Original Article

Exploring the Functional Potentials of Hydric Soils of Low and Wetlands of Delta State Nigeria

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Abstract

This study explores the functional potential of hydric soils located in the lowlands and wetlands of Delta State, Southern Nigeria. Often dismissed due to seasonal inundation and persistent saturation, hydric soils develop under anaerobic conditions that limit oxygen availability. Despite these constraints, such soils exhibit significant levels of organic matter and fertility that could be optimized for agricultural use, especially within the context of sustainable land management and environmental conservation. A field survey method was employed, involving the collection of ninety (90) soil samples—thirty (30) each from three stratified zones representing lowland and wetland environments across the Delta State. These samples were subjected to detailed laboratory analyses to determine their physicochemical properties. The resulting data were statistically analyzed to identify patterns in soil fertility, nutrient content, and suitability for cultivation. Results indicated a consistent presence of organic matter and similar nutrient availability across the studied landscapes, comparable to those in forest and fallow lands. This similarity supports the argument that lowland and wetland soils, though often underutilized, can serve as viable alternatives to conventional arable lands. Their utilization may reduce reliance on rainforest areas and promote ecological balance. In conclusion, the study underscores the importance of re-evaluating hydric soils for agricultural purposes. Leveraging their potential could support precision agriculture, reduce soil degradation, and contribute to achieving Sustainable Development Goals (SDGs) 12 and 13 related to responsible consumption and climate action. Thus, hydric soils represent both a challenge and an opportunity in modern land use planning.

Keywords: Exploring, Functional Potentials, Hydric Soils, Suitability, Low and Wetlands.

1. Introduction

Climatic factors such as rainfall, temperature and humidity determine the nature of the soil and vegetation cover. Other factors such as edaphic/soil factors are equally important in soil vegetation relationships and the duration of the presence of water in the land lowland wetland/ grasslands. Wetland vegetation exists within the lowland tropical rainforest where rainfall is over 2000mm – 3000mm. The main distinguishing factor of the wetland landscape is that they are seasonally or permanently flooded or inundated with water. Wetlands grasslands occur in almost every local government area of Delta State. Despite their abundant availability within the rainforest, they are either treated as abandoned, idle or marginalized vegetation landscapes (CODESSRIA, 2012).

The apathy with which these vegetation landscapes are treated does not place any premium on the soil fertility and capability potentials for arable crop and livestock production potentials on the soils of lowlands/ wetland vegetation landscapes. It is important to assess the soil fertility and capability of lowlands/wetlands compared to forests and other adjourning

vegetation landscapes to determine their nutrient status. This comparison can identify alternative cultivation sites, helping to prevent forest depletion and its negative environmental impacts. Exploring the functional potentials of the hydric soils of the lowland/ wetlands of Delta State is therefore imperative for sustainable development and protection and conservation of the forest estate. (Agbogidi & Arinze, 2014) posited that every environment is capable of providing ecosystem services. Edewor (2024) further noted that with appropriate soil management and conservation procedures, every soil environment can be profitable. The focus of this study is to interrogate the nutrient status of the hydric soils in Delta State and draw attention to the profitable utilization of these marginalized soil ecosystems. This could serve as a panacea for indiscriminate forest destruction.

