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Study of Soil Management for Cassava Production in Isoko, Delta State Nigeria

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ABSTRACT

This research work examined soil management for cassava production in Isoko, Delta State, Nigeria. The study adopted an exclusively field survey method. This involved the collection of soil samples in-situ for laboratory analysis. The study area was grouped into four zones based on close boundary villages. Major soil physiochemical parameters needed for cassava production were the main crust of the scientific investigation. They include NPK and soil pH. Results obtained from laboratory analysis, data were compared with minimum bench mark standards and threshold using FAO standards of land evaluation for cassava production. Results obtained from the soil analysis showed that Nitrogen is deficient in the soil with the value of (0.0325%) against the backdrop of FAO threshold standard of (1.5231%). Potassium was also found to be deficient in the soil with a mean value of 0.2895 cmol/kg which is below the FAO required threshold standard of 1.6350 cmo/kg needed for effective production of yield of tubers. Phosphorous though present in fairly adequate quantity, with a mean value of 2.4250 cmol/kg compared with FAO threshold of 3.1252 cmol/kg, its effective utilization may be highly impaired as a result of Nitrogen deficiency. Soil pH of 5.90 falls within the range of slightly acidic soil against the required standard of 7.0 which is considered natural. To test the hypotheses, postulated for the study, the ANOVA statistical tool was used to ascertain if a significant difference exists in the soil nutrient across the various zones. Based on the decision rule for f-ratio, the (F-cal) is 0.079 while the table value is 4.07 at 0.05sig. The implication is that, there is a significant difference between the required standard and the observed. The study thus confirmed that the soils of the study area are deficient in vital soil nutrients required for cassava production. Nutrient deficiency is therefore a major constraint to cassava production in the area. Strategies to ameliorate the soil constraints were also advanced.

Keywords: Soil, Isoko, Cassava, Management, Delta State.

1. INTRODUCTION

Cassava (Manihot species) is a root crop that grows in the humid tropics. Its production and usage, has acclaimed a universally recognized status over the years because of its role in sustainable and economic development at both the local and global climes. [1] opined that Africa produces about 50-80 million tons of cassava annually. It is ranked the third in staple food crop produced in developing countries after rice and maize [2], its global relevance for both diet and economic purpose across different regions makes it to attract diverse nomenclatures in various parts of the world. In Isoko, it is called egu in Urhobo it is known as imidaka, in Ibo it is akpu, in French it is called manioc, in Latin America it is called tapioca, the Portuguese call it mandioca, and the Spanish refer to it as Yucca.

The soil factor for cassava production in Nigeria is an imperative for sustainable cassava production in Nigeria. [3] identified Nigeria as the world largest producer of cassava, stating that over 41 million metric tons of cassava is produced per annum, followed by Brazil, Indonesia and Democratic Republic of Congo. Thailand does the largest business in world cassava production records as they export $20 billion worth of cassava annually.

With the above global and regional perspective of cassava production in the 21st century, it is obvious that cassava, hold its pride of place in sustainable development agenda from the global to the local domain and enhancement of its production through proper soil management practices should be accorded utmost priority, with a view to ensure its sustainability as an ameliorant to the already threatened food security.

Though cassava being a resilient crop can grow relatively well without extensive soil maintenance where many other crops would fail [4], in recent times the exponential rise in the population of sub-Sahara Africa, there have been unprecedented increase on the pressure of land to produce food to carter for the ever growing population, (Rafael Perez)[5] opined that for all people to have physical and economic access to food, there must be some form of soil improvement to match production with consumption. Hence the need for soil management in an era where food security is highly threatened and issues of land frag are on the increase.

As experienced in most rural and emerging semi-urban communities in Nigeria, over 80% of people in the rural communities are engaged in different forms of primary production and cassava is the lead crop produced [1].

The production of cassava and processing of its byproducts is the major economic hub of the Isoko people. It is cultivated for subsistence as well as for large scale production. Isoko land is richly endowed with the location advantage of being situated in the Niger Delta area of Nigeria with adequate rainfall of 3800 – 2400m [6] with adequate temperature and relative humidity, coupled with the advantage of lying in a fairly low undulating terrain, these environmental and adaptive qualities suffice for steady high returns however, as a result of the current land and soil quality depletion, there is need for soil improvement.

