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Assessment of Soil Quality Conditions for the Cultivation of Upland Rice in Bwari Area Council, Abuja Nigeria

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ABSTRACT

This study examined the suitability of the soil chemical properties in selected communities of Bwari Area Council, FCT, Nigeria for the cultivation of upland rice. The communities which include Igu, Gyeyidna, Kuchiko, Piawe, Dutse, Jikoko, Shere, Piko, Ushafa and Jigo, were selected as non-contiguous pair from five geographical wards (Igu, kuduru, Dutse, Shere and Ushafa) in the Area Council. They were purposively selected using the criteria of 500 metres and above elevation (upland condition) and agricultural preponderance. The soil samples were collected from farmland in each of the communities using systematic sampling techniques, which involved measuring out a 100 by 100 metres quadrat and dividing it into sixteen equal grid squares with a dimension of 25 by 25 metres. Soil samples were taken at the mid points of each grid square at a depth of 0 – 30cm. The sixteen soil samples for each quadrat were uniformly mixed into one bulk composite sample for each community. The soil results were compared with the standard land quality requirements for upland rice cultivation for Southern Guinea Savanna. To the first study objective, pH, organic carbon, total nitrogen, available phosphorus, calcium, magnesium, potassium, and cation exchange capacity (CEC) were assessed. Results show that there was no significant difference between the soil quality of the study area and standard soil quality requirements for the cultivation of upland rice. Based on these, it was concluded that the chemical soil properties of the sampled communities in Bwari Area Council will support the cultivation of upland rice, even though there are spatial variation in the soil chemical properties of the study area. Some strategic recommendation were made such as: the need to reduce the soil pH of the study area from its fairly alkaline state to moderately acidic level suitable for upland rice cultivation in Bwari Area Council.

Keywords: Soil, Quality, Condition, Upland, Rice, Cultivation, Bwari Area Council, Abuja, Nigeria

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1. INTRODUCTION

Soil, as a natural resource on the earth's surface is as vital as air and water for human survival and continuity of life in general. This has been an innate understanding in man, noticed in the siting of ancient settlements and migration of ancient people which were in accordance with areas of fertile soils (Tahat *et al.* 2020). Soil survey by United States Department of Agriculture (USDA) attempted a broad definition of soil as the natural medium for the growth of plants, whether with or without horizons. They stressed further that, people all over the world have attached so much importance to soil for its support for a variety of highly significant features on earth such as food supply, production of fibers and drugs, infiltration of surface water, purification of groundwater, recycling of solid wastes (especially, organic wastes), and other human wants. (Kassam *et al.* 2019). Whether regional or non-regional and whether comprehensive or specific, soils are studied in terms of identification of types, climatic regions, physical parameters, chemical parameters, biological parameters, specific use, vertical horizons, local influence, and mode of formation (Qaswar *et al* 2020).

Globally, rice production has grown at an annual average of 1.0% over the past decade, reaching 486.7 million tonnes in 2017. Most of this growth has come from Asia, accounting for 89% of global output. China and India are the largest producers, each with a share of 29.6% and 22.6% of global production respectively. In the rest of the world (ex-Asia), rice production has risen steadily over the past decades, accounting for 15% of total production by 2017, a marginal increase from 12% in the last two decades. Global rice consumption remains strong, driven by both population and economic growth in Asia.

Aondoakaa and Agbakwuru (2012) examined the suitability of the soil in Dobi, Gwagwalada Area Council, FCT, Nigeria for rice cultivation. The study reveals that although there is a standard land quality requirements for rice cultivation yet soil parameters varied considerably but in general the high pH for subsoil as against the normal range is not favourable for rice cultivation. Furthermore, when the calcium content in the soil is high which can be traced to the high soil pH which limits plant growth, rice yield will be limited. The study recommended that for sustaining future agricultural productivity, there is need for detailed suitability assessment and land evaluation, also, a high dosage of NKP fertilizer application was encouraged and that salt free irrigation water can be applied to leach down the level of soil pH which will benefit both government and farmers for sustainable agricultural productivity.

According to the Soil Science Society of America (SSSA) Soil quality determine the capacity of soil to function. The capacity of the soil to function can be within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation" (Irawan and Antriyandarti (2020).