The study is on Delta State, Nigeria, focusing on three ecosystems: Low and wetlands, fallow landscapes and rainforests.
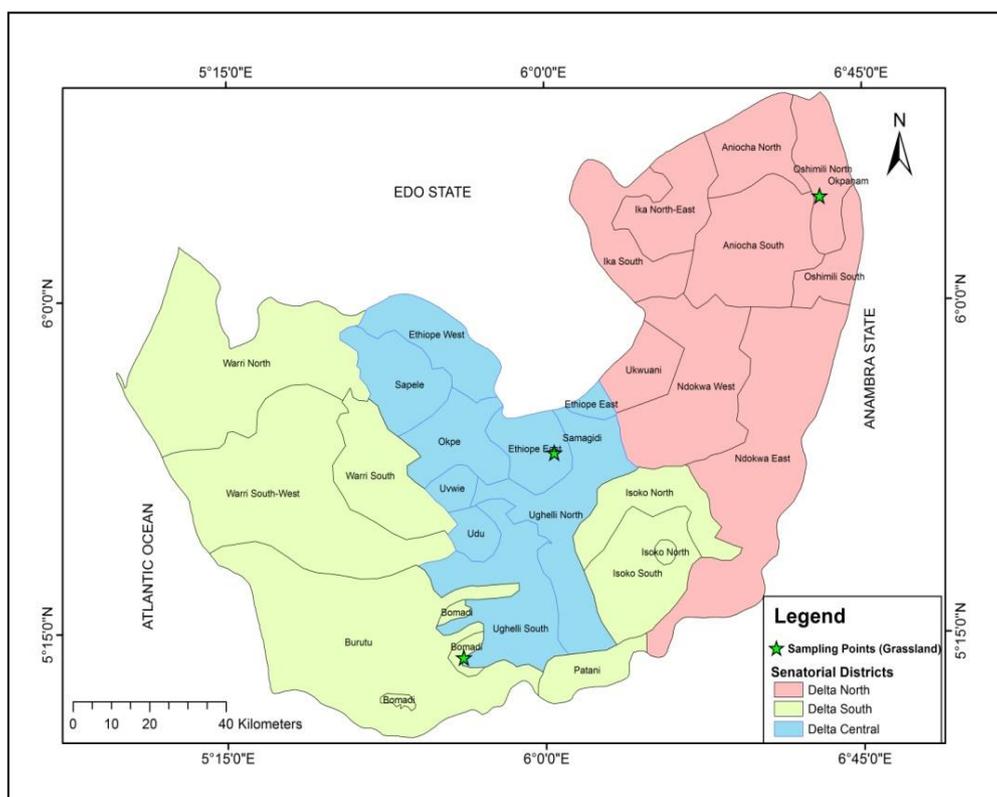

Figure 1. Delta State showing the division of Delta State into zones (Delta North, Delta Central and Delta South)
Source: Author's Fieldwork, 2019

Delta State experiences consistently warm and humid weather year-round, with average morning relative humidity at 90% and afternoon humidity at 55%. The gradual decrease in relative humidity from the coast to the north is evident in these patterns (Efe, 2007). Climatic factors of rainfall, temperature and humidity influence the vegetation.

2. Literature Review

2.1. Location, Size, and Boundary

Delta lies between latitudes 5° 15^1N and 6° 0^1N and longitudes 5° 15 E and 6° 45^1 E (see Figure 1, Nigeria showing the location of Delta state). Delta State has a geographical area of

about 17,440 square kilometers (Dittimi, 1995 in Edewor & Atubi (2021). Its nomenclature is a reflection of the Delta region of the river Niger. The state is located within the rainforest belt. The predominant physical features include swamps, creeks, rivers, and coastlines extending from East to West for about 163 kilometers on the Atlantic Ocean (Delta State, 2014). Delta state is surrounded by the river Niger and Anambra to the East, Balyesa state to the South, and Edo state to the North. It is also bordered on the Southern side by the Bight of Benin. The coastal area of Delta state is extensive, with a complex network of waterways including rivulets, streams, and various tributaries that form a portion of the Niger Delta region where the River Niger flows into the ocean (Awaritefe, 2013).

2.2. Geology and Soils

Delta State, which is a significant region within the Niger Delta, is characterized by sedimentary rocks that are predominantly yellow, white, and sandy with pebbles. Clay and sandy clay can be found in scattered pockets throughout the area (Peters, 2009). Typically, the research site is located in the Benin and Agbada formations with consistent geology. There are three similar geological formations present in the region, stacked on top of each other. The uppermost Benin formation is made up of coarse sand and gravel. Beneath the Benin Formation lies the second Agbada Formation, composed of sand and shales. The third layer is the Akata formation, found beneath the Agbada formation, and made up of clay and shales.

Samuel & Akinbani (2015) stated that a large part of the sedimentary rock formation is quite recent in age, being an accumulation of about 12,000 years. This enormous accumulation has been accentuated with recourse to the fact that the crust has been isostatically depressed by the weight of sediments. The deposits attain great thickness resulting in continued subsidence during the period of deposition.

