# Suitability Evaluation of Wetland Soils for Tomato Production in Okobo, South-South Nigeria

***[1]Mfoniso Victory Iyanam,[2]Christiana James Ijah, [3]Okezie William Nwaoba,[4]Udeme Sunday Akpan, and [3]Victor Emmanuel Osodeke**

[1]Department of Agriculture, Ministry of Agriculture, Uyo. Akwa Ibom State, Nigeria.
[2]Department of Soil Science, Akwa Ibom State University, Akwa Ibom State, Nigeria.
[3]Department of Soil Science and Land Resources Management, Michael Okpara University, Umudike, Abia State, Nigeria.
[4]Department of Soil Science and Land Resources Management, University of Uyo, Akwa Ibom State, Nigeria.
*Corresponding Author Email: Iyanammfoniso0@gmail.com; Tel: +2348032554236

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**ABSTRACT**

*This study assessed the suitability of selected wetland soils in Okobo, Akwa Ibom State, Nigeria, for tomato production based on their physicochemical properties. Tomato is an important vegetable crop widely consumed in the diets of people in Akwa Ibom State; however, limited studies have examined the suitability of Okobo wetland soils for its cultivation. To address this gap, two soil profile pits were excavated in two different communities and designated as Pedon 1 and Pedon 2. Soil samples collected from the profiles were analyzed to determine their physical and chemical characteristics and to evaluate their suitability for tomato production. The soil colour in Pedon 1 ranged from black (7.5YR 2/1) to dark yellowish brown (10YR 4/6), while Pedon 2 ranged from dark reddish brown to dark greyish brown (10YR 4/2). The textural class varied from loamy sand to sandy loam in Pedon 1 and from sandy loam to loamy sand in Pedon 2. Organic carbon values ranged from 1.60–2.40 g/kg in Pedon 1 with a mean of 2.0 g/kg, while Pedon 2 ranged from 2.2–2.8 g/kg with a mean of 2.5 g/kg, indicating generally low organic carbon content in both pedons. Available phosphorus had a mean value of 4.45 mg/kg in Pedon 1 and 5.20 mg/kg in Pedon 2, suggesting low phosphorus availability. Soil reaction showed that the soils were acidic, with mean pH values of 5.0 in Pedon 1 and 6.25 in Pedon 2. Exchangeable bases (Ca, Mg, Na, and K) were also found to be low in both pedons. Based on the land suitability evaluation, the soils met some of the basic environmental requirements for tomato cultivation, such as appropriate texture and humid conditions; however, fertility limitations were observed. The soils were classified as marginally suitable* ***(S3f)*** *due to low nutrient status, particularly phosphorus deficiency. The study therefore recommends the application of both organic and inorganic fertilizers to improve soil fertility. Amendments such as bone meal, a natural fertilizer rich in phosphorus, are suggested to enhance nutrient availability, promote root development, and improve flowering and fruiting of tomato plants. These improvements would enhance the productivity of tomato cultivation in the wetland soils of Okobo.*

***Keywords:*** *Suitability evaluation, Tomato production, Soil physicochemical properties, Wetland soils, South-South Nigeria*


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## INTRODUCTION

Suitability analysis or evaluation of soils helps in increasing the knowledge of its potential for cultivation of various crops. To achieve the full potential of any given land at any given time and space, the role or practice of suitability analysis most be in place. (Iyanam *et al*., 2026). Land suitability assessment is the method of evaluating land and identifying the major limiting factors for a particular use (Nwaoba *et al.,* 2024). Suitability analysis is a true medium of assessing the usefulness of a given or particular soil for different crop production. It also determines how the productivity of the crop can be determined based on the effectiveness of various physical, chemical and morphological properties of the soil suitable for its productivity.

Wetland soils are soils or habitats not basically suitable for crop production particularly when saturated with heavy downpour usually observed in the Akwaibom State. However, as the soil seeps down naturally and gradually becomes dry or possibly drained by certain activities by human forces, it becomes productive and economically valuable for growing crops such as vegetables, fruits, tree crops etc. Hence, it is common to see crops of such thrive in the area and certain domain of wetlands.