Similarly, Tahat *et al*. (2020) opined that assessing Soil quality helps in defining the objective state or condition of the soil, it further reveals that soil quality can be seen subjective because evaluation is dependent on personal and social determination. The study recommended that correspondently, Jian *et al.* (2020) evaluates that Soil quality assessment can be subdivided in its inherent capacity for crop growth and in a dynamic part, influenced by its user. The study assumes that when the soil operates at its full potential for a specific land use, optimal quality is achieved.

Miroslaw and Marzena (2020) suggested that various forms of soil assessment are encapsulated in different concepts based on the fact that land evaluation procedures can be used in many different ways and for a range of purposes, including sustainable land management. The study further concluded that the integration of soil quality and land evaluation goes as far as developing soil natural capital accounting system, stressing the importance of soil for human wellbeing.

In the assessment done by Diallo *et al.* (2016) in the peri-urban Niayes region of Senegal, they examined the suitability of soils for the cultivation of upland rice, cassava and groundnut in a peri-urban wetland outside of Dakar. The study reveals that Agricultural intensification is thought to be a cause of soil degradation and reduced biodiversity of numerous plant and animal taxa.

While reviewing the works of Irawan and Antriyandarti (2020) it postulate that Rice is generally considered as a tropical crop and is one of the most productive cereal grown in Tropical Africa (especially West Africa) on land from below the sea level to 1500m elevation. The average temperature for rice cultivation has to exceed 20°C and the minimum temperature has to exceed 10°C for 4-6 months. The optimum temperature for rice growth is 30-32°C. Rice needs generous rainfall or irrigation. In tropical countries the crops receive high rainfall (1000-1400mm). High relative humidity favors crop growth through the vegetative stage but also favors diseases. Low RHcauses shrunken grains. Light is not a limiting factor to growth in the early stages but becomes progressively more critical with the age of the plant. Throughout the growing period the sum of hours of sun is approximately 1200 hours. The intensity of sunshine should be higher in the later stages of the growth. The requirements of the slope and landform for the cultivation depend on the type of rice culture.

Additionally, Ayehu and Besufekad's (2015) research on land suitability analysis for rice production, using GIS based multi-criteria decision approach, Soil, climatic conditions, and topography were a criteria identified as necessary for the intended application. An Analytical Hierarchical Process (AHP) was used to rank the various suitability factors and the resulting weights were used to construct the suitability map layers using weighted sum overlay tool in ArcGIS 10.1 platforms. Then, the suitability map for rice crop production in the study area was formed. Accordingly, more than 70% of the total study area were found to be highly and moderately suitable for rice crop production. The relationship between suitability map and current vegetation cover of the study area was also computed and the result predicts the inverse relationship between the density of vegetation cover and rice land suitability. Overall, the results indicate that the study area has a huge potential for rice production. Therefore, economic levels of agricultural production can be achieved by cultivating rice crop in highly and moderately suitable areas, and practicing diversification of marginally suitable areas to crops other than rice.

Furthermore, in the assessment done by Diallo *et al.* (2016) in the peri-urban Niayes region of Senegal, they examined the suitability of soils for the cultivation of upland rice, cassava and groundnut in a peri-urban wetland outside of Dakar. While evaluating the chemical property of the soil was located along a toposequence., the results revealed that the soil texture varied from sandy to sandy loam. The organic matter concentration varied between 0 g kg^{-1}. Total Nitrogen and Organic Carbon had low values in all the sites except in one, while macronutrients (Ca, Mg, Na, K) varied across sites.

Calcium was the most abundant cation in the soils; followed by Mg, Na, and K. Based on these factors, they found that there is high suitability for groundnut production in peri-urban Dakar, slight potential for cassava and marginal or poor suitability for rice production.

In the work of Adamu *et al.*(2021) conducted a research on the fertility of soil for rice cultivation in Kadawa and Garun Mallam Local Government Areas of Kano State, Nigeria. The samples were analyzed for some soil fertility index parameters using standard routine laboratory tests. Mean values of soil parameter determined were computed so as to compare the results with the critical limits for interpreting levels of soil fertility. The findings indicated that the soil texture was generally sandy loam with brown colour. The soil was moderately acidic with mean pH values of 6.07 and 5.95 in water and $CaCl_2$ respectively. The study recommended that organic manure and inorganic fertilizer should be applied to the soils in order to improve nitrogen, phosphorus and potassium levels.