Physio-graphically, Awaritefe (1991) and Udo et al. (1984) stated that the three units visible in the delta region are:
a)   Beach sand pilled by the sea
b)   Saltwater swamp which carries a thick mangrove forest and
c)   Freshwater swamps which thrive raffia palms and other freshwater plants.

The area lies within the area of the recent Holocene sedimentary rock belt. This belt can be further subdivided into deltaic plain region, meander, and swamp deposit belt. The general presentation of the soils of the area is young hydromophic alluvial deposits. In the freshwater swamps of the delta, the soil is acidic and not salty, while in the mangrove swamps it tends to be saline and typically close to neutral or slightly acidic (Alakpodia, 2000).

Fagbemi (1985) posited that in Delta State, the genetic classification systems for the soils can be divided into three main groups: hydromorphic and alluvial soils, ferrasols, and ferruginous tropical soils. Approximately 80% of the state's total land area is covered by hydromorphic and alluvial soils. The ferrasols are deeply weathered red and yellow-brown with abundant free iron oxides. The tropical soils rich in iron are products of the underlying basement complex and layers of sedimentary rocks. These soils are highly porous, with a subsoil made up of dark reddish sandy clay loam. The geological makeup and soil composition in this region have provided the necessary conditions for the growth of forest vegetation and grasslands, which have been utilized for various human purposes throughout the years.

2.3. Relief and Drainage

The topography of Delta State consists of a flat delta plain with waterlogged depressions and swamps scattered throughout. The landscape is characterized by its relatively low elevation, with the highest point reaching only 91 meters above sea level (Odemerho & Ejemeyovwi, 2007). However, the land is a little elevated around Ika between 91-183 meters

above sea level. Despite the low relative relief and seemingly monotonous nature of the terrain, its landscape can be distinguished into five physiographic provinces namely:

a)   Coastal barrier islands and ridges
b)   Mangrove swamps- around Burutu and other coastal areas.
c)   Low deltaic plains-coastal areas
d)   Undulating plains- generally found across the state
e)   Dissected uplands- Delta north

Delta State is encompassed by five primary drainage systems. Among these are the Ramos-Niger Basin, Ase River network, Utor-Anwai River Basin, Forcados-Warri River Basin, and Benin-Ethiope River Basin. When it rains heavily, the highlands in the vicinity become inundated with water.

2.4. Climate

Delta State has a tropical equatorial climate where the wet season lasts from April to October. The amount of rainfall slightly decreases in intensity and duration as you move from the coast to the inland areas of Delta State (Efe, 2007). The wet season is usually interjected with a brief dry spell known as "August hiatus" otherwise known as August break with a duration between one to two weeks. Dry periods in the state typically last for a brief period, generally occurring between November and March, with sporadic rainfalls across most areas. Regions near the Atlantic Ocean may notice a slight dryness towards the end of December. These periods are linked to the presence of tropical maritime (mT) or Southwesterly monsoon air mass, tropical continental (cT) or Northwesterly air mass, and the movement of the inter-tropical discontinuity (Efe, 2007). The state receives a total annual rainfall of 2000mm and above. In Delta State, the pattern of rainfall throughout the year shows that July has the highest amount of rainfall, averaging 584mm. Conversely, the month with the lowest average monthly rainfall is recorded as 34.3mm. This suggests that there is not a distinct dry season in the area, as it receives two peaks of rainfall in July and September (Efe, 2007).

2.5. Vegetation

Vegetation refers to the plant coverage of an area. In a simple sense, natural vegetation means the type of plant that would grow in an area if there were no anthropogenic activities. Vegetation in Delta State includes a variety of types such as mangrove swamps, freshwater swamps, lowland rainforests, and grasslands known as derived Savanna landscapes. These landscapes are often considered as a symbol of environmental resistance (Alakpodia, 1999).

The landscape is typified by marshy terrain frequently divided by slim waterways and streams. Predominant economically valuable tree species found in the region consist of red mangrove *rhizopora racemosa*. The mangrove plants thrive in waters influenced by tides. As the water rises and falls, the land is overflooded. This exposes the environment to experience a nasty-smelling marsh. The mangrove trees are in some cases by-bushes and ferns. These form almost impenetrable multi-layered vegetation.