The use of wetlands for agriculture in South-South Nigeria is for production of crops like onions, okro tomato, garden eggs, rice, plantain, fish production etc .Wetlands soils in South South Nigeria are found in floodplains, swamps, coastal plains, inland depressions, river banks etc.( Iyanam *et al*.,2023). Wetland soils are also soils that limits the ability of water infiltration by sources like rainfall, irrigation, surface runoff, overflow of river banks and seepage from surrounding areas of water bodies. Wetland soils are soils saturated by water. There are mostly predominant during heavy rains or flooding. The inability of water infiltration in the some parts of south south terrain is basically as a result of its location on lowly and mostly flat terrain commonly found in the area.

In the neighbouring region, Southeastern Nigeria, wetlands are used for rice cultivation, sugar cane, and cocoyam. These wetland soils are also called the Fadama soils in the north Nigeria and Ndiogo in Ibibio speaking part South South Nigeria. Gleying and Ferrolysis are soil processes commonly found in wetland soils. These and other processes commonly found in wetland soil are occasioned by the different level of water saturation in the soil. Soil temperature and organic matter content are functions that encourage a high level of microbial activities in the soil. Various characteristics are found in wetland soils, evidence of various changes in soil colour down the soil profile and presence of mottles. (Iyanam *et al*., 2024). In wetland soils, when the water table is high, the oxygen becomes low there by bringing about a reduction in various forms of elements like iron and manganese which brings about certain colour changes in the soil like grey and reddish soil colors. Wetland soils can also be described as soils that are waterlogged or saturated for growing upland agricultural crops. Wet-soils are soils suitable for producing agricultural crops more productively when the moisture content is reduced or dried. However, they are boundaries between wetlands and wet soils that can easily be shifted by public policy, technology and economies. Wetland soils have great potentials and could vary in its position as it could be temporary, seasonal or even defined as permanent especially soils found in flood plains, coastal and riverine areas etc. They are wonderful creation of God (KJV Bible).The vary in their functions as determined by human activities and locations where they exist. Tomato (*Solanum lycopersicum*) is among the most cultivated and important vegetable in the world. Wetland soils such as coastal soils are adequate for cultivation of vegetables and various crops that do well in water logged soils (Iyanam *et al*., 2024).

Tomato is cultivated in temperate and tropical regions of the world. Tomato is grown in a wide range of varieties. They thrive well and better under irrigated soils or soils constantly fed by rain during wet seasons. Irrigation provides better growing conditions when cultivated in dry season. Tomato is sensitive to moisture availability. It is best cultivated in the early hours of the morning or evening when the sun is down. It should be planted as soon as the rains starts or is about to stop. It rarely tolerates moisture stress. This affects the fruiting process. Production of fresh tomatoes fruits is more than 177 million tonnes (FAO, Agricultural Production Statistics, 2022).It is of high value and has an annual market value that exceeds $90billion (FAO,2019). Tomato is an important source of lycopene carotenoids, vitamin A and C. It is known to reduce the risk of cancer in humans and also protects the skin from ultraviolet radiations. The crop also contains potassium, iron, and calcium. Lycopene present in tomato fruit acts as an anti-carcinogen, which can prevent cancer, especially prostate cancer. Phosphorus an essential nutrient for energy transfer within the plants should be incorporated early. This plays a vital role in fruit ripening. Tomato fruits are ready for harvest at 7 weeks planting depending on various factors such as the variety, soil type and time of the year. Climate plays a significant role in agricultural productivity and these affects the types of crops that can grow in a given area (Tawakalitu *et al.,* 2022). Agriculture is a complex sector. It encompasses several sectors such as: environmental, economic and social. This is evident in the fact that crop production is prone to climate change, with its varying impacts across the globe (Osman *et al*., 2021). Climate change can be defined various changes in climatic conditions of a particular area that can be detected by changes in time or variability in properties. According to the Intergovernmental Panel on Climate Change (2014), climate change can be defined as a change in climate conditions that can be detected by changes in time/or variability of its properties (using statistical tests), and that usually persists for an extended period of time, decades or more. The panel also recognized that change in climate occurs over time, whether due to natural variability or as a result of human activity. This meaning has been established separately from the United Nations Framework Convention on Climate Change (UNFCCC), which defines it as climate change attributable directly or indirectly to human activity that alters the composition of the global atmosphere and in addition to natural climate variability observed over comparable periods. Ani and Anyika (2021) described climate variability as the long-term summation of atmospheric elements such as solar radiation, temperature, relative humidity, and precipitation, and their variations over time.