In the work of Gyekye (2021) on Soil and Land Suitability Assessment for Rice Cultivation at Tono Irrigation Area in the Upper East Region, Ghana. Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, and Manganese were recognized as key elements in rice production and also land categories was established to designate areas appropriate for the growth of certain crops. The study reveals that land suitability studies assist in determining soils for optimal crop yields.Hence, information on soil qualities and conditions in the Tono dam area, as well as the soil's fertility status, is required to determine the physico-chemical properties of the soil for rice cultivation. The study concluded that Land suitability assessment involves the analysis of soil and landscape information as well as climate information of a given area to determine the suitability of the area for the production of specified crops under rain-fed or irrigated farming.

Integrated plant nutrient management also contributes to pest management: stressed crops are more susceptible to disease and to the effects of pest attacks. Crops growing in poorly structured soil, under low nutrient conditions or with inadequate water supply or retention will be stressed. Responding to disease or pest attacks by applying pesticides is a costly symptomatic approach to a syndrome which is better addressed by improving the ecological conditions and systems within which the crops are cultivated. In addition, agricultural products with less pesticides residues are less risky to consume. The need to adopt a wider concept of nutrient use beyond but not excluding fertilizers results from several changing circumstances and developments.

These are: - The need for a more rational use of plant nutrients for optimizing crop nutrition by balanced, efficient, yield-targeted, site- and soil-specific nutrient supply. - A shift from focusing on soil nutrient levels only to looking at nutrient balances in the soil and interrelation of different nutrients. - A shift mainly from the use of mineral fertilizers to combinations of mineral and organic fertilizers obtained on and off the farm. - A shift from providing nutrition on the basis of individual crops to optimal use of nutrient sources on a cropping-system or crop-rotation basis. - A shift from considering mainly direct effects of fertilization (first-year nutrient effects) to long-term direct plus residual effects.

There are efficiency and productivity gains in crop water use that can be captured both 'within' and 'outside' the crop water system. For example, agricultural practice that reduces the soil evaporation component of the overall crop evapotranspiration reduces non-productive water consumption. As a consequence, but purely in terms of the crop production system, this extra water can be used for more transpiration or if transpiration demand is met, declared as a net saving that can be used outside the specific crop water system. In this sense, a water use efficiency gain is made within the specific cropping system that may also result in more biomass production per unit of applied water. However, in cropping systems adapted to seasonal or low evaporative demand of the atmosphere, it may be other types of agricultural practice (fertilizer, improved varieties, weed and pest management) that result in more productive consumption of water available in the root zone. Hence the approach to water use efficiency gains and productivity boost has to be well understood in terms of the cropping system and the overall impact on drainage systems, leaching requirements and groundwater circulation. The water productivity in maize, rice and wheat; water productivity is rising faster at lower yields.

1.1 Objectives

The specific objectives are to;

i) Assess the chemical quality of soil in the study area.
ii) Assess the suitability of the Soil Chemical Properties for the Cultivation of Rice in the study area.

1.2 Research Hypotheses

H_{o1}: There is no significant difference between soil chemical quality requirements for the cultivation of upland rice and other rice species.

1.3 Study Area

Bwari Area Council is located at the North – East part of the Federal Capital Territory. It lies between latitudes 9^{o} 6' N and 9^{o}25' N and longitude 7^{o}12' E and 7^{o}44' E. It shares boundaries with Tafa Local Government Area (LGA) of Niger State to the West, Kagarko LGA of Kaduna State to the North, Abuja Municipal Area Council (AMAC) in the FCT to the South East, Gwagwalada Area Council in the FCT to the South West, and Karu Local Government Area (LGA) in Nasarawa State to the East (Bwari Area Council Information Unit, 2010).

According to Akpatae*t et al.*(2017) Bwari Area Council comprises of complex gently undulating plains with scattered rock outcrops. The terrain, which is highly undulated is dotted with granitic inselbergs. The area has a varying elevation ranging from 300m to 900m above mean sea level. The much-dissected topography is characterized by numerous valley depressions that are occupied by streams. This kind of topography has a substantial impact on soil formation due to its impact on water runoff as more clouds formed over the valley releases water into the soil making it to be wetter than other places around them providing the soil with the needed parent materials suitable for upland rice production in Bwari Area Council

The underlying rocks of the FCT consist basically of basement complex and sedimentary rocks. The basement complex rocks made up of igneous and metamorphic rocks cover about 48 % of the total area and in some places the land is occupied by hills and dissected terrain (Agu 2017). The rocks consist mainly of schists, gneiss and older granite. The mountain ranges together with some isolated inselbergs are believed to have been poured out of volcanoes within the tertiary period. The areas underlain by the sedimentary rocks cover about 52 % of the total area of the Federal Capital Territory and largely constitute the undulating plains. These plains form present day remnants of erosional processes of the quaternary period.

