plain is gentle slope. The study area also formed parts of the levee slope underlined by alluvial soils which are prone to flooding annually. Selected food crops are cultivated on the levee crest, levee slope, back swam and on recent alluvial soils deposited due to influx of alluvial materials from the rivers (Dickson *et al.*, 2022).

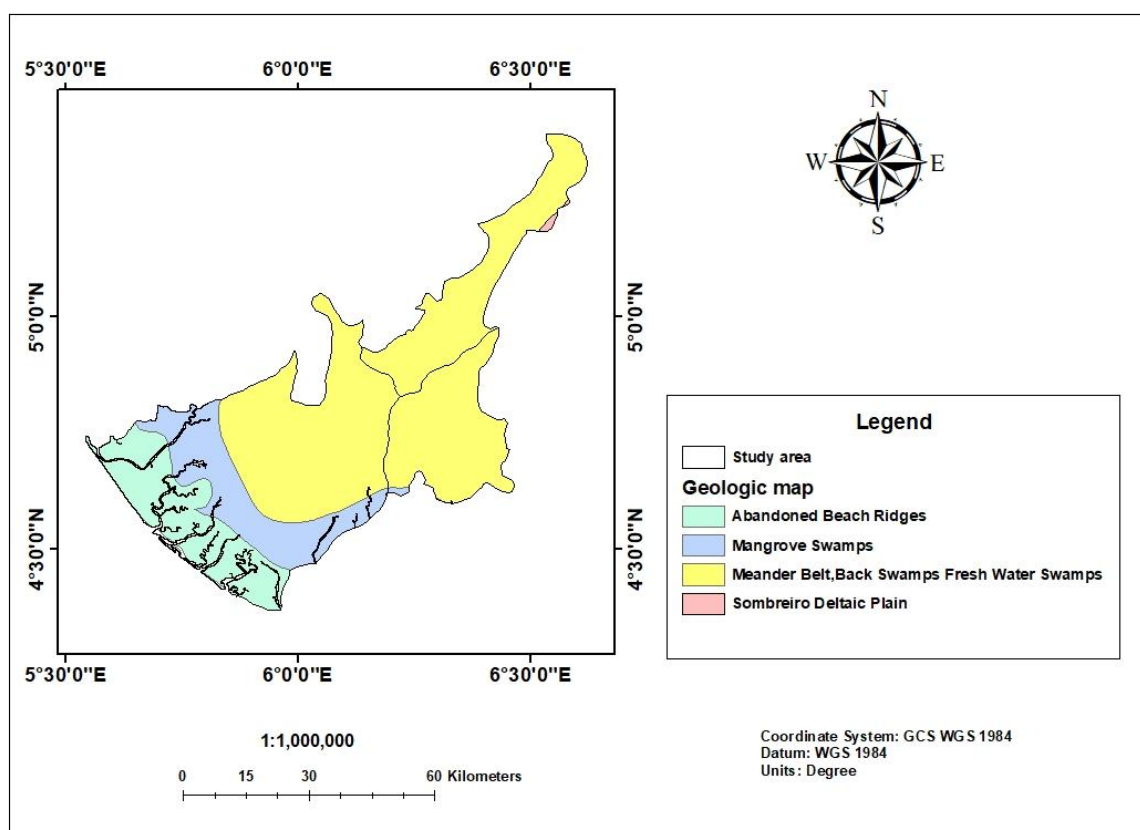


Figure 1: Map of the Study Area

Climatic Condition

Rainfall in Bayelsa State varies from one area to another. Rain occurs generally every month of the year with heavy downpour. Annual rainfall of the area is in the ranged between 2000-4500 mm which spreads over 8 to 10 months each year in a bimodal form with a peak in Jun. and Sep (Dickson *et al.*, 2022). The mean monthly temperature ranged between 25°C to 31°C and mean annual maximum temperatures ranged from 26°C to 31°C (Dickson *et al.*, 2022); which is uniform for the entire Bayelsa State. The hottest months are December to April. The difference between the wet season and dry season temperatures is about 2°C. Relative humidity ranged between 75 – 92%; while it is high in the state throughout the year and decreases slightly in the dry season (Dickson *et al.*, 2022).



Vegetation

The natural vegetation is tropical rainforest that has been tremendously altered by the impact of land degradation occasioned by crude oil pollution, uncontrolled forest exploitation and continuous land cultivation (Dickson, 2022 and Peter and Umweni, 2022). Like any other state in the Niger Delta, the vegetation of Bayelsa State is composed of four agro ecological zones namely: coastal barrier island forests, mangrove forests, freshwater swamp and lowland rain forests. These vegetation types are associated with the various soil units, and they constitute part of the complex Niger Delta ecosystems. The freshwater swamp forests also serve as home of several threatened and endangered for plant and animal species.