Similarly, studies in Nigeria show that climate variability is mainly related to rainfall and temperature, and food crops .Therefore, food crops consist of various categories of crops, including vegetables, thus confirming the challenges these countries are facing concerning climate change. For instance, Cho (2018) asserted that the production of vegetables and legumes could decline by 35 percent by the year 2100 due to ozone depletion, water scarcity and increased salinity as long as greenhouse gas emissions continue on their current path. Nalik *et al.* (2017) showed that climate change affects vegetable production globally, but its nature and impact vary depending on the degree, geographic region, and agronomic practices employed.

A study by Abewoy (2018) revealed that changes in climatic elements since the 1960s have significantly affected agriculture in different ecological zones of Nigeria. Ughelu (2017) also stated that Nigeria has been identified as one of the sub-Saharan African States that are vulnerable to changing climatic conditions. Some research works (Ikem, 2018; Uwazie, 2020) have shown that frequent environmental disasters in parts of Nigeria are attributable to unpredictable climatic variables, which invariably have worsened food productivity and human suffering over the decade. Changes in climatic variables brought about by climate change affects the six vegetative zones of Nigeria differently according to (Ughelu, 2017). In semi-arid Sudan and the Sahel savannah region, it brings low rainfall, drought and increased desertification; in the Northern and Southern Guinea Savannah belt, it changes rainfall patterns, often with late arrival of rain and a long dry season; the coastal zones experience severe flooding during the raining season (Ogbuchi, 2020).This also affects the crops as the flooding negatively impact on soil and invariably the crops grown. (Iyanam et al., 2026). In rainforest zones, it delays the onset of rains, longer dry seasons, heat waves, and flooding around coastlines, while in mangrove swamps, it usually results in flooding of dry plains as continued sea level rise poses a threat to the natural environment (Berhanu &Wolde, 2019). Hence, these fluctuations in climatic factors not only affect the natural environment but also specifically hinder food crop production, which includes vegetables. Vegetable crops can be classified as fruit vegetables such as tomato, watermelon, garden egg, and cucumber. Vegetables contribute significantly to the caloric intake and nutrition as their consumption makes vitamins, minerals, and energy available to the human body (Nalik *et al.*, 2017). Tomato is an important vegetable crop grown for its vegetable and fruit (Iyanam et al 2026). The crop also contains potassium, iron, and calcium. Daily consumption and demand for tomatoes are increasing in Akwa Ibom and various parts of the nation due to the increase in population (Iyanam *et al*., 2026). Tomatoes are very good health related supplement. They contain antioxidants such as ascorbic acid (Vitamin C), vitamin A, and tocopherol (Vitamin B). Tomatoes is eaten fresh as a salad, cooked in soups or stews, or used to make fruit drinks, pressed into a paste or pure. Due to the dearth of information on various suitability of wetland soils for crop production in South -South Nigeria and the absence of soil information and suitability maps, there is an overwhelming need for suitability evaluation of the soils for various crop productions like tomato. Therefore, the objective of the study is to evaluate the suitability of the soils of Okobo, South -South Nigeria for tomato production.