Towards the south west of the Federal Capital Territory there exist sand ridges with outliers of sandstone capings. Sandstone and clay also occur in significant proportions of parts of Abaji and Kwali Area Councils. These areas are easily dissected and indeed exhibit very glaring evidences of severe gully erosion. The Federal Capital Territory as almost predominantly underlain by high grade metamorphic and igneous rocks of Precambrian age. These rocks consist of gneiss, migmatites and granites and schist belt outcrops along the eastern margin of the area. The belt broadens southwards and attains a maximum development to the south-eastern sector of the area where the topography is rugged and the relief is high. In general, the rocks in the FCT are highly sheared (Akpa 2017).

The local geology of the study area comprises essentially of four geological class. These include; coarse porphyritic biotite/biotite hornblende, Biotite-hornblende gneiss finely bonded, muscovite/quartz-muscovite-schist, and medium to coarse grained biotite granite. All of these belong to the pre–cambrian/cambrian basement complex (Akpa 2017).

The geology to a very large extent determines the soil type. The areas underlain by the sedimentary rocks cover about 52 % of the total area of the Federal Capital Territory and largely constitute the undulating plains. These plains form present day remnants of erosional processes of the Quaternary period. Towards the south west of the Federal Capital Territory there exist sand ridges with outliers of sandstone capings. Sandstone and clay also occur in significant proportions of parts of Abaji and Kwali Area Councils. These areas are easily dissected and indeed exhibit very glaring evidences of severe gully erosion. The Federal Capital Territory as almost predominantly underlain by high grade metamorphic and igneous rocks of Precambrian age. These rocks consist of gneiss, migmatites and granites and schist belt outcrops along the eastern margin of the area. On the aforementioned rock types, Zonal Tropical Ferruginous soils have developed through the process of laterization. This is the dominant soil type in Bwari local government council.

Like the entire FCT and northern Nigeria in general, Bwari Area Council has tropical continental of Awtype of climate according to Koppen's climatic classification. A dry season from November to April is followed by a wet season lasting from May to October. The temperature is high all through the year, but it is often lowered a little by the heavy rains in the wet season. (Akpa 2017).

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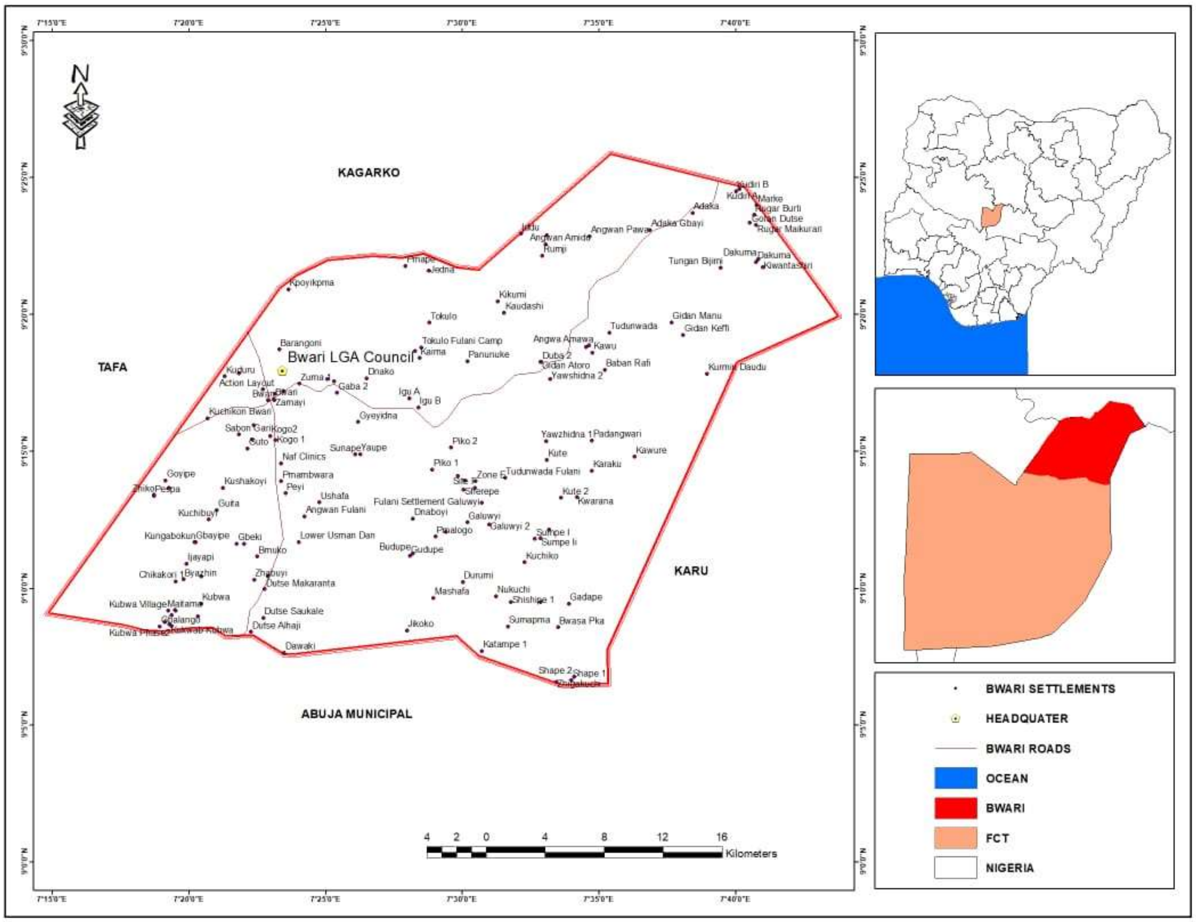