Soil

The major soil types in Bayelsa State are young, shallow, poorly drained Inceptisol (Ayolagha et al, 2012 and Douglas and Peter 2015). There are variations in the soils of Bayelsa State; some soil types occupy extensive areas whereas others are limited to a small area (Ozi *et al*, 2024). However, based on physiographic differences, several soil units could be identified in the state and this includes the soils of the high-lying levees such as sandy loam, loamy sandy, and silty loamy soils as well as sands; soils of the low-lying leaves with moderately fine texture, red silty or clay loamy soils; the meander belt soils which differ only slightly from the soils of the levees (Ozi *et al*, 2024). They also include the silty river belt soils such as peat for clay water bogged/logged soils found mainly in the beds of dead creeks and streams; the basin soils like the silty clay loam or sandy loam which are inundated by water for most of the year and the transition zone soils comprises of silt and sandy silt which are known to be under the daily influence of tidal floods.

A. Pre-field Study

A reconnaissance visit was carried out to identify the areas susceptible to flood in Southern Ijaw Local Government Area of Bayelsa State. This was followed by a pre-field survey using Semi detailed soil survey approach as described by Peter and Umweni, (2022). The Administrative Map of Bayelsa state showing boundaries, roads and settlements, in the Local Government Areas of interest was used as base map for the study. Subsequently, the map was geo-referenced and digitized in an Arc map environment forming the Shape file of the study area. The digitized map of the study area was gridded using the rigid grid methods for soil sampling.

B. Field Work

The coordinates of the various location identified and delineated were taken using the handheld Geographical Positioning System (GPS). One modal profile pit of 2m x 2m x 2m was dug at each representative point identified as a mapping unit and were described from bottom to top to avoid contamination using Peter et al (2022) guidelines and soil samples were also collected from identifiable horizons for laboratory analysis. Thus, sampling locations were delineated covering 5 hectares. Three profile pits were dug in the Local Government Area and were designated as AMA1, AMA2, and AMA3. A total of three (3) profile pits were dug with dimension of 2m x 2m x 2m except where there were obstructions due low depth to water table. Soil samples collected were processed for laboratory analysis.

LBORATORY ANALYSIS

Selected soil chemical properties were analyzed. Soil pH was determined using pH meter in a 1:2 water suspension. Organic carbon was determined by the dichromate wet oxidation methods of He *et al*, (2022). Organic matter was calculated by multiplying the result of organic carbon by 1.724. Total nitrogen (N) was determined by the macro-Kjedahl digestion distillation method (Hicks *et al*, 2022). Available phosphorus (P) was determined by spectrophotometrically. Exchangeable potassium (K) and sodium (Na) in the soil extract were determined by flame photometry, while exchangeable calcium (Ca), Cation exchange capacity (CEC) was determined by the ammonium acetate (NH₄OAc) method.