[7] emphasized the role of soil suitability evaluation and management for cassava production. The author's submission implied that data derived from such assessment and evaluation could provide veritable information for the optimal land improvement to boost cassava production.

Furthermore, [3] opined that the inability to identify improper cropping/farming systems and management practices in arable farming is a major threat to cassava production. The implication is reduction in crop yield. Reinhardt: 2017 noted that in many parts of the world, cassava has the reputation to degrade soil either by excessive absorption of nutrients or indiscriminate farming practices and crop removal during harvest. This is the justification for soil management.

Predominantly the Isoko people are an agrarian people whose main occupation is farming [8]. They are a people whose existence depends mainly on land and soil quality. The nature of soil and its suitability for crop production especially cassava which is the fulcrum of the existence of the Isoko people, it is the primary determinant of their wealth, social welfare and elemental survival of life. As applicable in most parts of Sub-Saharan Africa. The major agricultural practice prevalent in Isoko in distant past was shifting cultivation and bush fallow, these natural methods of soil replenishment was commensurate to the population of the area then. With the current increase in population size of various communities, farming practices are rapidly changing to farming systems such as continuous cropping and mixed farming.

This further increases the susceptibility and vulnerability of the soils to the vagaries of environmental hazards such as soil deterioration, soil desiccation, soil degradation and soil erosion [9]. [10] corroborated the reasoning that priority attention should be accorded to studies that are focused on soil management and suitability assessment of soil conditions to boost cassava production.

There is therefore need for soil improvement and proper soil management strategy to improve cassava yields and production capacity including production techniques especially in an era of increasing population pressure, land grab, and food insecurity. Environmental hazards occasioned by anthropogenic activities have induced ecological disturbances and environmental hazards such as climate change. This condition resulting from environmental degradation and changes in land use pattern, are inimical to cassava production. Especially as it doubles as a major food crop as well as a viable economic crop most importantly for the women. The relevance of cassava in the diet and economy of the Isoko people cannot be overemphasized. Cassava tubers can be sold or processed into Garri, Starch, Tapioca, Ifoniyan, Cassava powder, fufu or even as feed for livestock, fuel for ethanol, alcohol and others. To this effect, cassava and its by-product is the major economic commodity.

This paper therefore, seeks to advocate soil management practices that would boost cassava production of cassava which is a major pivot and economic hub in the economy of Isoko people, with a view to forestall looming food insecurity in an era of exponential increase in population growth and diverse ecological and environmental degradation.

According to [11], crop yield is a function of soil nutrient availability and prevailing climatic conditions. Y-F (C, S, N).

Where Y=Yield, C=Climate, N=Nutrient, S=Soil and F=Function.

The authors added that if the study is confined to an area, with homogenous macro climatic conditions, the equation will be given thus-

Y-F (SMN)

Where Y=Yield, F=Function (of soil management), Soil nutrient and crop yield are therefore two closely related phenomena that determines productive potentials of cultivated crops.

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2. STUDY AREA

Prior to the regional developmental strides of State and Local Government creation of the General Ibrahim Babangida led military administration, (Between 1991-1992) Isoko was one of the nineteen (19) Local Government Areas of the defunct Bendel state. Its headquarters situated in Oleh, in the present day Isoko South Local Government. In 1992, Isoko Local Government Area was splitted into Isoko North and South Local Government Areas. While Ozoro was named headquarter of Isoko North, Oleh maintained its status quo as Local Government headquarter of Isoko south. Isoko North and South are therefore Geo-political creations as Isoko North and South maintain similar geographical features except for the presence of more creeks and water bodies in the South, with a relatively drier inland North.