Figure 1.1: Bwari showing Geology
Source: Federal Capital Development Authority (FCDA, 2020)

2. MATERIALS AND METHOD

The data used for this research were obtained from both primary and secondary sources. Primary data were obtained from the laboratory analysis of soil samples collected from one farmland each in a selected pair of non-contiguous communities across five of the ten geographical wards in Bwari Area Council. The ten wards are: Kawu, Igu, Bwari Central, Shere, Ushafa, Dutse, Kubwa, Usuma, Byazhin and Kuduru. From these, five wards (Igu, Shere, Dutse, Ushafa and Kuchiko) were selected via purposive sampling method using the criteria of elevation that satisfies the upland condition for rice cultivation as well as areas with agriculture as the predominant landuse. The ten selected communities that most satisfy the upland and agricultural preponderance conditions are: Igu, Gyeyidna, Kuchiko, Piawe, Dutse, Jikoko, Shere, Piko, Ushafa and Jigo.

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Secondary data, such as climatic information were obtained from NIMET records, demographic data from the National Population Commission, socio-economic records of the study area were obtained from the information unit of Bwari Area Council, soil quality standard required for rice cultivation as well as information on the physical setting of the study area and some study concepts from published journal materials. For this study, the soil samples were collected from a measured quadrat of 100 by 100 meters (length and breadth) from one farm each in the ten selected communities. The quadrat was divided into 16 equal grid squares with a dimension of 25 by 25 meters. Soil samples were taken at the mid points of grid square at a depth of 0 – 30cm.

The 16 composite soil samples for each quadrat was mixed into one bulk composites oil sample for each of the selected community. This eventually gave ten (10) bulk composite soil samples, one (1) each for the ten selected communities. Global Positioning System – GPS was used to take coordinates of the soil sample points. Samples were collected in polythene bags, aptly labelled with the sample code, time of collection, location and coordinates. The samples were thereafter taken to the laboratory for analysis. The parameters tested include: soil pH, organic carbon, total nitrogen, available phosphorus, cation exchange capacity, calcium, magnesium and potassium.