RESULTS AND DISCUSSION

Chemical Properties of Soil of Southern Ijaw

The chemical properties of the soils of southern Ijaw are presented in Table 1. In pedon 1 (AMA1) pH ranged from 4.47 to 5.25 with mean of 4.90. Total organic content (TOC) ranged from 1.0 to 12.2 g/kg with mean of 6 g/kg. Total organic matter (TOM) also ranged from 1.7 g/kg to 9.6 g/kg with mean of 4.47 g/kg. There was an increase in the organic carbon content of the soils at the surface horizon. This is in contradictions with the finding of Akpoveta, *et al* (2014) who reported that the decreased in organic carbon content of soil adversely affects soil quality and fertility since organic carbon is required to stimulate microbial respiration and activities. This also contradicted the findings of Douglas and Peter, (2015) who stated that low organic matter (OM) content is associated with soils in the humid tropic region which Southern Ijaw belong due to high temperature that rapidly breakdown organic materials and inhibit nitrogen fixation. Again, the high organic contents observed at the soil surface due to the influx of plants and animal materials into the environment via flood water. This is also in tandem with the observations of Peter *et al* (2022); Peter and Umweni, (2020) as reported on Khana Soils. It was also observed that total nitrogen (TN) ranged from 0.4 g/kg to 1.5 g/kg with mean value of 0.9 g/kg. Phosphorus (P) values varied from 6.4 mg/kg to 50.8 mg/kg with mean values of 31.99 mg/kg, Sulphur (S) varies slightly as its value ranged from 0.2 g/kg to 0.6 g/kg with mean values of 0.4 g/kg. Calcium varied from 5.48 – 9.63 Cmol/kg, while Potassium ranged from 1329.41 – 4711.96 Cmol/kg with mean value of 2786.33 cmol/kg. The salinity of the soil varies and ranged from 0.05 dS/m to 0.11 dS/m in pedon 1 (AMA 1) while the mean value obtained was 0.07 dS/m. The cation exchange capacity (CEC) ranged from 28.33 cmol/kg to 42.12 cmol/kg with mean value of 34.34 cmol/kg. In pedon 2 (AMA2) of southern Ijaw, soil pH ranged from 5.08 to 5.67 with mean value of 5.48). The pH (5.96) of the A-horizon at depth 0-22cm was higher than the AB-horizon (5.08) at depth 22-56cm. TOC ranged from 3.4 g/kg to 12.4 g/kg with mean value of 6.1 g/kg while TOM ranged from 5.9 g/kg to 21.3 g/kg with mean of 10.5 g/kg. TN ranged from 0.3 g/kg to 1.2 g/kg with mean of 0.7 g/kg. Phosphorus (P) ranged from 0.26 mg/kg to 5.34 mg/kg with mean value of 3.59 mg/kg. Sulphur (S) also ranged from 0.1 g/kg to 0.02 g/kg with mean value of 0.2 g/kg, Calcium (Ca) varied from 5.8 – 55.70 Cmol/kg with mean value of 20.65 Cmol/kg and Potassium (K) also varied from 1967.01 – 2717.68 Cmol/kg with mean value of 2470.05 Cmol/kg. Soil salinity ranged from 0.05 dS/m to 0.1 dS/m with mean value of 0.09 dS/m. CEC at ranged from 30.82 cmol/kg to 37.54 cmol/kg with mean value of 34.55 cmol/kg which showed slight increase from the surface soil to the subsurface soil. In pedon 3 (AMA3, the pH also increased with depth and ranged from 4.83 to 5.68. while TOC ranged from 2.2 g/kg to 12.2 g/kg with mean value of 7.6 g/kg. TOM ranged from 3.9 g/kg to 21 g/kg with mean of 13.2 g/kg. Total nitrogen also ranged from 0.8 g/kg to 1.1 g/kg with mean value of 0.9 g/kg. Phosphorus also ranged from 0.94 mg/kg to 2.67 mg/kg with mean value of 1.62 mg/kg while, Sulphur ranged from 0.1 g/kg to 0.2% with mean of 0.1 g/kg. Calcium varied from 11.21 -46.14 Cmol/kg and Potassium (2983.15 – 3774.55 Cmol/kg) with mean value of 3293.69 Cmol/kg. Soil salinity also ranged from 0.05 dS/m to 0.11 dS/m with mean of 0.09 dS/m. There were slight variations in CEC values in pedon1 (AMA3) of Southern Ijaw ranging from 37.73.



Table 1: Chemical Properties of Soils of Southern Ijaw

Horizon Design	Depth (cm)	pH	TOC (g/kg)	TOM (g/kg)	Total Nitrogen (g/kg)	Phosphorus (mg/kg)	Sulphur (g/kg)	Ca (cmol/kg)	K (cmol/kg)	Salinity (dS/m)	CEC (meg/100g)
AMA1											
A	0-40	4.47	12.2	2.1	1.5	50.8	0.6	9.53	2317.63	0.06	32.56
B	40-84	4.98	5.6	9.6	0.9	6.4	0.4	7.51	4711.96	0.11	42.12
Bg	84-165	5.25	1.0	1.7	0.4	38.4	0.2	5.48	1329.41	0.05	28.33
	Mean	4.90	6.3	10.8	0.9	31.9	0.4	7.51	2786.33	0.07	34.34
AMA2											
A	0-22	5.96	12.4	21.3	1.2	2.6	0.2	12.22	1967.01	0.1	30.82
AB	22-56	5.08	4	6.9	0.6	53.4	0.2	5.82	2502.55	0.04	34.54
Bw	56-110	5.22	4.6	7.9	0.7	53.5	0.1	8.85	2692.96	0.15	35.29
Bgw	110-145	5.67	3.4	5.9	0.3	34.2	0.1	55.70	2717.68	0.05	37.54
	Mean	5.48	6.1	10.5	0.7	35.9	0.2	20.65	2470.05	0.09	34.55
AMA3											
A	0-21	4.83	12.2	21	1.1	12.6	0.2	11.21	2983.15	0.11	37.73
AB	21-57	4.92	8.5	14.6	0.8	9.4	0.1	18.29	3774.55	0.05	39.85
Bw	57-120	5.68	2.2	3.9	0.9	26.7	0.1	46.94	3123.67	0.11	38.66
	Mean	5.14	7.6	13.2	0.9	16.2	0.1	25.48	3293.79	0.09	38.75