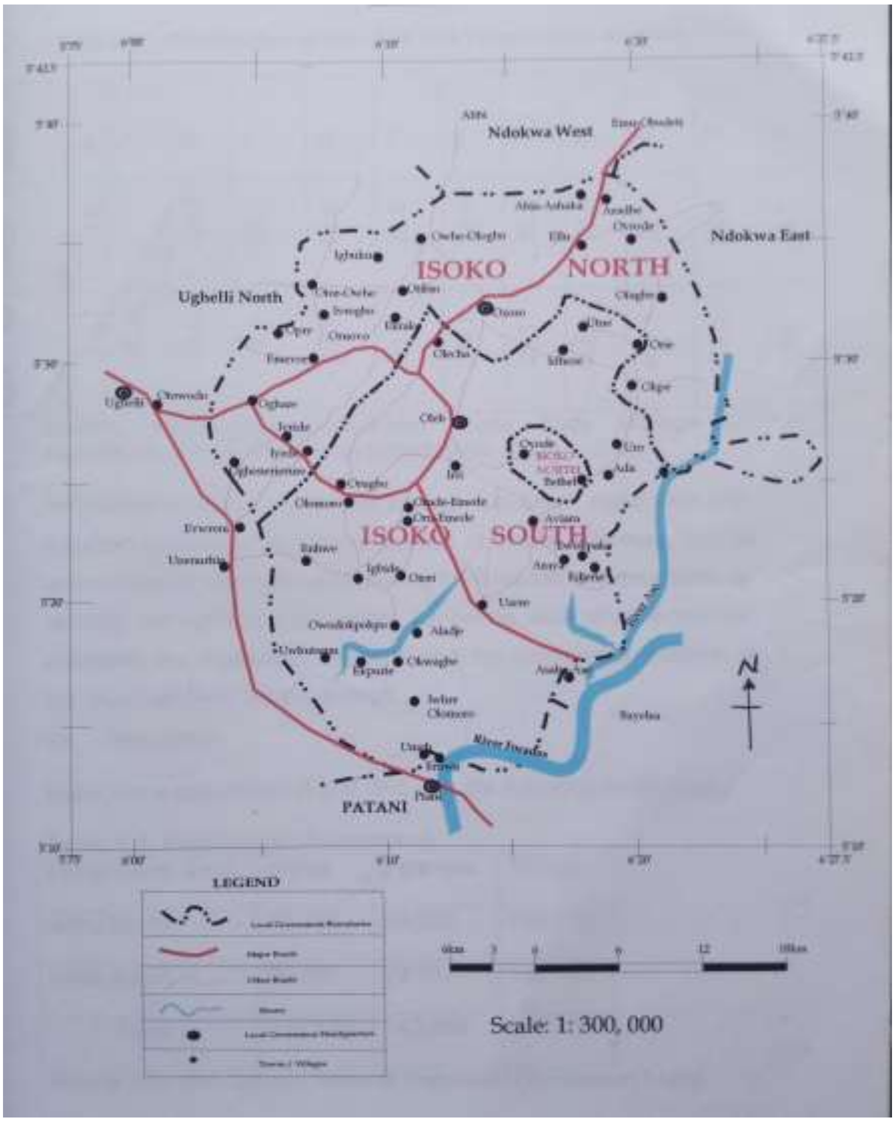

Figure 1, Map of Isoko North and South Local Government Areas, Delta State.

Source: Delta State Ministry of Lands and Survey, Asaba

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2.1 Location and Size

Isoko land lies on a low undulating terrain of about 20 meters above the sea level of the lower Niger Delta. The area is enclosed within latitude 5^0 15' and 5^o 4^o' north of the equator, and between longitude 6^0 05' and 6^0 15' east of the Greenwich meridian. It has an area of about 1,097.1 Sq KM. Isoko is bounded in the north by Kwale (Ndokwa) and east by Ase creek, to the west by its Urhobo neighbors, and to the south by the Ijaws.

2.2 Drainage

Isoko though a low-lying almost featureless undulating plain, has two outstanding features which are the two great swamp systems running roughly North North East (NNE)and South South West (SSE).

These are the Bethel and Owhe swamp systems. These areas are liable/prone to flooding from creeks that flows into the river Niger, during the wet seasons. This results in a significant increase in the volume of water in the river channel which also exposes the area to seasonal flood regimes. The major creeks in the area include, Ase Creek, Owhodokpokpo/Umeh Creek, and the Ekregbesi Creek.

2.3 Climate

Like other parts of Southern Nigeria, the climate of Isoko is influenced by its latitudinal location and wind system. The North East winds that blows from the North across the Sahara Desert between the period of November to March, is usually characterized by a dry and cold weather condition popularly known as harmattan, which causes dry season. This is subsequently replaced by a warm moisture laden South-west wind from the Atlantic Ocean. These winds bring about rainfall between the periods of April to October. In other words, Isoko experience two distinct climatic conditions commonly referred to as dry season and wet season. The area experience a minimal temperature range of about 5^0c, with mean annual temperature of 25^0C-28^0C. The rainy season is usually interrupted by a brief dry spell usually referred to as August break (August Hiatus). This could span for a period of few days to a couple of weeks. Double rainfall maxima is also experienced in the area. These double peaks of rainfall pattern favor the cultivation of deep rooted tuber crops such as cassava, yam, cocoyam and others. Also, oil palm thrives well in the area as a result of favorable climate conditions.