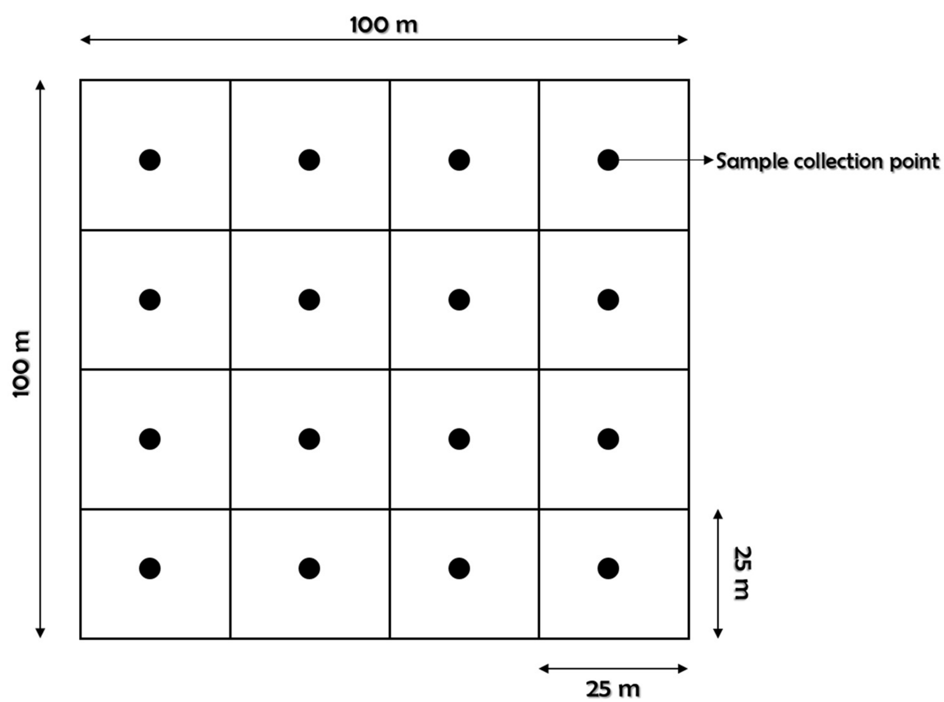

Figure 1: A graphical illustration of the sampling technique
Source: Field Survey, May 2022

2.1 Sample Size Estimation

The sample population for this study comprises the population of communities in Bwari local government area of Abuja. The area recorded a population of 229, 274 people based on 2006 population census. The 2020 projected figure stands at 341618 at annual growth rate of 3.5%. However, Bill Godden (2004) formula for finite population will be adopted in calculating the sample size thus:

$$SS = \frac{Z2 \times (P) \times (1-P)}{C2} \qquad (1)$$

Where:
SS = Sample Size
Z = Z-value[A] (e.g. 1.95 for a 95% confidence level)
P = percentage of population picking a choice (expressed as decimal)
C = confidence interval, expressed as decimal (e.g. 0.05 +/- percentage parts)

$$SS = \frac{3.8416 \times 0.5 \times (1-0.5)}{0.0025} = 384.2 \qquad (2)$$

Applying the population size of 72, 977, the sample size =

$$SS = \frac{SS}{(1+\frac{SS-1}{POP})} \qquad (3)$$

2.2 Sample Location from Selected Communities

For this research, ten non-contiguous communities were selected across five agrarian wards with elevation that satisfy upland condition for rice cultivation in Bwari Area Council. These communities, in no particular order, are: Igu, Gyeyidna, Kuchiko, Piawe, Dustse, Jikoko, Shere, Piko Panda, Ushafa, and Jigo. From each of these communities, sixteen composite soil samples were obtained following standard procedure, as was already explained in chapter three. Below are presented the coordinates for each of the soil sample collection points in each respective community.

Table 1: Sampled Communities, Coordinates and Elevation

S/N	Community	Ward	Sample Code	Coordinates		Elevation (m)
				Latitude (N)	Longitude (E)	
1	Igu	Igu	SS 01	9°16'14"	7°28'36"	659
2	Gyeyidna	Igu	SS 02	9°16'51"	7°26'18"	672
3	Kuchiko	Kuduru	SS 03	9°15'33"	7°19'21"	530
4	Piawe	Kuduru	SS 04	9°14'52"	7°22'00"	554
5	Dutse	Dutse	SS 05	9°10'07"	7°22'26"	501
6	Jikoko	Dutse	SS 06	9° 08'18"	7°28'12"	656
7	Shere	Shere	SS 07	9°13'52"	7°30'01"	700
8	Piko Panda	Shere	SS 08	9°14'30"	7°29'04"	682
9	Ushafa	Ushafa	SS 09	9°11'53"	7°23'33"	567
10	Jigo	Ushafa	SS 10	9°13'19"	7°23'10"	524

Source: Fieldwork, 2022

The data used in this study are quantitative and were generated from the laboratory analysis of soil samples collected from the selected communities. Eight chemical parameters were considered. They include Soil pH, Organic Carbon (%), Total Nitrogen (%),

Available Phosphorus (ppm), Calcium (CmoL kg^{-1}), Magnesium (CmoL kg^{-1}), Potassium (CmoL kg^{-1}), and Cation Exchange Capacity - CEC (CmoL kg^{-1}).