## MATERIALS & METHODS

The study was carried out in Okobo Local Government Area Akwa Ibom State. The Community lies between Latitude $4^0 53^{'} 25$” and Longitude $8^0 9^0 20^0$E with an elevation of 23m above sea level. The study area had mean annual minimum rainfall of 120mm while mean rainfall is 2000mm spread between April to early November. The average minimum and maximum temperatures range between 26 and $30^0$C, while the relative humidity varies within 75-80%.The landscape is lush with tall trees, dense undergrowth plants around it. The climate of the area is sub humid tropical having distinct rainy and dry seasons. Rainfall is at its peak in July and September. The landscape of the study area is lowly and flat terrain.

### Field Studies

Reconnaissance visit was conducted at project area. The study area surveyed using free survey method. Four profile pits were sunken at representative locations. Soil samples collected, air dried, crushed and sieved using a 2mm mesh. Particle size was carried out and other routine analysis. Profile pits were described following the FAO (2014) guidelines for soil profile description. Soil samples were collected based on generic horizon for laboratory analysis.

### Laboratory Analysis

The physic-chemical properties determined were particle size distribution, soil PH, organic certain, total nitrogen, available phosphorus, exchangeable acidity, exchangeable bases, effective cation exchange capacity and base saturation. Particle size distribution was determined by hydrometer method according to the procedure of Gee and Or (2002). Soil pH was determined using Ph meter and read at a soil water ratio of 1:2.5. Available phosphorus: Available phosphorus was determined by Bray P-1 extractant as described by Udo et al. (2009).Exchangeable acidity ($H^+$ and $Al^{3+}$) was determined using one normal potassium chloride (1NKCL) by titration method as described by Udo et al. (2009). Organic carbon was measured by Walkley and Black Wet digestion method (Nelson and Sommers, 1982) while total nitrogen (N) was estimated from organic carbon Exchangeable bases were extracted using normal ammonium acetate(Thomas,1996) .The exchangeable K and Na were determined by flame photometer. Effective cation exchange capacity ECEC) was determined by summation of exchangeable acidity and exchangeable bases (AOAC, 1990; Udo et al 2009). Base saturation was calculated by dividing the total exchangeable bases by the effective cation exchange capacity and multiplied by100.

$$\% \text{ BS} = \frac{\text{Total Exchangeable Base}}{\text{ECEC}} \times 100$$

### Land Suitability Evaluation

The land suitability evaluation method used to assess the suitability of the study area for tomatoes was non-parametric method and the interpretation guide for evaluating analytical data (FAO, 2004). The pedon was placed in suitability classes by matching various characteristics with the established agronomic requirements of tomatoes (Table 1). Depending on the extent to which the land characteristics meet the crop requirements, the suitability class indicated in numbers attached to the letter indicator and scores were allocated as follows: 100-95% - S1; 95-85% - S2; 85-60% -S3; 60-40% N1 and 0-40% - N2 (FAO ,2006). Morphological properties like depth, texture, structure consistency of each horizon was determined using munsell colour chart, soil colours of pedons were identified.

## RESULTS AND DISCUSSION

### Physical Properties of Soil in the Study Area

The physical properties revealed sand fraction as 83-71% with an average of 73% in pedon 1 while pedon 2 ranged from 68-75% with an average 72%.The silt content in pedon 1 ranged from 7-15% with average of 11% while pedon 2 land 16-20% with an average of 17%.Clay fraction in pedon I ranged from 10-20% with an average of 15% in pedon 1 and pedon 2, 7-15 with average of 11%. Sand values were high in both pedons followed by silt and clay (Table 2). There is an increase in clay content down the profile from 10% in the subsurface horizon to 20% with a reduction to15% as the reaches down towards the extreme of the profile pit. This is in line with the report of Peter and Wokocha (2019) and (Iyanam et al., 2023) that states that there is an increase in clay content down the profile pit. The process of illuviation and eluviation may be responsible for this increase and reduction down the horizon in pedon1.Same trend is observed in pedon 2. This also may probably due to the component of the soil parent material of which the soils were formed as observed by (Ijah *et al*., 2021). Silt fraction was low in pedon1 and pedon 2 Bulk density ranged from 1.52 – 1.80g/cm$^3$ with mean value of 1.62g/cm$^3$. While in pedon 2, it ranged from 1.60 -1.93g/cm$^3$ while the mean value was 1.80g/cm$^3$.