The freshwater swamp is situated further inland compared to the mangrove vegetation, and it is not affected by continuous ocean water.   The primary tree species in this area include *Raphia Specie, calamus species, Irvingia gabonensis, Termilania species*, among others.

Moving away from the mangrove, the tropical lowland rainforest contains a diverse range of tree species like wood climbers, creepers, and undergrowth. This forest is structured in layers, and the trees are predominantly evergreen in nature. The derived Savanna landscape (grassland vegetation) occurs in patches in nearly every local government within the state. The grassland of Delta State is known to be treeless and dominated by grasses such as *Impera cylindrical, Loudeita orundinacea, Panicum maximum and Hyperrheria* species (Aweto,

1987). The vegetation of Delta State has experienced a host of anthropogenic disturbances such as deforestation, bush burning, farming activities, building and constructions and others resulting from the vagaries of the forces of nature.

3. Methods

The field survey method was adopted to carry out this study. Soil samples were collected from the zonal stratification of Delta State (North Central and South-South). Thirty (30) samples were taken from each of the three lowlands and wetlands, for a total of ninety (90) samples. The soil samples were prepared and sent for laboratory analyses for in-depth soil analysis. The results obtained were statistically analyzed to draw inferences from the laboratory-analyzed soil samples.

4. Results and Discussion

4.1. Utilization of Lowlands/ Wetlands as Support Farmlands, Imperatives for Mitigating Soil Loss and Forest Depletion in the Rainforest Region

Ariyo & Mortimore (2015) identified Africa's Guinea Savanna agroecological zone as the world's largest underdeveloped land and agricultural resource. The use of low and wetland as alternative farmlands will form the basis of some new trajectories of agrarian and industrial transformation in the contribution to national food security and employment through a scientific study of land capabilities and soil evaluation to mitigate and remedy the limitations of underutilization of derived Savanna.

Studies on Biological Footprints Fields (2001) indicate that there are growing ecological deficits. Building on this premise, Chinsinga & Chasukwa (2012), emphasize the need to place a premium on idle, marginalize or abandoned landscape in the Human Appropriation of Net Primary Production (HANPP). Hall & Scoones (2015) also noted that the place of development is a departure from what the situation was before now, the trend is moving in such a manner that an Environment can move from a Footprint nearly five times larger than its bio-capacity because of indiscriminate land use without sustainable profiles. Ariyo (2015) also posited that the intensity of indiscriminate use of forest resources is alarming. He added that the use of derived Savanna landscapes would engender sustainability of soil resources, as well as preserve and conserve the resources of the forest estate.

Environmentalists have emphasized the estimation of forest loss and its attendant soil impoverishment in the tropical forest zone (Akinbode, 2002; FAO, 2001). The international community is expanding its frontiers and interest on the current environmental issues that border on Greenhouse Gas Emissions (GHG) and their local and global effects on the environment, deforestation and climate change (Leach et al., 2015) and its consequent role on ozone depletion.

The IPCC of 2000, as part of the UNFCCC, described deforestation as the deliberate act of turning forested land into non-forested or grassy areas due to human activity. A forest is considered to be land with trees covering 10% to 30% of the area, with the ability to grow up to 2m - 5m in height.

Utilitarian actions on landscapes depend on how the society values different landscape structures and species (CODESRIA, 2012). In Delta State, the utilitarian value accorded the lowlands/ wetlands landscapes is relatively low because of the natural endowment because of the southerly geographical location of the area whereby the cultivated fallow landscape is

capable of regenerating and replenishing itself without any form of maintenance or conservation measures, encourages constant exploitation of the forest resources with little or no effort to regenerate the constantly depleted forest soils. Such tendencies could take a toll on the natural environment, which could result in environmental degradation.