2.3 One Sample t-Test
The One Sample t-Test, which is used to determine whether the sample mean of a set of observation is significantly different from a known or hypothesized population mean, in the case of this study was used to assess the soil chemical parameters (pH, organic carbon, total nitrogen, available phosphorus, cation exchange capacity, calcium, magnesium and potassium) of the ten (10) composite soil samples obtained, one each from the respective communities sampled, against the identified standard for rice cultivation.

This analysis was undertaken with the aid of the SPSS (Version 16.0) software package.

The test statistic for a One Sample t-Test is denoted "t", and is calculated using the following formula:

$$t = \frac{\bar{X} - \mu}{S_{\bar{x}}} \quad (4)$$

Where,

$$S_{\bar{x}} = \frac{S}{\sqrt{n}} \quad (5)$$

Where,
μ = Proposed constant for the population mean
$\bar{X}$ = Sample mean
n = Sample size (i.e., number of observations)
S = Sample standard deviation
$S_{\bar{x}}$ = Estimated standard error of the mean (s/sqrt(n))

The calculated t value is then compared to the critical t value from the t distribution table with degrees of freedom df = n - 1 and chosen confidence level. If the calculated t value > critical t value, then we reject the null hypothesis.

2.4 Coefficient of Variation (CV)
The Coefficient of Variation was used to measure the relative/spatial variability of the soil chemical results for the ten communities sampled in order to determine whether there is statistical evidence to show spatial variation in the soil chemical properties across the study area. This test was carried out using the Microsoft excel.

The formula for the coefficient of variation is:

Coefficient of Variation = (Standard ;Deviation / Mean) * 100 (6)
kl

In symbols: CV = (SD/ X) * 100 (7)

2.5 Test of Hypotheses

For this research, three hypotheses were formulated.

a) **Hypothesis One:** To verify the first hypothesis, the Paired sample t-Test was used. Here, the averages of each of the respective chemical parameters for the ten communities sampled was obtained. These were statistically compared with the soil standards for rice cultivation at 95% confidence level.

The test statistic for the Paired Samples t-Test, denoted t, is given as stated below:

$$t = \frac{\bar{X}_{diff} - 0}{S_{\bar{x}}} \qquad (8)$$

Where,

$$S_{\bar{x}} = \frac{S_{diff}}{\sqrt{n}} \qquad (9)$$

Where,

$\bar{X}_{diff}$ = Sample mean of the differences
n = Sample size (i.e., number of observations)
S_{diff}= Sample standard deviation of the differences
$S_{\bar{x}}$ = Estimated standard error of the mean (s/sqrt(n))

The calculated t value is then compared to the critical t value with df = n - 1 from the t distribution table for a chosen confidence level. If the calculated t value is greater than the critical t value, then we reject the null hypothesis (and conclude that the means are significantly different)

2.6 Soil Test Result for Study Area

Presented in Table 1 are the soil test results for the ten sample points across the study area. The selected communities sampled as shown on Table 1 include: Igu, Gyeyidna, Kuchiko, Piawe, Dutse, Jikoko, Shere, Piko, Ushafa, and Jigo. The soil parameters tested are Soil pH, Organic Carbon (C), Total Nitrogen (N), Available Phosphorus (P), Calcium (Ca), Magnesium (Mg), Potassium (K), and cation Exchange Capacity (CEC).