The high bulk density was attributed to less aggregation of soil particles. (Iyanam *et* al., 2023). Silt fraction was low in pedon1 and pedon2. The high bulk density of the study area could be the cause of the soil compaction of the area this has a tendency to create or make porosity low which adversely affects water intake of plants thereby reducing root penetration and adversely affecting the plant growth. In wetland soils, flooding and heavy rainfall sometimes lead to high water saturation in the soil. The specific bulk densities caused by high level of water saturation most times affects soil aeration and root growth.The moisture content ranged from 50.7 to 41.2% in pedon 1 with mean of 45%.

The same was observed in pedon 2 as the moisture content ranged from 60.3 to 54.2% with a mean of 57.3%. This may be due to the heavy rains experienced in the area and which dispersed to various bodies of water thereby bringing a reduction in percolation down the profile. The morphological properties of the soils in the study area are presented in (Table 3).

The morphological of soils in the study area are presented in (Table 3). The morphological properties indicate colour (chrome, hue and value using the munsell colour chart). It ranged from Black to Brown then yellowish 7.5YR 2/1- 7.5YR 5/3- 7.5yrs 5/8 Brown and dark yellowish brown 10YR 3/6 in pedon 1 and varied from Dark reddish brown 5YR 2.5/2 to Pale Brown 10YR 6/13, 10YR 7/1 light grey to Dark Greyish 10YR 4/2. The consistency was very friable and non-sticky. The soil structures ranged subangular block to angular block then blocky as presented on the (Table 3). While features present were abundant roots, few roots and no roots in pedon I same was obtained in pedon 2.

Brady and Weil, (2002) that postulated that soil colour at the surface horizons are brownish to dark due to the presence of organic matter. The brownish colour observed at the surface level in pedon1 is an indication that the soil had high organic matter probably due to the deposits from eroded materials after heavy rainfall. This finding were in agreement with the findings (Iyanam et al., 2024).In pedon 1 and 2, the texture ranged from loamy sand to sandy loam and sandy clay loam. Wet and moist features of the top soil were observed, indicating the soil to be wetland in consistency (Iyanam *et al*., 2023). The chemical properties

**Table 1:** Factor rating of land use requirements for tomato

| Land characteristics | Unit | Highly suitable SI | Moderately suitable S2 | Marginally suitable S3 | Not suitable N |
|---|---|---|---|---|---|
| Mean temperature | $0^0$C | 25-28 | 29-32 | 15-19 | <15>36 |
| | | | 20-24 | 33-36 | |
| | Mm | 600-750 | 500-600 | 400-500 | <400 |
| | | | 750-1000 | >1000 | |
| Total annual rainfall | | | | | |
| | % | 1-3 | 3-5 | 5-10 | >10 |
| Slope | | | | | |
| | Class | Wel | Moderate | Imperfect | Poor |
| Soil drainage | | | | | |
| | C6SS | L,SL,Cl SCL | Sic, SiCl, Sc, C | C(ss) | Ls,S |
| Texture | | | | | |
| | Cm | >75 | 50-75 | 25-50 | L25 |
| Effective rooting depth | | | | | |
| | Water | 6-7 | 5-5.9 | <5 | |
| P/H | | | 7.8.5 | >8.5 | |
| | cmol/ kg | >15 | 10-15 | 5-10 | >5 |
| CEC | | | | | |
| | (mg/kg) | >7 | <6-4 | <4 | >3 |
| Avail. P | | | | | |
| | % | <30 | >20 | >10 | <2 |
| Base Saturation% | | | | <5 | |
| Org C | g/kg | >1. | <1 | <..5 | <.2 |

Source Adopted from Sys *et al.,* (1991), Iyanam *et al*., (2026).