Alakpodia (1999) opined that the lowlands/ wetlands in Delta State can be profitably utilized to mitigate deforestation and soil depletion in the forest zones if properly managed. In the southern part of Nigeria, the forest zone is subtly suffering from soil depletion and desiccation. The inhabitants in most parts of the south (Delta) do not envisage any danger in the continued exploitation of the forest soils because of the high rate of regeneration of secondary re-growth vegetation caused by heavy rainfall and rich humus forest soils occasioned by leaf fall and eventual decay of leave fall that give rise to humus. This view is myopic because the long-term effect could lead to soil erosion, exposure of soils to vagaries of weather and climate such as soil desiccation and disturbance of the water balance in the river basins, including climate change.

Arable farming which involves the clearance of vegetation to make way for the cultivation of crops is an inevitable activity for the survival of man. The way it is practiced in the rainforest zone has led to the depletion of the original forest at a very high rate., quite several studies have been carried out on forest depletion within the rainforest zone (Akinbode, 2002; FAO, 2001) but none of these studies have considered a qualitative enquiry into the physio-chemical parameter of soil capabilities in the derived Savanna landscapes as alternative farmlands in relation to the fallow landscapes with the rainforest, with an outright comparison with the rainforest.

Alakpodia (1999) carried out extensive studies on the evolution of low and wetlands landscapes in Delta State, but there were no comparative and evaluative soil capabilities with the fallow and derived Savanna landscapes of Delta State. Clayton (1996) also studied the low and wetland of Urhobo plains, but the research did not examine the physio-chemical parameters of Low and wetland landscapes as probable alternative farmlands that could serve the same purpose as the fallow landscape and the rainforest, given the fact that they exist under the same environmental conditions though with heterogenous plant cover, in a homogenous environment.

Edewor & Atubi (2021) studied the ecosystem services with an emphasis on vegetation parameters such as tree height, tree girth, and species diversity. Similarly, priority attention was not accorded to soil capability and empirical evaluation of the soil Physio-chemical properties of the low and wetland landscapes on environmental stability and sustainability. Rewat (2007) reported that the world's forests are under threat of destruction and their disappearance could result in hazardous environmental deterioration which could have serious global and local import on the environment especially in an era of dwindling duration of fallow periods.

Bruce et al. (2018) estimated that about 600,000 hectares of Nigerian forest is lost yearly through indiscriminate uncontrolled and careless exploitation of forest resources. FAO (1995) report noted that reforestation and soil replenishment effort is barely about 25,000 hectares annually. The percentage of the replenishment attempt is only 4% of the loss. Earth Policy Institute (2002) noted that the world lost 94 million hectares of forested landscapes during the twentieth century. It further stated that the developing countries lost 130 million hectares, while the developed and industrialized world gained and reclaimed 36 million hectares from previously marginalized and abandoned landscapes for agricultural and industrial uses.

In light of the above development, qualitative and scientific research can also bring about the reclamation of the seemingly abandoned marginalized low and wetlands of the

rainforest zone in Delta State through appropriate soil improvement, management and conservative measures. FAO (2001) stated that the Nigerian tropical forest and the soils are depleting fast as a result of anthropogenic factors and further advocated that alternative land use should be devised to reduce the pressure on the forest estate. This is the situation in Delta State where the forest estate is constantly depleted and exploited for various economic endeavours, while large expanses of grasslands that exist in nearly all the local government areas of the state are left abandoned, underutilized, marginalized, or idle landscapes all year round.

This research work seeks to advocate the effective utilization of lowlands/ wetlands. This will promote and in turn improve the quality of endangered and deteriorating environments, especially in this era of climate change and the role of deforestation in accentuating the hazardous effects of climate change (Melissa et al. 2015). It also addressed the challenges of soil scarcity, especially in an era of land grabs and food security.

Excessive forest exploitation and its attendant hazardous environmental impact cannot be undermined, with such important functions of the forest estate such as cycling of nutrients, regulation of climatic conditions stabilization of soils and maintenance of the water balance of the earth, there is an urgent need therefore, to explore alternative land use such as derived Savanna grasslands in the forest zone to reduce the pressure on the forest resources with the awareness that the original Savannas are fully utilized for diverse economic ventures where forest alternatives are not in existence. Bouma et al. (2017) studied the functional potentials of the soils and posited that soils under distinct vegetation covers evolve their specific nutrient availability and productive potentials that suit arable farming activities.