Selected Metals (Trace elements) in Soils of Southern Ijaw

Results obtained on selected metals (Trace elements) in Pedon 1 (AMA 1) of Southern Ijaw location are presented in Table 2. Cu ranged from 0.82 to 31.18 mg/kg with mean values of 12.95mg/kg. Iron (Fe) content was observed to be high in Pedon 1 (AMA 1) and ranged from 12187.56 to 16540.02 mg/kg with mean values of 14388.04 mg/kg and Zn increased from 30.43 – 74.93 mg/kg with mean values of 40.21 mg/kg. In pedon 2 (AMA 2) Cu ranged from 9.18 to 10.64 mg/kg with mean values of 9.77 mg/kg. Iron content in AMA2 varied from 13626.52 mg/kg to 14622.47 mg/kg with mean of 14084.48 mg/kg and Zn values increased from 40.80 to 60.09 mg/kg with mean of 47.59 mg/kg. Table 4.15 also revealed that in Pedon 3 (AMA3), Cu ranged from 6.77 to 16.04 mg/kg with mean of 11.67 mg/kg. Iron (Fe) increased from 12187.56 to 16540.02 mg/kg with mean of 14,388.04 mg/kg and Zn values ranged from 48.67 to 52.63 mg/kg with mean of 50.38 mg/kg. Zn contents of soils increased from 22.97 to 28.64 mg/kg with mean values of 25.72 mg/kg.

Table 2: Selected Metals (Trace elements) in Soils of Southern Ijaw

Horizon Design	Depth (cm)	Cu (mg/kg)	Fe (mg/kg)	Zn (mg/kg)
AMA1				
A	0-40	6.36	14436.54	42.28
B	0-84	31.18	16540.02	74.93
Bg	84-165	0.82	12187.56	30.43
	Mean	12.79	14388.04	49.21
AMA2				
A	0-22	9.71	13626.52	41.75
AB	22-56	9.18	13636.22	40.80
Bw	56-110	9.55	14452.71	47.70
Bgw	110-145	10.64	14622.47	60.09
	Mean	9.77	14084.48	47.59
AMA3				
A	0-21	6.77	15202.91	48.67
AB	21-57	12.21	15980.60	52.63
Bw	57-120	16.04	15429.26	49.84
	Mean	11.67	15537.59	50.38

CONCLUSION AND RECOMMENDATIONS

The results strongly indicated that soils of the study area were highly impacted by flood as observed in the study area. It implies that, some nutrients such organic carbon were in abundance at surface level due to influx of organic materials into the area in flood water. There were also indications that some soil chemical properties such as pH, nitrogen, phosphorus and even exchangeable bases were very low due to leaching at flood recession. Thus soils of the study area had their inherent characteristics such as low level of nutrient elements (low fertility), due to excessive leaching, but this can be easily managed for sustainable crop production through proper soil fertility management system should be adopted in the study area.

REFERENCES

- Akpoveta, V. O., Osakwe, S. A, Ize-Iyamu, O. K., Medjor, W. O. & Egharevba, F. (2014). Post flooding effect on soil quality in Nigeria: The Asaba, Onitsha Experience. *Open Journal of Soil Science*, **4**: 72-80.
- Ayolagha, G. A., Peter, K. D. and Ebie, J. S. (2013). Effect of Remediation of Crude Oil Polluted Inceptisols on Maize (*Zea mays*) Production Using Organic and Inorganic Fertilizers at Yenegoa, Bayelsa State. *International Journal of Soil Science*, **8** (2): 47-57. DOI: 10.3923/ijss, 2013, 47-57
- Dickson, A. A., Tate, J. O. & Ogboin, P. T. (2022). Capability groupings of some nun river flood plain soils of Bayelsa State, Southern Nigeria. *Agro-Science Journal of Tropical Agriculture, Food, Environment and Extension*, **21**(2): 121-129.



- Douglas, K. and Peter K. D (2016). Assessment of selected soil quality indicators in Obio/Akpor Local Government Area of Rivers State South-eastern Nigeria, *International Journal of Geography and Environmental Management*. Vol. (2) N. 2016
- Ozi, V., Peter, K. D. Gobo, A. E. and Ngah, S. A. (2024) Suitability Assessment of Flood Recedes Soils for the Cultivation of Rice (*Oryza Sativa*) in Southern Ijaw, Bayelsa State, *Nigeria Journal of Environment, Earth Sciences and Ecology*, **6**(1): 1-10.
- Peter, K. D. and Umweni, A. S (2020). Morphological, Physical and Chemical Properties of Soils Developed from Coastal plain Sands and Alluvium in Khana Local Government Area of Rivers State, Southern Nigeria. *African Journal of Sustainable Agricultural Development (AJSAD)*, **1**(1): 1 -19.
- Peter, K. D., Umweni, A. S. Orji. O. A. (2022). Soil Suitability Studies for Okro (*Abelmoscus esculentus L.*) and Fluted Pumpkin (*Telferia occidentalis, L.*) Cultivation in Khana LGA, Rivers State, Southern Nigeria. *Pantnagar Journal of Research (Formerly International Journal of Basic and Applied Agricultural Research* **20** (1), Pp 62 – 70