**Table 2.** Physical Properties of Soil in the Study Area.

| Location | Horizon | Sand(%) | Silt (%) | Clay (%) | Bulk density (g/cm$^3$) | Texture class | Moisture Content (%) |
|---|---|---|---|---|---|---|---|
| Pedon 1 | AP | 83 | 7 | 10 | 1.80 | Loamy Sand | 50.7 |
| | AB | 74 | 12 | 14 | 1.60 | Sandy Loam | 45.5 |
| | B | 65 | 15 | 20 | 1.52 | Sandy Loam | 42.6 |
| | BC | 71 | 14 | 15 | 1.56 | Sand Clay Loam | 41.2 |
| Mean | | 73 | 11 | 15 | 1.62 | | 45 |
| Pedon 2 | AP | 75 | 18 | 7 | 1.93 | Sandy Loam | 60.3 |
| | AB | 69 | 16 | 15 | 1.82 | Sandy Loam | 59.2 |
| | B | 68 | 20 | 12 | 1.85 | Sandy Loam | 55.3 |
| | BL | 74 | I5 | 11 | 1.60 | Sandy Loam | 54.2 |
| Mean | | 72 | 17 | 11 | 1.80 | | 57.3 |

LS= Loamy Sand, SCL= Sand Clay Loam,SL=Sandy Loam

**Table 3:** Morphological properties of soils in study area.

| Location | Horizon | Depth cm | Colour description | Texture | Structure | Consistency | Feature |
|---|---|---|---|---|---|---|---|
| Pedon 1 | AP | 0-20 | 7.5yr 2/1 Black | LS | SAB | WNM | AR |
| | AB | 20-74 | 7.5ys 5/3 Brown | SL | SAB | NS | FR |
| | B | 74-92 | 7.5yr 5/8 Yellowish brown | SCL | AB | VF, SP | FR |
| | BC | 92-140 | 10YR 3/6 Dark Yellowish Brown | LS | B | VF, NS | NR |
| | AP | 0-14 | 5yr 2 5/2 Dark Reddish Brown | LS | SAB | WNM | AR |
| Pedon 2 | | | | | | | |
| | AB | 14-45 | 10yr 6/3 Pale brown | LS | AB | VF, NS | FR |
| | B | 45-68 | 10 yr 7/1 light grey | SL | B | VF,NS | FR |
| | BC | 68-120 | 10yr 4/2 Dark greyish brown | LS | B | VF,NS | NR |

SCL=Sandy Clay Loam,LS = Loamy Sand, SL= Sandy Loam
SAB=Sub angular Blocky,AB=Angular Blocky,B= Block
VF = Very Friable ,NS= Non Sticky.WNM=Wet and Moist
AR = Abundant Roots ,FR=Few Roots,NR=No Root .