Natural Resource Conservation Services (2004), emphasized the need to explore alternative land use for family and industrial uses as a means of reducing pressure on the forest estate, and soil conservation. Erickson et al. (2014), the NEST-Nigerian Environmental Study Team (1991), also reported that over 3,500 hectares of rainforest vegetation is constantly being depleted yearly, and subject to subsequent fallow due to arable farming activities alone, whereas the low and wetland are idle or underutilized all year round. Madulu (2004) referred to a man as a "destructive intruder to the natural ecosystem". Based on this view, the study maintains that a proper evaluation of the soil capabilities and fertility potentials of derived Savanna landscapes would reduce the impact of man on the rainforest zone especially in this era of land grab and food security challenges (Sessan, 2013).

Mugachi (2005) also reiterated that the fallow periods which are the natural soil regenerative and replenishment strategies adopted for subsistence agriculture in the forest zone had been drastically reduced to a few years (between 1 – 2 years) against the backdrop of 10 – 15 years in the time past in some cases continuous cropping which may lead to further impoverishment of the soil without provision for soil regeneration. This calls for alternative land use as advocated by the World Bank (2010), especially in Delta state where there is the prevalence of "idle", underutilized or marginalized derived Savanna.

According to Vanlauwe et al. (2002), lowlands/ wetlands have been landscapes that generate notable concerns over the years. The research focused on analyzing the soil fertility in the derived Savanna and northern Guinea Savanna regions, looking specifically at the impact of different soil types and land management practices on the availability of key nutrients for plant growth. The focus of the study is mainly on the nutrient status of the soils as formed under different geological units in the low and wetlands and others. Major findings in the study revealed significant fertility potential in topsoil physio-chemical parameters. Cole, (1986) investigated the peculiarities of lowlands/ wetlands and their potential fertility and capability values for sustainable arable farming. Bouma (2017) in a study titled "Soil

Capability: Exploring the Fertility Potentials of Soils" identified the intrinsic capacity of soil to contribute to ecosystem services which are major life support services that sustain the human race. The study provided vital information on maximizing soil potential and linkages with ecosystem services and sustainable development, especially in the evaluation and utilization of soil fertility potentials under different land covers.

Abubakari et al. (2012) also carried out a study on comparative characteristics of soils in Shea Parklands of Ghana. The major focus of the study was a critical assessment of the role of soil physio-chemical properties. Adamu et al. (2015) further posit that the most prominent constraint to food production in most parts of the world is hinged on low soil fertility and capability potentials of soils. Therefore, soil fertility and capability management remain a key factor for increased food production. The study also advocates the need for a sustainable development goal mantra in environmental conservation and protection in the 21st century, especially as it relates to SDG 13 which addresses environmental protection and sustainable food production.

4.2. Functional Potentials of Soil Fertility and Capability of Lowlands/ Wetlands in Delta State

Field surveys conducted for this research paper indicate that the soil parameters values of the rainforest landscapes are not much at variances with rainforests. In other words, the utilization of derived Savanna for crop production and other arable ventures could be used as a tool to mitigate and salvage the current trend of forest destruction in the face of glaring alternatives. The Natural Resources Conservation Services (NRES, 2004) posited that the most important characteristics of soil is its fertility and capability status. Having ascertained a comparable nutrient soil fertility and capability status of the derived savanna and the rainforest vegetation landscapes, it is therefore sufficient to postulate that the use of lowlands/ wetlands will ameliorate the fast rate of forest depletion which will translate to environmental sustainability and sustainable development.