2.4 Vegetation

Isoko lies within the tropical rainforest vegetation belt, with luxuriant vegetation of diverse species. Some of the trees found includes Ebony, Iroko, Irvingia, oil palm trees, rubber trees and others. The vegetation is generally characterized by the lowland rainforest and the fresh water swamp vegetation.

In recent times, the vegetation structure of the area has been distorted as a result of anthropogenic disturbances arising from deforestation, farming, construction activities, land and water pollution and others. The natural vegetation in most parts of Isoko has been distorted due to anthropogenic disturbance, what now exist is secondary re-growth.

3. MATERIALS AND METHODS

For the purpose of this study, the field survey design was employed. Soil samples were collected based on field study with the aid of soil auger. Soils were collected at the depth of 0-15mm which is top soil layer and the zone of illuviation. The communities where soil samples were collected were grouped into close boundary villages and towns. The mean of each group was taken. Thereafter, they were categorized into four groups. The mean of the various groups was compared with the ideal standard of NPK and soil pH using the One Way ANOVA at $P<0.05$ level of significance.

The communities were chosen based on field studies as the major cassava communities of Isoko land. The grouping is shown below;

Table 1, Grouping of the Study Area into Zones based on Close Boundary Villages

A	B	C	D
Ozoro	Oleh/ Irri	Uzere	Owhelogbo
Ofagbe	Emede	Aviara	Emevor
Ellu	Igbide	Araya	Iyede

Laboratory soil tests was conducted at the Analytical Chemistry Laboratory of the Nigerian Institute for Oil Palm Research (NIFOR), Edo state.

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4. DISCUSSION OF RESULTS AND FINDINGS

Table 2, shows the Mean Nitrogen content, Phosphorous, Potassium and Soil pH of soil laboratory analysis across the various zones obtained from the soil laboratory test. The figures obtained from the means at different locations indicate that the nutrient status across the zones falls within the same range of the same nutrient availability.

Table 2. Mean Result of Soil Laboratory Test

Zones	Mean Nitrogen %	Mean Phosphorous	Mean Potassium
A	0.05%	3.19	0.145 cmol/kg
B	0.03%	2.53	0.671 cmol/kg
C	0.02%	1.96	0.118 cmol/kg
D	0.03%	2.02	0.224 cmol/kg

Table 3, shows the comparison of the Mean soil parameters for NPK and soil pH from soil laboratory tests and Food Agricultural Organization (FOA) [12&13] required standard soil parameters for cassava production.

Table 3. Standard Soil Parameters of the Study Area; Soil Test Results

Soil Parameters	N	P	K
Mean Soil Parameters	0.0325%	2.4250ppm	0.2895cmol/kg
FOA Standard Soil Parameters	1.5231%	3.1251ppm	1.6350 cmol/kg

Table 4, Table of pH Ranges

Denomination	pH Range
Moderately Acidic	5.6-6.0
Slightly Acidic	6.1-6.5
Neutral	6.6-7.3 acid
Slightly alkaline	7.4-7.8

The result of the laboratory analyses showed that Nitrogen is deficient in the soil (0.0325%) compared to the required Standard of (1.5231%). Also potassium was found to be deficient; the level of potassium found in the soil was (0.2895 cmol/kg) this is below the 56 required standard of (1.6350). Phosphorous is present in a fairly high level (2.4250 cmol/kg) compared to the required (3.1251 cmol/kg) the soil pH level of (5.90) is slightly acidic compared to the required neutral standard of (7.0).

The implication is that there is a significant difference between the observed and the required standard. The null hypothesis is therefore rejected and the alternative hypothesis is accepted. This implies that the soils of the area are deficient in the vital nutrients required for cassava production and nutrient deficiency is a major impediment to cassava production.

The null hypothesis posed for the study states that there is no significant variation in soil nutrient across the various zones (NPK and soil pH). To test this hypothesis, the One Way ANOVA was used to ascertain the significant variation in soil nutrient status across the zones. This computation was made based on the results obtained from the soil laboratory tests. The decision rule for the ANOVA result states that if the F-ratio, calculated value (F-cal) is greater than the table value (F-tab) the null hypothesis is rejected and the alternative hypothesis is accepted.