**Table 4:** Chemical Properties of Soil in the Study Area.

| Pedon | Hor. | Depth | Ph | OrgC mg/kg | Total N % | Avail P mg/kg | Ca Cmol/kg | Mg Cmol/kg | K Cmol/kg | Na | Al | H | ECEC Cmol/kg | BS % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pedon1 | Ap | 0-20 | 6.50 | 1.6 | 0.09 | 4.50 | 1.20 | 4.80 | 0.10 | 0.04 | 2.20 | 1.06 | 11.80 | 50 |
| | AB | 20-79 | 6.40 | 1.8 | 0.07 | 4.60 | 1.50 | 6.32 | 0.11 | 0.05 | 2.00 | 0.80 | 12.84 | 51 |
| | Bt$^1$ | 79-92 | 6.20 | 2.0 | 0.06 | 4.30 | 1.80 | 6.68 | 0.12 | 0.05 | 2.40 | 1.65 | 13.60 | 54 |
| | Bt$^2$ | 92-140 | 6.30 | 2.4 | 0.06 | 4.40 | 1.50 | 6.40 | 0.13 | 0.06 | 1.62 | 0.05 | 14.70 | 52 |
| | | MEAN | 5.00 | 2.0 | 0.07 | 4.45 | 1.50 | 6.08 | 0.11 | 0.05 | 2.05 | 0.71 | 13.23 | 52 |
| | Ap | 0-14 | 6.20 | 2.2 | 0.14 | 5.30 | 1.60 | 6.90 | 0.11 | 0.06 | 2,08 | 0.28 | 18.50 | 55 |
| Pedon2 | | | | | | | | | | | | | | |
| | AB | 14-45 | 6.20 | 2.4 | 0.12 | 5.20 | 1.30 | 6.80 | 0.12 | 0.07 | 2.26 | 1.90 | 16.64 | 56 |
| | Bt$^1$ | 45-68 | 6.31 | 2.6 | 0.11 | 5.10 | 1.50 | 6.70 | 0.12 | 0.06 | 2.25 | 0.80 | 15.82 | 54 |
| | Bt$^2$ | 68-120 | 6.30 | 2.8 | 0.10 | 5.20 | 1.60 | 6.20 | 0.11 | 0.04 | 2.30 | 0.80 | 16.80 | 58 |
| | | MEAN | 6.25 | 2.5 | 0.11 | 5.20 | 1.40 | 6.65 | 0.11 | 0.06 | 2.20 | 0.88 | 16.94 | 56 |

Orgc = Organic Carbon, TN = Total Nitrogen, AVP = Available Phosphorus, Ca = Calcium, Mg = Magnesium K = Potassium, Na = Sodium, BS = Base Saturation, ECEC = Effective Cation Exchange Capacity,M= Magnesium

of the soils in the study area are presents in (Table 4). The result showed that in (Pedon1) Okopedi, soil pH ranged from 6.20 – 6.50 with average mean of 5.0 while soil pH of horizons in (Pedon 2) Ekeya, ranged from 6.20 – 6.30 with mean of 6.25. Iyanam et al., (2023) evaluated the suitability of wetland soils of Etinan for rice production and found similarities in the mean values of pH as the values ranged from 5.20-6.20 with mean of 5.60. Iyanam et al., (2024) found out that some coastal soils which are basically wetland soils were strongly acidic with pH values ranging from 4.5-5.7 The acidic nature of wetland soils in the study area is attributed to the oxidation of ions like nitrides and sulphides. Organic carbon ranged from 1.60 – 2.40 g/kg in Pedon 1 with a mean average of 2.0 g/kg while in Pedon 2, it ranged from 2.2 – 2.80 g/kg with a mean average of 2.50 g/kg. Organic carbon was very low in both pedons according to Peter et al., (2019) .The low organic matter in both pedons could be attributed to leaching due to flooding and heavy rainfall. The total nitrogen % in Pedon 1 ranged from 0.09 – 0.06% with a mean range of 0.07% while Pedon 2 had in various horizons ranges of 0.14-0.10% with an average of 0.10%.Total Nitrogen was highest in top soil, decreasing down the profile. This is in line with the findings of (Ukaegbu and Akamigbo, 2004). The sodium content Na was low as it was found to with mean value of 0.05mg/kg in pedon1 and 0.06mg/kg in pedon2. Phosphorus ranged with a mean of 4.45mg/kg in Pedon1 while in Pedon 2, it ranged with mean of 5.20 mg/kg. Calcium concentration in Pedon 1 ranged from1.20cmol/kg to 1.50cmol/kg with mean of 1.50cmol/kg. In Pedon 2, it ranged from with an average of 1.30 to 1.60cmol/kg with a mean of 1.40cmol/kg. Magnesium concentration ranged from 4.80 to 6.68cmol/kg with an average of 6.08 cmol/kg in pedon 1 while pedon 2 ranged from 6.20-6.90 with mean of 6.65cmol/kg.