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Table 2: Soil Test Results for the Study Area

Parameter	Igu	Gyeyidna	Kuchiko	Piawe	Dutse	Jikoko	Shere	Piko	Ushafa	Jigo	Average
Soil pH	7.50	7.60	8.00	7.80	7.70	8.00	8.10	7.90	8.00	7.80	7.84
Organic Carbon (C) %	0.78	0.69	0.26	0.31	0.64	0.59	0.82	0.79	0.90	0.68	0.65
Total Nitrogen (N) %	0.78	0.51	0.35	0.47	0.38	0.42	0.50	0.61	0.56	0.58	0.52
Available Phosphorus (P) ppm	0.44	7.89	9.64	8.58	11.36	10.04	7.45	6.90	8.60	7.95	7.89
Calcium (Ca) CmoL kg^{-1}	5.30	4.80	6.10	7.02	5.61	4.50	4.90	5.81	3.98	3.36	5.14
Magnesium (Mg) CmoL kg^{-1}	0.34	0.80	0.56	0.74	0.81	0.93	1.10	1.14	2.07	2.11	1.06
Potassium (K) CmoL kg^{-1}	1.69	1.72	2.00	1.96	1.63	1.63	0.94	0.89	1.36	1.40	1.52
Cation Exchange Capacity (CEC) CmoL kg^{-1}	2.62	2.78	3.13	3.59	3.05	2.78	2.85	3.21	3.30	3.11	3.04

Source: Laboratory analysis, 2022

3. RESULT AND DISCUSSIONS

Soil quality standard for rice cultivation in Southern Guinea Savanna by Kyuma *et al.*, 1986 as cited by Aondoakaa and Agbakwuru (2012) was used in this assessment. These standards were a result of detailed and comprehensive study of the soil properties of the different regions in Sub-Saharan Africa and their suitability for rice cultivation. In the work of Kyuma *et al.*(1986), Soil properties of the topsoil (0 - 15 cm) and subsoils (15-16 cm) were used to evaluate the fertility status of the different geographic regions of Sub-Saharan Africa as well as to determine the tolerable ranges of these soil qualities for rice cultivation.

Furthermore, to achieve the objective of understanding the spatial differentiation in the soil quality of the study area, Coefficient of Variation (CV) test was employed to analyse the differences among the group means of the soil chemical parameters that were obtained from the ten communities (across the five – 5 wards). This test gave a statistical basis to the conclusion reached on whether or not, the soil quality (as determined by the tested chemical parameters) of the ten communities are similar.

4. CONCLUSIONS

Based on the findings of this study, the following conclusions were made:

i) From the one sample t-Test, none of the assessed soil chemical properties statistically agreed with the standard requirement for upland rice cultivation. However, Organic Carbon and CEC levels fell within the standard requirement for upland rice cultivation. For Available Phosphorus, Kuchiko, Dutse, Jikoko and Ushafa possessed levels that fell within the standard requirement for upland rice. Magnesium level in Igu, Gyeyidna, Kuchiko, Piawe &Dutse are within the standard requirement, while pH, Total Nitrogen, Calcium and Potassium in all the ten (10) sampled communities exceeded the range of the standard requirement for upland rice cultivation.
ii) There is a positive relationship between the results obtained from the study area and the standard requirement for upland rice cultivation.
iii) There is clear empirical justification to conclude that there is no significant difference between the soil chemical quality of the study area and standard soil quality requirements for the cultivation of upland rice. Implying that the chemical soil properties of the sampled communities in Bwari Area Council will support the cultivation of upland rice.

5. RECOMMENDATIONS

Based on the research findings, the following recommendations are made:

i. There is need to reduce the soil pH of the study area from its fairly alkaline state to moderately acidic level suitable for upland rice cultivation by adding Elemental sulfate and aluminum sulfate which is relatively affordable and available via local agriculture suppliers and garden centers. It must be allowed to react through two processes, a biological and a chemical process which may take a period of 3 to 6 months of warm soil temperature. Elemental sulphur may be used to acidify alkaline soil to the desirable pH range. It may also be used to maintain pH in the desirable range, on soils that tend to become alkaline with management. The acidification of the soil will adjust the level of the Calcium and Potassium to tolerable limits for upland rice.
ii. Inspite of the fact that the soil chemical properties of the sampled communities in Bwari Area Council will support the cultivation of upland rice, it is very important to continuously monitor the fertility status of the soil as per quality evaluation. This will improve the suitability of the land for upland rice cultivation. It will also benefit both the government and the farmers and invariably improve the production and supply of food for consumption and revenue generation among the increasing population.In addition, it will bring about sustainable development in agriculture especially in the area of rice cultivation.
iii. It is also very important to add that fertilizer should be applied following the locality-specific recommendations for rice for optimum yield. This will extenuate the levels of Nitrogen, Phosphorus and Potassium in the soil. It will also boost soil water holding capacity.

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