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From the results of the ANOVA, the (F-cal) is 0.079 while the table value (F-tab) is 4.07 at 0.05 level of significance. The import of this outcome is that there is a significant variation in the soil nutrient status of NPK across the zones.

Table 5, Summery of ANOVA Results of Soil Analyses across the Zones

Sum of Variation	Sum of Squares	Df	Ms	F-cal	Table
Between Groups	0.43	3	0.143	0.079	4.07
Within Groups	14.55	8	1.818		

Level of significance 0.05

Table 6. Table showing square of Means

	A	A^2	B	B^2	C	C^2	D	D^2	
N	0.05	0.0025	0.030	.0005	0.002	.0004	0.030	0.009	
P	3.19	10.176	2.530	6.4009	1.940	3.8316	2.028	4.0804	
K	0.145	0.0210	0.871	0.4502	0.118	0.0135	0.020	0.0502	
	3.385	10.1995	3.231	6.8520	2.098	3.8559	0.224	4.1315	

4.1 Findings

From the results of the soil analyses, Nitrogen (0.0325%) is deficient in the soil compared to the Standard of (1.5231%) the implication is that vegetative growth which has a relationship with Cassava yield would be retarded.

Potassium was also found to be deficient. The soil had a mean or 0.2895 cmol/kg this is below the standard of (1.6350 cmol/kg) needed for effective growth yield storage of tubers. Phosphorus though present in a fairly high quantity, its effective utilization may be highly impaired as a result of Nitrogen deficiency

From the results of the soil analyses, the pH level (soil reaction) of the soil is (5.90); this falls within the range of a slightly acid soil. The famers in the area will need to apply lime or organic fertilizers to reduce the acid level to neutral level of (7.0). The implication of Nitrogen deficiency in the soil is that the plants will grow with whizzy Leaves and will be stunted in growth. The leaves may appear pale. This may also affect yield per hectare because green leaves define the photosynthetic ability of green plants. The implication of potassium deficiency is that tubers may decay before maturity period. That is to say, tubers may not store for a long time. Therefore, the farmers are forced to either consume their products prematurely within a short period, or sometimes it could lead to total loss of crops even before harvest. This could pose a hazardous effect to both food security and the economy of the people.

The study found out that Nitrogen is deficient in the soils of the study area. This may hamper vegetation growth, which in turn leads to decline in crop yield. Potassium was also deficient. The implication is that cassava yield may begin to decay before harvest period. Phosphorus though present, in appreciable quantity, cannot be effectively utilized in the absence of Nitrogen and Potassium. The combination of these major physiochemical properties may pose as hindrance to cassava production and agricultural productivity in general.

5. POLICY IMPLICATION/ RECOMMENDATIONS

1. The soils of Isoko land were found to be deficient of major soil nutrients needed for cassava production (NPK + soil pH). There is need for proper land use planning and farm practices based on the findings from this study to protect the land from degradation both for the present generation and posterity.
2. The soils of the area are poorly managed due to absolute reliance on natural regeneration. This has greatly affected the soil quality which is major constraint to cassava production.
3. The study also revealed that soils of the study area are slightly acidic and there is need for application of liming materials to regulate the soil pH level to neutral which is the best soil condition for cassava production. Fertilizer application may be required; therefore, institutional interventions is an imperative.

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4. In the era of climate change, and rapid environmental degradation, it is pertinent to note that issues of climate change and anthropogenic disturbances such as pollution, gas flaring, oil spillage and others can negatively affect cassava production. Therefore, there is need for soil improvement.

5. CONCLUSION

The study considered the theme "Soil Management for Cassava Production in Isoko, Delta State, Nigeria". Inferences were drawn from the research that the soils of the study area are deficient of major soil physiochemical parameters based on FAO standards for cassava production which are Nitrogen, Potassium, and Phosphorous and soil pH. Soil fertility management and conservation practices could be introduced to improve soil nutrient at the study area since cassava forms the major economic hub, and also as the fulcrum of the diet of the Isoko people.

When soil is properly managed for precision arable farming of crops such as cassava, issues of food insecurity, hardship and starvation can be effectively monitored to ensure a healthy and wealthy Isoko land.

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