Table 1. Soil parameters values of the Various Lowlands/ Wetlands Soils

Soil Parameters	Delta North L/W Lands	Delta Central L/W Lands	Delta South-South L/W Lands
pH	5.22	4.48	4.18
OC (%)	2.17	4.29	2.41
Total Nitrogen (%)	0.24	0.48	0.27
Avail. Phosphorus (ppm)	7.25	7.64	33.98
Calcium (cmol/kg)	0.42	0.31	0.27
Sodium (cmol/kg	1.57	1.60	1.93
Magnesium (cmol/kg	0.46	0.36	0.55
Potassium (cmol/kg)	0.10	0.10	0.11
Sand (%)	78.20	84.80	77.20
Silt (%)	11.40	9.40	10.20
Clay (%)	10.40	5.80	12.60
ECEC	2.56	2.37	2.90
SFI	10.00	10.14	12.22

Source: Fieldwork, 2019

Table 2. Soil parameter mean values for the three landscapes (Rainforest, Derived Savanna, fallow landscapes)

	Low/ Wetlands	Standard	Source
pH	4.63	5 – 6	SFCC (Sanchez et al, 1982)
OC (%)	2.96	3 – 8%	Miller & Donahue (1990)
Total Nitrogen (%)	0.32		SFCC (Sanchez et al, 1982)
Phosphorus	16.29		SFCC (Sanchez et al, 1982)
Ca	0.33		SFCC (Sanchez et al, 1982)
Mg	0.45		SFCC (Sanchez et al, 1982)
K	0.10	> 0.20 meq/ 100g	SFCC (Sanchez et al, 1982)
Na	0.17		SFCC (Sanchez et al, 1982)
ECEC	2.60	> 4 meq/ 100g	SFCC (Sanchez et al, 1982)
Sand	80.06	Not loamy sand or sand	SFCC (Sanchez et al, 1982)
Silt	10.3	Not loamy sand or sand	SFCC (Sanchez et al, 1982)
Clay	9.60	Not loamy sand or sand	SFCC (Sanchez et al, 1982)

Source: Sanchez and Donahue (1982)

This study therefore posits that the lowland/ wetland soils can be harnessed for precision agriculture to sustain hydric crops that have short periods of maturation. The specific findings include:

a) Similarities in the grasslands and rainforest in terms of the contribution of certain parameters as well as being strongly related to common or similar soil parameters in other landscapes. This implies therefore that the soil parameters of the wetland grasslands are comparable to the fallow and forest. This further confirms the similarity and comparability of the soil of the wetland grasslands with that of the rainforest, bringing to the fore the potential for productivity like that of the rainforest for arable farming.

b) That a significant relationship exists in the soil Physio-chemical parameters of the various landscapes. A number of the major soil parameters varied significantly at 0.05 sig level with some trace elements such as EXCH Acidity (0.020), Exch H, (0.027) Exch. Alh (0.031), Calcium 90.004), Magnesium (0.012) and ECEC (0.004). This shows that all the computations in all the zones evolved their peculiar characteristics in the various landscapes.

c) From the soil fertility index calculated, the lowland/ wetland hydric soils have comparative utilitarian values with the rainforest and fallow landscapes. This dismisses negative allusions to its underutilization and idle status.

d) The relevant characteristics and peculiarities of physio-chemical parameters were identified. Specifically, the study revealed that the soils of the three landscapes in the various zones are generally acidic as they fall within the pH level 4.62-4.79. These are less than the threshold standard values of 5-6.

e) Soil constraints in the study area are site-specific and will require peculiar conservation measures for each site as shown in the soil fertility index and soil capability classification.

5. Conclusion

The study examined "Exploring the functional potential of hydric soils of lowlands/wetlands of Delta State Southern Nigeria. The study thus revealed some, similarities in the availability of Physio-chemical properties in the soil of the three different landscapes. Specifically, the low and wetland vegetation which are usually viewed with apathy for cultivation and other arable uses, are justified as cultivable landscapes as they are as rich in organic content as it is obtainable in the forest landscapes. From the results of this study, it would suffice to advocate the use of the low and wetland as cultivable landscapes as they share the same nutrient availability and soil constraints, observable in both the rainforest (control) and the fallow landscapes, thus a justification of their use as alternative landscapes to ameliorate the rate of depletion of the rainforest as a preferred choice for soil resource exploitation is key. Such realization will also mitigate soil depletion and indiscriminate forest removal, especially in the wake of environmental hazards in the areas of soil deterioration, soil desiccation and climate change, addressing the current climate change challenge of the 21st century. This aligns with the objectives of Sustainable Development Goals (SDGs 12 and 13, focusing on promoting sustainable consumption and production practices and taking immediate measures to address the effects of climate change.

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