Ground water influx may sometimes be the reason for the high values of exchangeable bases. Potassium range from 0.10 -0.13 with mean of 0.11 in pedon.The values of exchangeable potassium were similar in a study carried out on wetland soils of Oron by Iyanam et al.,(2024). Onyekwere et al., (2001) observed that the wetland soils of Ebughu had moderate to high levels of exchangeable bases. The CEC in pedon1 varied across different horizons from 11.80-14.70cmol/kg while in pedon 2 it ranged across the different soil horizons from 18.50-16.80 with mean value of 16.94cmol/kg. In most wetland soils,cation exchamge capacity varies thereby affecting the nutrient holding capacity as observed by Iyanam et al., (2024). Soils become easily acidic when CEC is low. When the CEC of a soil is low, the Ph level is affected and vice versa. The value of base saturation ranged from 50-54% with mean value of 52% in pedon1 while pedon 2 ranged in values from 55-58% with mean of 56%.The high values of base saturation is common in some soils of wetlands.

## Suitability Classification for Tomato Production in the Study Area

The suitability classification for tomato production in the study area was done the interpretation guide for evaluating analytical data (Table 5a-c) (SPFS, FMARD) (FAO, 2019).

**Table 5a:** Interpretation Guide for Evaluating Analytical Data Cation Exchange Capacity CEC

| Range (%) | Class |
|---|---|
| <5 | Very low |
| 5-12 | Low |
| 12-25 | Moderate |
| 25-40 | High |
| >40 | Very high |

**Table 5b**: Percentage Base Saturation (%)

| **Range (%)** | **Class** |
|---|---|
| **0-10** | **Very low** |
| 10-40 | Low |
| 40-60 | Moderate |
| 60-80 | High |
| >80 | Very High |

**Table 5c:** Organic Matter Rating and Interpretation Rating Metson (1961), Modified by Iyanam (2026).

| Range (%) | Class |
|---|---|
| <1 | Very low |
| 1-4 | Low |
| 4-10 | Moderate |
| 10-20 | High |
| >20 | Very High |

**Table 6:** Suitability Class Scores and Aggregate Suitability Classification for Tomato Production**.**

| Location | MAR (mm) | MAT ($^0$C) | Texture | CEC Cmol/kg | BS (%) | OM g/kg | ASC | SUC |
|---|---|---|---|---|---|---|---|---|
| Pedon 1 | S1 | S1 | S1 | S2 | S3 | S3 | S3 | S3f |
| Pedon 2 | S1 | S1 | S1 | S2 | S3 | S3 | S3 | S3f |

Mar – Mean Annual Rainfall, MAT = Mean Annual Temperature
CEC = Cation Exchange Capacity, BS = Base Saturation, OM = Organic Matter, ASC = Aggregate Suitability Class, SuC = Suitability Subclass with (f) Soil Fertility Limitation, SI = Highly Suitable , S2 = Moderately Suitable,S3 = Marginaly Suitable, N= Not Suitable.

## Land Suitability Evaluation

By using the matching of land quality rating or characteristics, as shown by the characteristics of the soil based on the study area. The requirements needed for production of the suitability class for tomato production in the study area are indicated in (Table 6).

## CONCLUSION AND RECOMMENDATION

The soils of the study were marginaly suitable (S3) for tomato production. The limitation was fertility. Phosphorus as observed was not available in enough quantity to enable proper growth and fruiting which is a necessity for tomato production. Organic fertilizers such as powdered wooden ash, is a very good source of potassium and should be applied to the soil in planting holes. Bone meal also a source of phosphorus, in grinded form, also known as natural fertilizer should be applied .When added to the soil, it will boost the level of phosphorus and will promote root development, flowering and fruiting of plants. Calcium derived from animal bones also forms a complex with carbon to give calcium carbonate, an essential element that enables soil acidity. Crop rotation as a way of managing pest of pest control should be practiced as it would boost nutrient availability. Drip irrigation which gives water directly to the root of the crops should be practiced for more productivity and to help prevent moisture tension or moisture loss in the tomato plants. Moisture stress can also be reduced by using cover crops and mulching at the early stage of tomato production.

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